Agricultural Extension and Research

Achievements and Problems in National Systems

Dennis L. Purcell
Jock R. Anderson

A World Bank Operations Evaluation Study

Agricultural Extension and Research

Achievements and Problems in National Systems

Other Titles in the Series

PREPARED BY THE
WORLD BANK OPERATIONS EVALUATION DEPARTMENT

Fiscal Management in Adjustment Lending
(1997)*

Reforming Agriculture: The World Bank Goes to Market
(1997)*

Paddy Irrigation and Water Management in Southeast Asia
(1997)*

1995 Evaluation Results
(1997)*

Zambia Country Assistance Review: Turning an Economy Around
(1997)*

Aga Khan Rural Support Program: A Third Evaluation
(1996)*

Lending for Electric Power in Sub-Saharan Africa
(1996)*

Industrial Restructuring: World Bank Experience, Future Challenges
(1996)*

Social Dimensions of Adjustment: World Bank Experience, 1980–93
(1996)*

1994 Evaluation Results
(1996)*

Ghana Country Assistance Review: A Study in Development Effectiveness
(1995)*

Evaluation and Development: Proceedings of the 1994 World Bank Conference
(1995)

Developing Industrial Technology: Lessons for Policy and Practice
(1995)*

The World Bank and Irrigation
(1995)*

1993 Evaluation Results
(1995)*

Structural and Sectoral Adjustment: World Bank Experience, 1980–92
(1995)*

Gender Issues in World Bank Lending
(1995)*

The World Bank's Role in Human Resource Development in Sub-Saharan Africa: Education, Training, and Technical Assistance
(1994)*

1992 Evaluation Results
(1994)*

New Lessons from Old Projects: The Workings of Rural Development in Northeast Brazil
(1993; contains summaries in French, Portuguese, and Spanish)

World Bank Approaches to the Environment in Brazil
(1993; contains summaries in French, Portuguese, and Spanish)

Trade Policy Reforms under Adjustment Programs
(1992)*

World Bank Support for Industrialization in Korea, India, and Indonesia
(1992)*

Population and the World Bank: Implications from Eight Case Studies
(1992)*

The Aga Khan Rural Support Program in Pakistan: Second Interim Evaluation
(1990)*

*Contains summaries in French and Spanish.

Agricultural Extension and Research

Achievements and Problems in National Systems

Dennis L. Purcell
Jock R. Anderson

THE WORLD BANK
WASHINGTON, D.C.

Manufactured in the United States of America
First printing June 1997

Cover: Lab worker at IITA in Ibadan, Nigeria
Credit: International Institute for Tropical Agriculture (IITA)

ISSN 1011-0984

Library of Congress Cataloging-in-Publication Data

Purcell, Dennis
Agricultural extension and research : achievements and problems in national systems / Dennis L. Purcell, Jock R. Anderson.
p. cm. —(A World Bank operations evaluation study)
Summaries in English, French, and Spanish.
Includes bibliographical references.
ISBN 0-8213-3878-1
1. Agricultural extension work—Developing countries—Evaluation. 2. National agricultural research systems—Developing countries—Evaluation. 3. Agricultural development projects—Evaluation. 4. World Bank—Developing countries—Evaluation. I. Anderson, Jock R., 1941– . II. Title. III. Series.
S544.6.P86 1997
630'.71'5—dc21 97-3416
CIP

Contents

Figures

Tables

Foreword

Higher agricultural productivity of sustainable production systems in the developing world is essential for economic development and poverty alleviation. Recognizing that technological progress is a necessary ingredient in the development process, the World Bank has invested substantial resources in agricultural supporting services, particularly research and extension projects.

Bank-supported projects have helped to substantially institutionalize improved services in developing countries. But the review also points to many areas where better results could have been obtained, and makes recommendations for the design and management of the Bank's future assistance. For both research and extension, greater emphasis needs to be given to the government's capacity to fund public sector institutions, and governments need to be continually reminded of the justification for, and economic benefits of, investment in improved agricultural technology. At the same time, beneficiaries of technology development should assume a share of the costs of its production and dissemination whenever feasible.

Technology must respond to the needs of farmers and other stakeholders in agriculture if it is to contribute to increased productivity and welfare. A number of logical design and management principles can be used to develop effective, efficient, and sustainable services, and how these principles are used in practice depends on country circumstances. Such planning demands a knowledge not only of economic, fiscal, institutional, and human resource issues, but also a sound understanding of farming systems. Participation by intended beneficiaries in developing and disseminating technology helps to ensure relevance, which is essential to the efficient use of fiscal resources.

Bank management endorsed most of OED's findings and responded with specific action plans designed to foster improvements in the development impact of its research and extension projects.

Robert Picciotto
Director General
Operations Evaluation

Preface

The Operations Evaluation Department of the World Bank reviewed the Bank's agricultural research and extension investments that were operational in the 1980s and early 1990s. The findings on the extension portfolio were made available in an internal Bank document in April 1994, and a report on the research portfolio was released in June 1996. As technology development and dissemination should be considered parts of an integrated process, this book brings the two reports together. Part 1 deals with extension, and Part 2 with research.

The review covers all Bank-defined regions. The nature of the Bank's assistance to developing countries has led most projects to focus on the smallholder agricultural systems, although not to the exclusion of larger, commercial agricultural interests, particularly for research. For extension, the analysis included all projects approved and completed in the review period, as well as a representative sample of other agricultural projects with a substantial extension component. For research, all completed projects and most ongoing projects in an advanced stage of implementation were included, except for the Africa region, where a sample of the large number of participating countries was taken to represent the region's diversity.

The design and performance of investments are compared with the recommendations of an earlier review of the subsector produced by OED in 1983, and with a research policy paper released by the Bank in 1980. Extensive use was made of evaluation reports on individual completed projects to determine the extent to which each project was relevant to country circumstances, was efficiently implemented, and was efficacious in meeting project objectives. Due to the nature of the investments and to prevailing Bank practice in processing these types of projects, these ex post assessments generally did not involve economic impact assessments. This meant that judgments had to be made on how well the projects contributed to factors that are generally perceived as critical for sound development of public sector service institutions in agriculture. Development of these institutions was usually the immediate objective of projects in the portfolio, even though the ultimate objective was invariably to enhance sustainable productivity and welfare.

The Bank's operational regions and divisions generally supported the review's findings, and the Bank's management defined action plans to implement the recommendations. However, the Africa region did not fully agree with some aspects of the recommendations concerning the Bank's future involvement in extension projects; the report addresses these differences. For the research findings, the only point of contention concerned the priority that should be given to the introduction of economic analysis into the national agricultural research systems to enhance the research prioritization and evaluation processes. While appreciating its importance, many staff were concerned that this might divert scarce social science skills in national research organizations from the essential role of helping scientists better understand farming systems and measure the adoption of technologies and their impact on the systems.

Prólogo

El desarrollo económico y el alivio de la pobreza del mundo en desarrollo requieren, como condición previa, una productividad agrícola más alta y sistemas de producción sostenibles. El Banco Mundial, convencido de que el avance tecnológico es un componente necesario del proceso de desarrollo, ha invertido cuantiosos recursos en servicios de apoyo a las actividades agropecuarias, sobre todo en proyectos de investigación y extensión agrícola.

Los proyectos respaldados por el Banco han coadyuvado considerablemente a institucionalizar servicios de mayor calidad en los países en desarrollo. No obstante, en el examen que se presenta a continuación se señalan también muchas esferas en las que podrían haberse obtenido mejores resultados, y se formulan recomendaciones para el diseño y la gestión de la futura asistencia del Banco. Tanto en materia de investigación como de extensión, es necesario hacer más hincapié en la capacidad del gobierno para financiar instituciones públicas y hay que recordar continuamente al gobierno la necesidad y los beneficios económicos de la inversión en una mejor tecnología agropecuaria. Al mismo tiempo, los beneficiarios del desarrollo tecnológico deberán asumir, siempre que sea posible, una parte de los costos de su producción y diseminación.

La tecnología debe responder a las necesidades de los agricultores y de otras partes interesadas en la agricultura; sólo así contribuirá a una mayor productividad y bienestar. Pueden emplearse varios principios lógicos de diseño y gestión para establecer servicios eficaces, eficientes y sostenibles, pero su aplicación práctica dependerá siempre de las circunstancias del país. Este tipo de planificación requiere el conocimiento de las cuestiones económicas, fiscales, institucionales y de recursos humanos, pero también de los sistemas de explotación agrícola. La participación de los beneficiarios en el desarrollo y difusión de la tecnología coadyuva a asegurar su aplicabilidad, requisito esencial para fomentar el uso eficiente de los recursos fiscales.

La Administración del Banco refrendó la mayoría de las observaciones del Departamento de Evaluación de Operaciones y formuló planes de acción concretos para que los proyectos de investigación y extensión tengan mayor repercusión en el desarrollo.

Robert Picciotto
Director General
Evaluación de Operaciones

Prefacio

El Departamento de Evaluación de Operaciones del Banco Mundial (DEO) efectuó un examen de las inversiones en investigación y extensión agrícola que tuvieron lugar en el decenio de 1980 y primeros años noventa. Las observaciones sobre la cartera de proyectos de extensión se plasmaron en un documento interno del Banco, de abril de 1994, y en junio de 1996 se publicó un informe sobre la cartera de proyectos de investigación. Dado que el desarrollo y la difusión de la tecnología son parte de un proceso integrado, en este libro se combinan ambos informes. La parte 1 se refiere a las actividades de extensión y la parte 2 a las de investigación.

El examen abarca todas las regiones definidas por el Banco. Debido a la índole de la asistencia de la institución a los países en desarrollo, la mayoría de los proyectos se centran en sistemas agrícolas donde predominan las pequeñas explotaciones, lo que no significa que se excluyan las actividades agrícolas comerciales de mayor envergadura, sobre todo tratándose de la investigación. En el caso de las actividades de extensión, se incluyen en el análisis todos los proyectos aprobados y concluidos en el período que abarca el examen, así como una muestra representativa de otros proyectos agrícolas que cuentan con un considerable componente de extensión. En el caso de las actividades de investigación, se consideran todos los proyectos concluidos y la mayoría de los proyectos que se encuentran en una etapa avanzada de ejecución, excepto en la región de África, donde se escogió una muestra de los numerosos países participantes como representativa de la diversidad de la región.

Se comparan el diseño y los resultados de las inversiones con las recomendaciones de un examen previo del subsector formuladas por el DEO en 1983, y con un documento de política de investigaciones publicado por el Banco en 1980. Se utilizaron ampliamente informes de evaluación de proyectos específicos concluidos para determinar en qué medida cada proyecto se ajustaba a la situación coyuntural del país, se ejecutó eficientemente y logró cumplir sus objetivos. Por las características de las inversiones y el procedimiento normal del Banco para la tramitación de este tipo de proyectos, en estas evaluaciones ex post en general no se evaluaron las repercusiones económicas. Esto quiere decir que hubo que valorar la eficacia con que los proyectos contribuyeron a factores que suelen percibirse como críticos para el firme desarrollo de instituciones de servicio público en el sector de la agricultura. En la mayoría de los casos, el objetivo inmediato de los proyectos de la cartera era el desarrollo de estas instituciones, si bien el objetivo final era invariablemente mejorar la productividad sostenible y el bienestar.

En general, las regiones y divisiones operativas del Banco estuvieron de acuerdo con las observaciones del examen, y la administración formuló planes de acción para poner en práctica las recomendaciones. No obstante, la región de África no estuvo plenamente de acuerdo con algunos aspectos de las recomendaciones relativas a la participación futura del Banco en proyectos de extensión; en el informe se tratan estas diferencias. En lo que respecta a las observaciones sobre las actividades de investigación, el único punto de controversia es la prioridad que deberá darse a la introducción del análisis económico en los sistemas nacionales de investigación agraria a fin de mejorar los procesos de asignación de

prioridades y de evaluación de la investigación. Muchos funcionarios, aun reconociendo su importancia, expresaron la inquietud de que, con ello, el escaso número de especialistas en ciencias sociales con que cuentan las organizaciones nacionales de investigación tenga que abandonar su función esencial de ayudar a los científicos a entender mejor los sistemas de explotación agrícola y a medir la adopción de tecnologías y su repercusión en dichos sistemas.

Avant-propos

Il est indispensable, pour assurer l'expansion économique et faire reculer la pauvreté, d'accroître la productivité de systèmes de production agricole viables dans le monde en développement. Consciente du fait que le progrès technologique est un élément indispensable au processus de développement, la Banque mondiale consacre des ressources considérables aux services de soutien à l'agriculture, et particulièrement aux projets de recherche et de vulgarisation.

Les projets bénéficiant de l'appui de la Banque ont aidé à institutionnaliser dans une large mesure des services de meilleure qualité dans les pays en développement. Mais l'étude indique également les nombreux domaines dans lesquels de meilleurs résultats auraient pu être obtenus et elle formule des recommandations concernant la conception et la gestion de l'aide future de la Banque. Dans le cas de la recherche comme de la vulgarisation, il faut veiller davantage à ce que l'état ait la capacité de financer les institutions du secteur public, et il faut rappeler constamment aux gouvernements la justification des investissements destinés à améliorer la technologie agricole, ainsi que les avantages économiques en découlant. En même temps, les bénéficiaires du développement technologique devraient prendre en charge autant que possible une part des coûts liés à la production et à la diffusion des technologies.

La technologie doit répondre aux besoins des agriculteurs et des autres acteurs du secteur agricole si l'on veut que celui-ci contribue à une amélioration de la productivité et des conditions de vie. Un certain nombre de principes logiques, de conception et de gestion peuvent être suivis pour mettre au point des services efficaces, efficients et viables, ces principes devant être appliqués concrètement en fonction de la situation propre à chaque pays. Pour procéder à une telle planification il faut non seulement connaître les problèmes économiques budgétaires et institutionnels et ceux qui concernent les ressources humaines, mais aussi bien comprendre les systèmes d'exploitation agricole. La participation des bénéficiaires prévus à la mise au point et à la diffusion des technologies aide à mieux adapter celles-ci aux besoins, ce qui est indispensable pour que les ressources budgétaires puissent être utilisées efficacement.

La Direction de la Banque a approuvé la plupart des conclusions du Département de l'évaluation des opérations (OED) et a en conséquence établi des plans d'action précis visant à renforcer l'impact qu'ont ses projets de recherche et de vulgarisation sur le développement.

Robert Picciotto
Directeur général
Évaluation des opérations

Préface

L'OED de la Banque mondiale a examiné les investissements de la Banque consacrés à la recherche et à la vulgarisation agricoles qui avaient atteint leur régime de croisière dans les années 80 et au début des années 90. Les conclusions sur le portefeuille de projets de vulgarisation ont été communiquées dans un document interne de la Banque en avril 1994, et un rapport sur le portefeuille de projets de recherche a été diffusé en juin 1996. Étant donné que la mise au point et la diffusion de technologies devraient être considérés comme des éléments d'un processus intégré, ce document regroupe les deux rapports, la première partie traitant de la vulgarisation et la seconde, de la recherche.

L'étude couvre toutes les régions définies par la Banque. Du fait de la nature de l'aide apportée par celle-ci aux pays en développement, la plupart des projets mettent l'accent sur les petites exploitations agricoles, sans pour autant exclure l'agriculture commerciale à plus grande échelle, particulièrement dans le cas de la recherche. Pour la vulgarisation, l'analyse a inclus tous les projets approuvés et achevés durant la période considérée, ainsi qu'un échantillon représentatif d'autres projets agricoles comprenant une importante composante vulgarisation. Pour la recherche, tous les projets achevés et la plupart des projets en cours qui en sont à un stade d'exécution avancé ont été inclus, sauf pour la région Afrique où un échantillon de pays — sur les nombreux pays participants — est censé représenter la diversité de la région.

La conception et la performance des investissements sont comparées aux recommandations formulées dans le cadre d'un examen antérieur du sous-secteur auquel a procédé l'OED en 1983, ainsi qu'à un document sur la politique de recherche diffusé par la Banque en 1980. On a abondamment utilisé les rapports d'évaluation rétrospective concernant différents projets achevés pour déterminer dans quelle mesure chacun d'eux était adapté à la situation particulière du pays, avait été exécuté de façon efficiente et répondait bien aux objectifs fixés. Du fait de la nature des investissements et des pratiques suivies par la Banque pour instruire les dossiers de ces types de projets, ces évaluations ex post ne comportaient généralement pas d'évaluations de l'impact économique obtenu. Cela signifie qu'il fallait porter un jugement sur la façon dont les projets influaient sur les facteurs généralement considérés comme critiques pour assurer un développement harmonieux des institutions assurant des services publics dans le secteur agricole. Le développement de ces institutions était généralement l'objectif immédiat des projets figurant dans le portefeuille, bien que l'objectif final poursuivi ait invariablement été d'obtenir une amélioration durable de la productivité et des conditions de vie.

Les régions et divisions opérationnelles de la Banque ont généralement approuvé les conclusions de l'examen et la Direction de la Banque a défini des plans d'action pour mettre en oeuvre les recommandations formulées. Toutefois, la région Afrique n'a pas été tout à fait d'accord avec certains aspects des recommandations concernant la participation future de la Banque aux projets de vulgarisation. Le rapport examine ces différences de point de vue. Pour les conclusions concernant la recherche, le seul point de divergence concerne le degré de priorité qu'il conviendrait d'accorder à l'introduction de l'analyse économi-

que dans les systèmes de recherche agronomique nationaux pour améliorer les processus de fixation des priorités en matière de recherche et d'évaluation rétrospective. Tout en reconnaissant que c'est là un point important, de nombreux experts de la Banque craignent que de ce fait, les rares spécialistes en sciences sociales dont disposent les organismes nationaux de recherche ne puissent pleinement accomplir la tâche essentielle consistant à aider les scientifiques à mieux comprendre les systèmes d'exploitation agricole et à déterminer la mesure dans laquelle les technologies sont adoptées et leur impact sur ces systèmes.

Acknowledgments

The extension study was prepared by Dennis Purcell, Principal Evaluation Officer, OED. Elizabeth Robinson and Charles Sheerin provided research assistance, and Helen Claverie provided administrative assistance.

Dennis Purcell and Jock Anderson, Evaluation Advisor, OED, authored the research study. Regional working papers were prepared by consultants John Coulter (Africa region), P. Tamboli (South Asia region), John Doolette (Europe, Central Asia, Middle East and North Africa regions), and Herb Floyd (Latin America and the Caribbean region), and by Andrew Spurling, Principal Evaluation Officer, OED, for the East Asia and Pacific region. Charles Sheerin and Elizabeth Robinson furnished research assistance. Charina Go, Helen Claverie, Megan Kimball, and Diana Qualls provided administrative support.

Alice Dowsett was the copyeditor, Angie Gentile-Blackwell managed production of the combined reports, and Debra Malovany managed composition.

Colleagues in other Bank units offered valuable comments on drafts of both the research and extension studies, which enhanced the validity of the documentation and judgments made therein.

Abbreviations and acronyms

AARD	Agency for Agricultural Research and Development (Indonesia)
ADB	Asian Development Bank
AFR	Africa region
AIDAB	Australian International Development Assistance Bureau
ARI	Agricultural research intensity ratio
BAR	Bureau of Agricultural Research (Philippines)
BARC	Bangladesh Agricultural Research Council
CARP	Council for Agricultural Research Policy (Sri Lanka)
CCIA	Colombian Company for Agriculture and Livestock Research
CGIAR or CG	Consultative Group on International Agricultural Research
CIMMYT	International Center for Improvement of Maize and Wheat
CIP	International Potato Center
EA	Extension agent
EAP	East Asia and Pacific region
ECA	Europe and Central Asia region
EMBRAPA	Brazilian Agricultural Research Corporation
ESDAR	Agricultural Research and Extension Group (Environmentally Sustainable Development Vice Presidency, World Bank)
FAO	Food and Agriculture Organization of the United Nations
FRIM	Forestry Research Institute of Malaysia
GDP	Gross domestic product
GTZ	German Agency for Technical Cooperation
ICA	Colombian Agriculture and Livestock Institute
ICAR	Indian Council of Agricultural Research
IDA	International Development Association
IFAD	International Fund for Agricultural Development
INIFAP	Mexican National Institute for Forestry, Agriculture, and Livestock Research
INIPA	National Institute for Research in Agriculture and Livestock (Peru)
INRA	National Institute for Agricultural Research (Morocco)
IRESA	Institute of Agricultural Research and Higher Education (Tunisia)
IRR	Internal rate of return
ISNAR	International Service for National Agricultural Research
LAC	Latin America and the Caribbean region
MARDI	Malaysian Agricultural Research and Development Institute
MIS	Management information system
MNA	Middle East and North Africa region
MOA	Ministry of agriculture (used generically for ministries of agriculture, livestock, and so on)
NARS	National agricultural research system
NGO	Nongovernmental organization
OECD	Organization for Economic Development and Cooperation
OED	Operations Evaluation Department

PAR	Performance audit report
PARC	Pakistan Agricultural Research Council
PCR	Project completion report
SAR	Staff appraisal report
SAS	South Asia region
SAU	State agricultural university (India)
SPAAR	Special Program for African Agricultural Research
SSTC	State Science and Technology Commission (China)
T&V	Training and visit system
UNDP	United Nations Development Programme
USAID	U.S. Agency for International Development

Summary

This report reviews the World Bank's experience in supporting the development of national agricultural research and extension systems in developing countries in the 1980s and early 1990s. It makes recommendations for future Bank support for this agricultural subsector. The major database was the extensive series of reports on projects that were implemented and completed during the review period. The review covered all of the Bank's operational regions, although East and Central Asia had little representation (except for Turkey) due to the scarcity of subsectoral activities in the review period.

The review concludes that Bank interventions have had a significant positive impact, but also maintains that serious deficiencies persist in most of the supported national systems. Better planning and appropriate guidance during implementation could have reduced many of these problems. The sustainability of institutions and systems developed under Bank projects is of particular concern. This demands that future projects be more cognizant of the circumstances of each country in supporting a particular scale and mode of operation, as these projects are essentially of an institution-building nature and must be considered long-term investments. There will continue to be a need for public spending on research and extension services and for external support of implementing institutions, but fiscal resources will need to be used more efficiently.

The Bank has had a significant positive impact on the development of national agricultural research and extension systems

Bank involvement

The broad objectives of rural development are growth, poverty alleviation, and improved management of the natural resource base. Technology development and its rapid adoption in agricultural production and processing systems are key elements in achieving these broad sectoral objectives. The Bank's appreciation of the role of agricultural research and extension is demonstrated by its increasing commitments to this subsector at a time when the level of funding of agricultural projects in general has stagnated and declined as a percentage of total Bank lending.

Prior to the review period and through most of the 1980s, extension received more Bank support than research. More recently, research has received as much Bank investment as extension. In the 16 years to the end of 1992, the Bank committed more than $3.0 billion and $2.0 billion to extension and research, respectively, and in recent years more than $200 million to each annually. There has also been an evolution from a preponderance of support for research and extension as components in other agricultural projects (termed "component" projects in this review) in the 1970s to support for free-standing projects that focused on research, extension, or both services. This evolution demonstrates the Bank's goal of helping to develop institutions that can deliver the required services. The frequent repeater projects that aim to further improve the performance of institutions supported in earlier projects also attest to this goal.

Bank-supported research projects often aimed to improve research infrastructure, staff development, and operational efficiency...

Research projects commonly aimed to improve research infrastructure, staff development, and operational efficiency of major components of the national agricultural research systems (NARSs). To this end, the projects usually sought to improve research coordination (as new or strengthened apex organizations), and often supported specific research programs and areas of emphasis. But interventions were not normally directed at changing the basic structure of institutions. (A structure based on commodity programs supported by scientific disciplinary units was most common, and a regional orientation also occurred in many instances.)

The mode of Bank intervention in extension projects followed a different trend. In the 1960s and 1970s, an expansion of rural development activities led to the expansion of multifunctional extension staff (technology transfer, input supply and coordination, and credit delivery or supervision). Many in the Bank came to the view that although this type of field staff served a useful development purpose, their many duties detracted from the potential for technology transfer. A hierarchically organized method of extension management was designed to focus exclusively on technology and deliver selected, timely messages to farmers with strict regularity. The concept also aimed to provide feedback on farmers' needs to the research system, and to maintain close links between research and extension. It was called the training and visit (T&V) model.

T&V was first introduced in Turkey in 1967 and subsequently spread to the South Asia (SAS) region in the early 1970s. This marked the beginning of T&V dominance in Bank-supported extension projects, especially those in SAS, East Asia and Pacific (EAP), and Africa (AFR) regions. The Bank continued to support commodity-specific extension services, technical assistance aligned with credit delivery, and other intensive services associated with specific development projects. But many projects sought to install the T&V model of extension management, with its related organizational changes and investments in infrastructure, equipment, and training.

The Bank had an economic rationale for its emphasis on agricultural research and extension. Although difficult to calculate, econometric estimates of the effects of technology development and dissemination on productivity, and the consequent economic benefits, have generally supported this type of investment. The public good nature of the investments further justifies the Bank's support of these public institutions—most of the knowledge generated and disseminated cannot be appropriated by an individual or group. Nor does use of knowledge by adopters reduce the resource's availability to others (even though early adopters may be able to temporarily capture relatively greater benefits). Public investment in these services, however, should not preclude recovery of costs from end users of technology where opportunities exist.

Investment in technology development and its dissemination cannot be expected to increase productivity unless stakeholders operate in an otherwise conducive environment. Appropriate macroeconomic and sectoral policies, favorable market opportunities, access to resources, inputs, and credit are all necessary to realize the full potential of new technology. Bank commitments for research and extension, between 12 and 14 percent of total agricultural lending, provide ample opportunity for complementary investment.

The Bank's project performance ratings

OED rates the performance of each Bank project at completion as either satisfactory or unsatisfactory. Unfortunately, the nature of the extension and research

investments generally does not allow for rigorous, quantitative assessment of performance. The expectation that satisfactory economic benefits would be highly likely, and the inherent subjectiveness of ex ante estimation of benefits that might be linked to the investments, led to the Bank excepting research and extension projects from its normal requirement for an economic rate of return estimate at project appraisal. This, when combined with the weak evaluation capability in projects, meant that the economic performance data generated were few. Ex post project evaluation had to rely on non-quantitative performance measures (as does this OED review), and largely was based on the extent to which the project met its institutional development objectives.

The extension and research project samples in this review attained satisfactory ratings of 70 percent and 72 percent, respectively. This is above the average of about 63 percent for the agricultural portfolio as a whole in the same review period. However, taking into account the key roles of technology development and dissemination in improving agricultural productivity and alleviating both rural and urban poverty, the Bank should consider this level of performance unacceptable. This concern is exacerbated when one considers the "softness" (or lack of rigor) of the rating process, and the fact that this same ex post rating system found sustainability to be uncertain in two-thirds of extension projects and in almost one-half of research projects that had been judged to be satisfactory.

...while extension projects focused on technology and the delivery of select, timely messages

Performance of the extension and research portfolio

OED reexamined projects individually and on a regional basis. It assessed institutional aspects that are commonly accepted as necessary for effective, efficient, and sustainable research and extension organizations: human resource development; adequacy of facilities; effective organization, management, implementation, review, and evaluation procedures; relevance of services to farmers' needs; links among research, extension, and their clients, and, in the case of research, links among national research entities and with external sources of technological and organizational support; adequate funding, especially for operational support; and appropriate incentives for staff.

Performance in these areas was then measured against the recommendations of a 1983 OED review of the subsector and, in the case of research, also against the guidelines of the Bank's 1980 research policy paper. This approach assumes that if the services' institutional arrangements and operational procedures are appropriate, then the institutional investments will lead to the generation and use of improved technology and yield favorable economic returns. The research and extension evaluation literature mentioned above, as well as the few instances when empirical studies were undertaken on Bank-assisted programs, support this assumption.

Parts 1 and 2 of the report deal separately with extension and research. The overall findings and recommendations of each are summarized separately here.

Extension

Findings

Undoubtedly, the Bank's large extension portfolio has increased borrowers' attention to the role of technology dissemination and adoption in increasing productivity and smallholder welfare. In addition, the focus of most projects on

improved organization and management has increased coverage of smallholders by public extension services. Despite these considerable achievements, the following observations, many of which are negative, have to be made:

For the extension portfolio as a whole:

Despite considerable achievements, the extension portfolio as a whole lacks adequate funds to operate services properly

- Inadequate funds to operate the services properly was a common phenomenon, with a high proportion (76 percent) of free-standing projects having an uncertain or unlikely sustainability rating.
- Inadequate funding for recurrent costs reduced effectiveness.
- Insufficient relevant technology was frequently a problem and a major constraint in resource-poor environments.
- Linkages with research were generally weak, and neither research nor extension was sufficiently conscious of the need to understand the constraints and potentials of the different farming systems as a basis for determining relevant technology and technology development requirements.
- With few exceptions, project design and implementation paid little attention to the farming community's systematic participation in problem definition, problem solving, and extension programming. Where participation was emphasized (cases in Thailand and Mexico), however, results were very positive.
- A "top-down" culture is traditional in the public sector institutions in most developing countries; this persisted in most Bank projects and was contrary to the development of responsive services.
- Staff quality was a major constraint in nearly all free-standing projects that required large staffs, both at the level of farmer contact and in the technical support staff. Deficiencies in the latter category limited the potential impact of continuous training programs in large state programs.
- Lack of commitment by senior government officials was noted in nearly half of free-standing projects and affected implementation and funding support, and monitoring to support management and justify funding was weakly developed in nearly all projects.

For the T&V free-standing projects specifically:

- As the major extension model in Bank projects, T&V must be given a lot of credit for the positive achievements attained, but cannot be divorced from many of the shortcomings of the free-standing projects. (T&V was the model of choice in 90 percent of these projects.)
- Recurrent cost funding and sustainability concerns, lack of appropriate technology, deficiencies in staff quality, and poor development of a responsive attitude among staff should be anticipated in most nationwide staff-intensive extension programs in developing countries, regardless of the management system used. In addition, the hierarchical structure and "message-centered" delivery in T&V has done little to change the traditional "top-down" approach to formulating recommendations, despite T&V objectives of using farmer feedback to ensure relevant recommendations.

- The Bank promoted the T&V model (especially in earlier projects) in a relatively uniform set of investments and extension practices applied in large state and national programs. It should have adjusted project design to take account of the fiscal, institutional, human resource, farming system, and technology stock circumstances. This would have increased the chances of developing efficient and cost-effective services that would have attracted the necessary financial and political support.

- Despite these criticisms of projects based on the T&V system, many of the organizational principles included in the T&V model are internalized in the majority of "good" extension services and are unquestionably sound: programming of activities; the technology focus; continuous staff training; program supervision; close research-extension links; and farmer feedback to allow adaptation of technology to farmer circumstances. Unfortunately, many of these principles were not adequately developed in projects.

- The T&V concept of a contact farmer as the primary recipient of extension visits (for subsequent transfer of technology to other local farmers) was not very effective and was often modified to a farmer group focus (which more recent projects have almost universally adopted). This was partly because the contact farmers were unrepresentative of the limited resource circumstances of most of those to be influenced. But even projects with the group focus did not pay enough attention to making sure the farmers had similar resources and constraints. Thus, the potential for increased effectiveness through group problem definition and ownership of problem solutions was not fully realized (nor were staff trained in how to facilitate this process).

Although an integral part of "good" extension, the training and visit method cannot be divorced from many of public extension's shortcomings

For other projects:

- In integrated rural development projects, the outcome of extension services—whether T&V or other even more intensive service models—was usually related to the availability of relevant technology for the targeted farming systems and the efficiency with which the complementary input supply and credit services were delivered.

- Commodity-specific extension programs demonstrated their ability to provide all the ingredients needed for technology adoption to enhance the production of the targeted commodity. As these programs usually involve commercial crops, however, some form of cost recovery should normally be anticipated. Specialized public services with cost recovery and private sector services can be complementary to general public extension services.

- Rural smallholders often live at or near subsistence levels, which limits the extent to which they can pay for services. But some form of farmer ownership of services should be the ultimate objective, regardless of resource circumstances. At the other end of the spectrum, results confirmed that the private sector should provide directly the highly professional and responsive services needed for specialized higher value crops (for example, vegetables and export fruits and flowers). (There was only one case [Chile] of a project sponsoring [successfully] private sector extension services.)

- Extension supplied as an adjunct to a credit delivery program was usually effective in supporting technology adoption by farmers. Deficiencies sometimes occurred in the use of credit in inflexible production packages that were not always relevant to farmers' circumstances. But where these services were provided at public cost, an equity issue arose in that an intensive and

costly service was being provided to a very small proportion of the smallholder subsector, and usually only to those with a better resource base, implying reduced resources for extension to the majority.

- Periodic extension campaigns in response to a widely acknowledged crisis were usually effective as they were able to avoid many of the constraints faced in developing an efficient "permanent" service.

No single extension model is sufficiently superior to justify its adoption in all circumstances

No single extension model is sufficiently superior to justify its uniform adoption in all smallholder farming circumstances. Rather, several key principles determine the effectiveness of extension services. Chief among these is the principle that extension recommendations be relevant to the conditions of the client. This, in turn, requires extension projects to understand the characteristics of the targeted farming systems and the factors that impinge on these systems, and be underpinned by an effective capacity to generate and adapt technology.

Having met these basic tenets, methodological innovations such as programming and scheduling activities can enhance service efficiency and efficacy in meeting objectives, as long as a primary consideration in project design and implementation is responsiveness to farmers' needs. The desired impact cannot be obtained, however, unless extension investments are designed with full recognition of other potentially limiting factors, such as fiscal, institutional, and human resource constraints. Although investment in extension is usually justified as a public good in most developing countries, fiscal realities dictate that extension programs be as cost-effective as possible to minimize demands on the recurrent budget and enhance prospects for sustainability of the service. Just as the unavailability of a supply of new relevant technology will lead to diminishing returns of an extension service, so too will a scarcity of funds, which limits the field activities in staff-intensive, face-to-face services. Apparent efficiency and effectiveness, of course, are conducive to funding support.

Recommendations

Annex 4 of this report elaborates on the recommendations for future and ongoing Bank interventions in agricultural extension. The major thrust of the recommendations is that the Bank give considerably more attention to preproject analysis and give adequate help to borrowers with project preparation. Only with this emphasis, and with an analytical approach to defining institutional and farmer circumstances, can a responsive extension strategy and an investment program representing current strategy be developed. Rapid rural appraisal techniques are likely to be necessary to analyze the existing farming systems. Heavy borrower participation in this process is essential to ensure ownership and commitment.

The recommended project design would, among other things, prioritize target groups; take account of public and private sectoral services; incorporate traditional mass media and modern information technology as appropriate; define the scale, type, and intensity of face-to-face services in particular areas according to needs and resources; consider the needs of all socioeconomic groups, including women in farm households; and develop a needs-based staff training program that focuses not only on technology but also on methods of interacting with farmer groups to maximize their participation in problem definition and resolution and their support for the extension process.

In addition, an appropriate program design would have to be complemented by responsive actions by the borrower and the Bank during implementation. Bor-

rowers should appreciate that success is not measured by having the planned service organization in place but by the extent to which the service is providing relevant technology as defined by farmers in the targeted farming systems. This would require institutionalizing a capacity for ongoing evaluation to permit responsive decisions by extension management. Projects would also have to adhere to the design principles that aim to ensure that appropriate technology is generated and extended.

For the Bank, more emphasis would be given to monitoring the system's effectiveness in providing efficient and relevant services to each of the farming systems in the program, and the responsiveness of the service to evolving circumstances.

Acceptance of these recommendations, however, would mean that a number of issues be confronted:

- Fiscal, human resource, complementary service, and technology stock constraints may dictate that investment in statewide, staff-intensive services is inappropriate. When this is the case, some Bank departments may have to modify their traditional approach of installing (or continuing to support) relatively uniform national programs regardless of local circumstances.

- The Bank must face the limited capacity of most borrowers, and even of some of its staff, to undertake the required analysis of extension design. Few Bank staff have had significant experience in extension design and operations outside the Bank. Most staff dealing with extension projects have had little exposure to systems other than T&V due to its dominance in Bank projects over the past 15 years. Limited divisional expertise may also constrain Bank supervision capacity. This implies extensive use of experienced consultants in project design, but also suggests in-house training within the Bank assisted by external experts.

- Rapidly changing economic, trade, and sectoral conditions will affect the type of extension services needed. The respective roles of private and public technical assistance will also have to adjust to these demands. Not only must the national strategy to encourage technological improvements be responsive to changing circumstances, but any program to develop a cadre of extension staff should be aware of the need for staff who meet the requirements of a more responsive service (whether private or public).

The roles of private and public sector technical assistance will have to adjust to changing economic, trade, and sectoral conditions

Research

Findings

The Bank's research portfolio has had a significant positive impact on the national agricultural research systems of its client countries. However, as with extension, a number of deficiencies persist and detract from system performance.

The net result of investment has been an improved human resource base (albeit with some mismatches between available and needed skills); a substantially expanded research infrastructure in facilities and equipment, combined with doubts about the appropriateness of some investments; improved links with external research entities; advances in agency coordination within NARSs, but inadequate attention to involvement of academic institutions; mixed results in improving research-extension-farmer linkages; weak development of the incen-

tive structure for researchers; and, despite considerable emphasis in the second half of the review period, slow progress in improving the efficiency of resource allocation in NARS agencies.

The Bank has done a better job of expanding research capacity than of improving management and overall system efficiency

The performance record suggests that the Bank has been better at expanding the research capacity of particular agencies within the NARSs than at improving management and overall system efficiency. This is of concern, given the inadequacy of national funding for public research institutions and serious doubts about their sustainability. Although expansion and efficient resource use should not be incompatible, expansion has proven to be the more attainable outcome, and this may have even contributed to the weak results in improving efficiency.

Ultimately, the NARSs and the governments to which they report must take responsibility for enhanced technology development and the transfer of knowledge to farming communities. However, the Bank, as the largest single source of external financing for agricultural research in developing countries, has a key role to play in helping to:

- enhance the prospects for sustainability of NARS investments;
- prioritize improved management of NARSs and their agencies so that the most cost-effective use is made of resources and the quality of research output is improved; and
- ensure that effective and sustainable arrangements are in place to introduce appropriate technologies to the targeted farming communities.

The major findings of this review of agricultural research can be summarized under three broad headings: sustainable investment and research funding, research management and efficiency, and use of relevant technology.

Sustainable investment and research funding

Inadequate national funding to operate the public agricultural research establishment is a critical constraint in most developing-country NARSs. The importance of the agricultural sector as reflected in its contribution to GDP, employment, and export income certainly varies across regions and countries. However, in all countries where the Bank is helping NARSs, agriculture's contribution is important enough to warrant strong budgetary support of an efficient research system. Government support has been evident in a willingness to expand the research establishment, albeit in most cases with substantial loan or grant assistance. Unfortunately, while the staffing of public sector components of NARSs has increased, the financing of research operations has not kept pace with staff expansion. Consequently, the funding per researcher has declined in most countries, with salaries consuming an unhealthy share of recurrent funding. Efficiency and effectiveness have suffered as a result, and institutional sustainability has become doubtful. The Bank and donor community have strongly supported expansion and even taken exceptional measures to support operational funding. But governments' reticence to provide funds to properly use research assets brings into question their commitment to high-quality research. The untimely release of approved budgets, which occurs all too frequently, also demonstrates that governments do not fully appreciate the damaging consequences of program delays to research productivity, and the potential benefits of efficient agricultural research.

On average, research expenditure as a proportion of agricultural GDP (agricultural research intensity), typically at a level of about 0.5 percent, did not increase in any developing region except AFR. Africa's increase is directly linked to the exceptional level of Bank and donor support rather than to government funding; sustainability is endangered by a critical recurrent-cost funding problem.

Given the scarcity of funds, countries could benefit from joint production of technology for shared agroecological regions

Governments seemingly appreciate a need for publicly funded agricultural research but, given resource scarcities, commitment is not such as to give it priority over competing uses for recurrent outlays. The Bank, through its economic dialogue with borrowers, has the opportunity to highlight the benefits of investment in efficient research and recommend appropriate funding levels. The demand for public funds can be minimized by (a) transferring the cost of research to beneficiaries (through private research or cost recovery); (b) rationalizing public research investment and ensuring that the potential of all internal and external research resources is realized; and (c) ensuring that the management of public agencies maximizes cost-effective production of technology. The supply of funds, in the long term, depends on governments being convinced that the public research system is efficient and that its social benefits are high enough to justify a high priority for funds.

The public good rationale for public investment in agricultural research (and extension) has already been stated. When this argument is combined with the fact that high proportions of farmers in many developing countries operate at subsistence or near-subsistence levels (and, therefore, are less likely to be able or willing to pay for technology development), continued public sector investment in research is justified. Nevertheless, the projects reviewed did not address adequately the possibility of transferring part of research costs to direct beneficiaries. But such transfer has occurred to a significant degree in some NARSs, particularly in Latin America and the Caribbean, and frequently in the case of export commodity crops in all regions, the latter usually as a carry-over from a colonial period. Furthermore, the Bank has rarely used its public expenditure reviews to enhance allocations to research or to promote strategies that enable cost recovery.

The Bank has tended to help expand agencies rather than rationalize them, although some recent projects have attempted to rationalize and reduce staffing levels. The Bank, in its interactions with governments and donors, could also have given more attention to the totality of NARSs in defining appropriate intervention areas. Most NARSs do not capitalize on the research potential of agricultural faculties at academic institutions. Closer collaboration between the Bank's agricultural sector and human resource divisions would have led to more comprehensive treatment of the issue.

Scarce funding suggests that countries would benefit from joint production of technology for shared agroecological regions. The Bank and donors have made a commendable effort in AFR in establishing a Special Program for African Agricultural Research (SPAAR), but have not yet fully exploited collaborative opportunities elsewhere. Regional cooperation aims to rationalize research and initiate cooperation among donors and NARSs to fully use the comparative advantages and strengths of the individual research systems. Four regional frameworks for action have been initiated under SPAAR. This concept is consistent with the proposition that the small size of agricultural sectors and the scarcity of funding and experienced staff in many AFR countries preclude the independent development of all technology needs. Nevertheless, donors are still somewhat reticent to adjust their support away from research areas they have traditionally sponsored. Also, the willingness of national governments to fund research outside their NARSs is not as strong as it might be.

Direct Bank and donor support for operational costs, up to 100 percent in some recent AFR projects, reflects the acceptance of a critical need for technology development. However, there is a real danger of developing excessive dependency on external support. Fiscal sustainability must be a priority; otherwise, substantial investments will not be efficiently maintained or used over the long run. The Bank and donors should not offer high levels of support without carefully analyzing the government's fiscal support for the sector and for research within the sectoral allocation. Commitment should be demonstrated. The agreed research strategy should clearly show a willingness to adopt prioritization processes that limit programs to available resources and maximize efficiency, and a willingness to enter into and support legitimate regional research initiatives. Ideally, the policy framework should be conducive to agricultural investment and profitable use of improved agricultural technology.

Collaboration of NARSs with the centers for the Consultative Group on International Agricultural Research (CGIAR) has mutually benefited the continued development of relevant technology for farming communities. However, Bank project documents have only recently been forthright in specifying participation of Consultative Group (CG) centers in actions to improve NARSs.

In the investment packages financed by the Bank, apart from some instances of inadequate attention to rationalizing agency investment in South Asia and Africa, the type and scale of infrastructure investments were largely justified. Scientific and field equipment also contributed to research capacity. But equipment needs were often poorly defined; items procured were less than appropriate for the programs or for the maintenance capacity within institutions. This issue, which should have been addressed more vigorously, was associated with insufficient attention at preparation and appraisal or to a sequencing problem in which equipment was ordered before the research programs were clearly defined.

Bank projects have strongly supported library facilities in the NARSs, but the continued usefulness of these facilities is in jeopardy owing to constrained funding for journal procurement in many systems. Recently, there has been some (but insufficient) attention to electronic communication systems and networking facilities. In addition to researchers using scientific literature more effectively, the process of producing and reviewing scientific papers based on research findings in the NARSs is an area that needs improvement.

Research as a component in agricultural projects can be a good investment when linked to a well-organized public or semi-public research institution

Research as a component in agricultural projects can be a viable and sustainable investment if it is of sufficient size to warrant attention, is linked with a well-organized existing public or semipublic research institution, and is complementary to the program of such an institution. However, many interventions in Bank projects did not have enough of these characteristics to generate useful results. Sectoral adjustment loans in Europe and Central Asia and the Middle East and North Africa regions had some positive impact on the reform of research institutions, but were part of ongoing dialogues on research in the agricultural sector rather than isolated interventions. Elsewhere, research components in this type of adjustment lending were of little consequence.

Research management and efficiency

Bank projects have often introduced an agroecological dimension to provide a framework for enhanced research relevance and commonly promoted the creation or strengthening of an apex coordinating institution for the NARSs. Where the latter has not been feasible, coordination among the dominant group of insti-

tutes has usually been supported. Improved coordination mechanisms have facilitated the Bank's efforts to promote links—to allow efficient use of resources, develop national research strategies, and institute program planning and review procedures—even though the outcome of these measures has not always been as favorable as anticipated.

With some notable exceptions, universities conducted little agricultural research, as science and agricultural faculties were usually constrained by mandatory funding and facilities. However, some academic (and private) research institutions were successfully involved in components of a research strategy; special funds that the institutions could tap were created under Bank projects.

Improved research management and planning efforts in Bank projects have usually involved technical assistance provided under the loan or by donors. The International Service for National Agricultural Research (ISNAR) has been particularly active in this field. However, the overall outcome of this support can only be described as a "significant start" to a more rational planning process in most NARSs, or in major agencies within NARSs. At the broad strategy level, there has been considerable progress, although performance has been much weaker in analyzing resource availability and in establishing priorities.

Because of weaknesses in the prioritization process, documents often outline courses of action to meet the projected demand for technological improvement, but do not face up to the task of setting priorities in the face of resource constraints. Experience indicates that research master planning is unlikely to be very beneficial unless it is "owned" by funding and implementation agencies, is comprehensive in its coverage of potential contributors, adopts robust prioritization procedures in the face of resource constraints, and is able to link macroeconomic considerations with the real needs of farming communities.

Projects often have trouble setting program priorities in the face of resource constraints

Some NARSs, especially in AFR, have also tended to accept governments' stated sectoral policies without attempting to influence the priority-setting process when policies seem inappropriate. This, and the commonly occurring "softness" in the overall prioritization process, can be partly linked to a weak capacity in policy and economic analysis in most NARSs.

To make the best use of available resources, program design must give primary consideration to the needs of research users. To inform such resource-allocative decisions, there appears to be no substitute for the use of economic analysis, preferably as an economic surplus model (that is, a representation of changed consumer and producer surpluses induced by adoption of research findings) in its comprehensive or simplified forms, to assist in priority setting among programs and subprograms. Subjective judgments will inevitably be involved, but organizing information in a manner consistent with such a model increases the probability of providing cogent assessments. A byproduct of the approach can be a set of estimates of internal rate of return, benefit/cost ratio, and net present value, which can be used to help argue for budgetary allocations.

Simplified scoring methods can be used to compare programs where resources are not available for complete analysis, provided appropriate weights are given to assessment criteria. However, at least rough economic efficiency indices must be calculated for these methods to be worthwhile. Informal methods that make structured judgments based on an analysis of the principal determinants of research's net present value are likely to be more reliable than poor execution of simplified scoring methods, and other non-scoring methods such as "congruence" tests.

For between-project priority assessment, which often has to be done within institute programs, the full-blown quantitative economic measurement of likely impact is normally not warranted. Technical review in committees of peers, combined with an awareness and use of the principal determinants of the net present value of research, can go a long way to attaining efficiency in the use of resources available to individual research managers. The effectiveness of the peer review process should not, however, be taken for granted. Full expression of this critical process has been especially difficult where public-service and seniority-driven traditions tend to discourage the free exchange of frank scientific criticism, particularly if addressed to the most-established scientists.

A number of projects have successfully developed the idea of independent program review using experts from other local institutions or international institutions. In addition to enhancing local programming ability, this intensive review complements the postgraduate training and technical assistance programs that the Bank has funded to improve the quality of scientific research. However, more attention needs to be given to the institutionalization of needs-based training processes. The development of long-term training and research relationships with reputable education and research institutions in more developed countries can be profitably expanded to enhance scientific research capacity. The CG centers also have a major role to play in both program review and hands-on training.

The economic benefits of programs should be analyzed to help plan research and to justify public and private funding

As mentioned, the near absence of ex post evaluation capacity needs to be remedied. The scarcity of economic expertise precludes ex post evaluation of all programs on a routine basis, but economic benefits of selected programs or parts of programs should be analyzed to assist in future research planning, and to justify expenditures to public or private funding entities. The robustness of any analysis is enhanced by the extent to which it measures farmers' actual adoption of technology. Unfortunately, this aspect of research management (monitoring of impact) has been sorely neglected to date.

Progress in evaluation will not be possible unless Bank staff and research agencies cooperate in the design and implementation of practical methods of measuring performance and impact. Although the Bank must put more resources into the ex ante and ex post economic evaluation of research, its focus should not be on estimating the economic return on the projects it supports. Such a narrow interest would not add much to improving the efficiency of the technology development process. Rather, the Bank should focus on institutionalizing the capacity within NARSs to use economic analysis, especially in setting program priorities.

The introduction of management information systems (MISs), which have the potential to facilitate research planning, monitoring, evaluation, and individual and unit accountability, was promoted by many Bank projects in the latter part of the review period and by donors (especially USAID), often with the involvement of ISNAR. In general, MIS adoption has been limited and has not had the full support of institute management and staff. Even straightforward accounting systems need major improvement in many NARSs.

Improved facilities, postgraduate training opportunities, and improved planning and review procedures provide not only a capacity for more relevant research but also an incentive for staff to stay in the public research organizations. However, they are unlikely to yield the intended dividends unless there is a suitable incentive framework for researchers to perform well. The scarcity of operating funds is an overriding disincentive to performance. There has been some limited success in obtaining more attractive salary levels for researchers

under an autonomous institute arrangement, although the latter has generally not been sufficient to guarantee such consideration. Nor has the adoption of a semi-autonomous status normally been adequate to introduce reward and promotion systems based on performance, which in reality may only be achievable under completely autonomous arrangements—a rare occurrence.

Use of relevant technology

A good way to ensure that developed or adapted technology is quickly adopted by the targeted farming community is to ensure that it addresses a clearly identified problem. The majority of Bank projects have highlighted the need to make research more relevant to the needs of smallholder farmers, especially in the more difficult production environments. Interventions have included adjustments in resource allocations to correct imbalances, and a range of techniques to improve research-extension-farmer linkages. The latter have been designed to inform researchers of the real constraints facing farmers, and to derive practical recommendations on new technology for extension services and farmers. Organization of regular meetings between research and extension personnel to achieve these objectives has had mixed results. On-farm research capacity has been substantially expanded, although it has suffered from a number of problems, the most important of which is that it is often the first program to suffer in times of funding shortfalls.

Bank-supported projects have widely promoted the adoption of a farming system perspective, but this concept will need continued nurturing to become an established part of the research process. Helping other researchers understand farming systems and their requirements arguably has the highest priority for use of scarce socioeconomic expertise in NARSs. The process is not complete, however, unless the adoption of technology resulting from research is measured in the targeted communities.

The Bank should build on the gender work done by others and address the issue with borrowers

Women head a substantial proportion of farm households in many regions, and are important elements in most farming systems. The emphasis on institutionalizing a farming system perspective implies that gender is considered when analyzing and responding to household needs and opportunities, but this has not resulted in the required recognition of the gender issue. Gender considerations are important for effective farming system diagnosis, research planning and evaluation, and technology adoption studies in smallholder farming communities. The CG centers and some NGOs have given considerable attention to gender; the Bank should build on this knowledge and address the issue in its dealings with borrowers.

Demand-driven research should involve the intended beneficiaries (farmers and other industry stakeholders) in its design and evaluation. The expansion of on-farm adaptive research encourages beneficiary involvement, but this has not always occurred in projects and often only in a limited way when it has. Researchers must be made aware of the circumstances of farmers, whether through direct interaction with farming communities or their representatives, significant reliance on intermediaries in public or private extension systems, or a combination of these approaches (which is most common). Regardless of methods used, this interaction has to be an integral part of the research process.

Recommendations

Recommendations of this review of the research portfolio, recorded in Chapter 10, can be summarized as follows:

Regarding the *role of research,* the Bank should increase its consideration of the agricultural sector and particularly the contribution of research in its policy dialogue, economic and sector work, and country assistance strategies. To promote synergies among educators, scientists, extension agents, farmers, and other industry stakeholders, the Bank should consider technology generation, acquisition, and adoption as components of a single system. The relationship between research and education in borrower countries and in the Bank also deserves more attention. The Bank and borrowers would be well served by the Bank's continued support for international agricultural research (CGIAR), active alliances with CG centers and donors, and facilitation of links between NARSs and other research entities.

To promote an *investment's sustainability,* the Bank must support the comprehensive development of research systems while insisting that the chances of continued funding be high and that borrowers demonstrate their commitment. Moreover, it should finance high proportions of operating costs and specific research programs (on a temporary basis) only when borrowers have demonstrated commitment to supporting an agreed-upon, prioritized research agenda. As appropriate, the Bank should rationalize existing resources instead of, or in addition to, expanding facilities. It should ensure that policy and regulatory environments are favorable for private-sector research and technology acquisition, and encourage client NARSs to introduce feasible research cost-recovery systems. By taking a leading role in donor and regional NARS coordination, the Bank can encourage the more efficient use of external resources. Sustainability would also be enhanced if the Bank focused more on the phasing of support to NARSs for timely procurement of suitable equipment and facilities, and on engaging expert opinion in specifying equipment needs. Where comprehensive support for a NARS is not appropriate, the Bank should consider supporting specific research programs.

The Bank could play a greater role in helping borrowers to increase user involvement in research design and evaluation

The Bank should continue to promote coordination within NARSs and the use of *research master plans* and research prioritization procedures. But it needs to pay more attention to ownership of the procedures and outputs by national staff, and to the quality and validity of the processes and their use in resource allocation. Unless all of these elements are in place and policymakers are brought on board, the planning process may be of little value.

The development of a *monitoring, evaluation,* and *socioeconomic analytic capability* in NARS agencies deserves greater Bank attention. The Bank needs to put more effort into developing, with clients, ex ante economic evaluation of programs and practical research performance indicators before projects start; defining which research programs will be measured for economic impact; and ensuring that arrangements are in place to identify whether the skills are available for such analysis. Finally, it should closely supervise implementation of monitoring and evaluation and use program impact assessments in ex post project evaluation.

Also worthy of continued attention by the Bank are efforts to improve the *quality of scientific research,* especially through needs-based training, technical assistance, more effective links with the CG centers, external review of research programs and projects, and local and international scientific networking.

To be effective, research must be client-driven and *responsive* to defined client needs. While the Bank invariably promotes this concept, it could play a greater role in guiding borrowers on how to involve users more in research design and evaluation, and on how gender affects the planning and conduct of research.

With regard to *performance*, the Bank should insist in dialogues with borrowers and research agencies that staff be given adequate performance incentives to promote efficiency. To enhance the results of the research portfolio, the Bank will have to establish a core of staff with specialized research skills, who can maintain links with the international agricultural research community and assist, inform, and train less-specialized staff with task-manager responsibility for research projects.

As some of the recommendations represent a departure from current practices and others imply changes in emphases, the review recommends that a *strategic issues paper* be produced to guide managers and staff concerned with the agricultural research subsector.

Bank response

The review concludes that the Bank has made a significant contribution to the development of NARs and of systems to increase the rate of adoption of relevant technology. But with closer attention to the issues raised in this review, impact could be much greater. The importance of technology in the development process dictates that the Bank stay the distance in fostering agricultural research and extension for the less-developed world, as well as continue to monitor counterpart developments in the more-developed world.

Bank management has responded favorably to the review's recommendations, and has developed action plans to address the major issues in both research and extension. The AFR region had no disagreement with the basic extension principles highlighted in the report, including the recommendation that the location and rate of introduction of extension investments should be in accordance with local circumstances. It differed, however, in how the latter should be interpreted in practice; Chapter 5 of this report elaborates on these differences.

The Bank and the international community can assist in the development of relevant agricultural technology services, but the main task rests with borrowers and their implementing institutions. If borrowers are willing to define appropriate and sustainable commitment levels and to meet these commitments, there is a great opportunity to substantially improve institutional capacity to enhance the effectiveness, efficiency, and relevance of critical research and extension services.

Resumen

En este informe se examina la participación del Banco Mundial en el desarrollo de sistemas nacionales de investigación y extensión agronómicas en países en desarrollo en el decenio de 1980 y primeros años noventa. Se presentan recomendaciones sobre el respaldo futuro del Banco a este subsector agrícola. La base de datos principal fue la numerosa serie de informes de proyectos ejecutados y concluidos durante el período que abarca el examen. Se incluyen todas las regiones operativas del Banco, con menor representación de Asia Oriental y Central (con excepción de Turquía) debido a la escasez de actividades subsectoriales durante ese período.

La conclusión a la que se llega en el examen es que las intervenciones del Banco tuvieron efectos positivos significativos, pero también se señala que persisten graves deficiencias en la mayoría de los sistemas nacionales respaldados. Con una mejor planificación y la orientación adecuada durante la ejecución podrían haberse reducido muchos de estos problemas. Preocupa, en particular, la escasa sostenibilidad de las instituciones y los sistemas desarrollados en el marco de los proyectos del Banco. Por lo tanto, en los proyectos futuros es menester tener más en cuenta la coyuntura de cada país antes de apoyar una escala y modo de operación específicos, dado que estos proyectos son esencialmente de desarrollo institucional y deben considerarse inversiones a largo plazo. Seguirá existiendo la necesidad de asignar una partida del gasto público a los servicios de investigación y extensión y de contar con respaldo externo para las instituciones de ejecución, pero también será preciso utilizar con más eficiencia los recursos fiscales.

Participación del Banco

Los objetivos generales del desarrollo rural son el crecimiento, el alivio de la pobreza y una gestión más acertada de la base de recursos naturales. El desarrollo de la tecnología y su rápida adopción en los sistemas de producción y transformación agrícola son elementos fundamentales para lograr estos objetivos sectoriales de gran alcance. El Banco reconoce la importancia de la investigación y la extensión agrícola, como demuestran sus crecientes compromisos con este subsector en un momento en que el nivel de financiamiento de proyectos agrícolas, en general, se ha estancado, e incluso ha disminuido en porcentaje del financiamiento total del Banco.

Antes del período que abarca el examen y durante la mayor parte del decenio de 1980, las actividades de extensión recibieron más respaldo del Banco que las de investigación. En los últimos años, ambas han recibido del Banco un volumen de financiamiento semejante. En el período de 16 años que concluyó al final de 1992, el Banco comprometió más de US$3.000 millones y US$2.000 millones a las actividades de extensión e investigación, respectivamente, y en los últimos años más de US$200 millones anuales a cada una. Además, la preponderancia, en los años setenta, del respaldo a la investigación y a la extensión como com-

ponentes de otros proyectos agrícolas (los proyectos "por componentes", como se denominan en este examen) dio lugar al respaldo de proyectos independientes centrados en la investigación, la extensión o ambos servicios. Esta evolución pone de relieve la meta del Banco de ayudar a desarrollar instituciones que puedan prestar los servicios requeridos. La frecuencia con que se repiten proyectos encaminados a mejorar aún más el desempeño de las instituciones respaldadas en proyectos anteriores confirma también la importancia de esta meta.

En la mayoría de los casos, los proyectos de investigación tenían por objeto mejorar la infraestructura investigativa, el perfeccionamiento de los recursos humanos y la eficiencia operacional de los principales componentes de los sistemas nacionales de investigaciones agronómicas. Para ello, por lo general procuraban incrementar la coordinación en materia de investigación (mediante el establecimiento o consolidación de organizaciones centrales) y, a menudo, respaldaban programas de investigación y esferas de interés específicas. Sin embargo, las intervenciones no se dirigían normalmente a modificar la estructura básica de las instituciones (la más común era la estructura basada en programas de productos básicos respaldada por unidades en distintas disciplinas científicas, en muchos casos con una orientación regional).

La intervención del Banco en los proyectos de extensión siguió una tendencia diferente. En los años sesenta y setenta, la expansión de las actividades de desarrollo rural dio lugar a la multiplicación de los extensionistas multifuncionales (transferencia de tecnología, suministro y coordinación de insumos y entrega o supervisión de créditos). Muchos funcionarios del Banco opinaban que si bien este tipo de personal servía a un propósito útil para el desarrollo, sus múltiples obligaciones mermaban su capacidad de transferencia de tecnología. Se diseñó entonces un modelo jerárquico de extensión, que se centraría exclusivamente en la tecnología y que transmitiría a los agricultores con rigurosa periodicidad mensajes seleccionados y oportunos. Otro objetivo de este modelo era recoger para el sistema de investigación datos sobre las necesidades de los agricultores y mantener vínculos estrechos entre las actividades de investigación y de extensión. Se conoció con el nombre de modelo de capacitación y visitas.

Este sistema se introdujo por primera vez en Turquía en 1967 y posteriormente se extendió a la región de Asia meridional a principios de los años setenta, con lo que comenzó la preponderancia de la capacitación y las visitas en los proyectos de extensión respaldados por el Banco, sobre todo en las regiones de Asia meridional, Asia oriental y el Pacífico, y África. El Banco continuó apoyando los servicios de extensión para productos básicos específicos, la asistencia técnica aunada al otorgamiento de créditos y otros servicios intensivos vinculados a proyectos de desarrollo específicos. No obstante, en muchos proyectos se procuró introducir el modelo de capacitación y visitas, con sus correspondientes cambios a nivel de organización e inversiones en infraestructura, equipo y formación de recursos humanos.

El Banco justificaba desde el punto de vista económico el hincapié que hacía en las actividades de investigación y extensión agrícolas. Si bien es difícil hacer cálculos, las estimaciones econométricas de los efectos del desarrollo y la difusión tecnológica sobre la productividad, y los beneficios económicos consiguientes, han respaldado, en general, este tipo de inversión. El carácter de bien público de las inversiones ofrece una nueva justificación al respaldo que el Banco otorga a estas instituciones públicas: la mayor parte del conocimiento generado y difundido no puede ser propiedad de un individuo o grupo. Además, la aplicación de esos conocimientos por quienes los reciben no reduce las posibilidades de acceso de los demás (aunque los primeros en utilizarlos pueden cosechar por un

tiempo beneficios relativamente mayores). La inversión pública en estos servicios, sin embargo, no debería impedir la recuperación de costos de los usuarios finales de la tecnología, cuando sea posible.

La inversión en desarrollo de tecnología y su difusión no puede aumentar la productividad a menos que las partes interesadas cuenten con un entorno propicio en otros sentidos. Es necesario contar con políticas macroeconómicas y sectoriales apropiadas, oportunidades de mercado favorables, acceso a recursos, insumos y crédito para aprovechar plenamente el potencial de la nueva tecnología. Los compromisos del Banco con las actividades de investigación y extensión —que comprenden entre el 12 por ciento y el 14 por ciento del financiamiento total para fines agrícolas— ofrecen amplias oportunidades de inversión complementaria.

Clasificación de los resultados de los proyectos del Banco

Una vez concluidos los proyectos del Banco, el DEO clasifica los resultados de cada uno de ellos como satisfactorios o insatisfactorios. Lamentablemente, la índole de las inversiones en actividades de extensión e investigación no permite, en general, una evaluación cuantitativa rigurosa de los resultados. La expectativa de que muy probablemente se obtengan beneficios económicos y el inevitable carácter subjetivo de toda estimación ex ante de los beneficios que pudieran estar vinculados a las inversiones hicieron que el Banco eximiera a los proyectos de investigación y extensión del requisito normal de que se estime una tasa de rentabilidad económica en la evaluación inicial del proyecto. Esto, aunado a la poca capacidad de evaluación de los proyectos, explica la escasez de datos generados sobre los resultados económicos. La evaluación ex post tuvo que basarse en mediciones no cuantitativas de los resultados (como se hace en este examen del DEO) y en la eficacia con que el proyecto satisfizo sus objetivos de desarrollo institucional.

Las muestras de proyectos de extensión e investigación que se incluyen en este examen obtuvieron clasificaciones satisfactorias del 70 por ciento y el 72 por ciento respectivamente, nivel superior al promedio de alrededor del 63 por ciento para toda la cartera de proyectos agrícolas en el mismo período de examen. Sin embargo, si se toma en cuenta la contribución decisiva del desarrollo y difusión de la tecnología a la productividad agropecuaria y a la lucha contra la pobreza rural y urbana, el Banco debería considerar este nivel de resultados como inaceptable. Esta inquietud se agrava cuando se considera la falta de rigor del proceso de clasificación y el hecho de que este mismo sistema de clasificación ex post determinó que la sostenibilidad no estaba garantizada en dos tercios de los proyectos de extensión y en casi la mitad de los proyectos de investigación que se habían juzgado satisfactorios.

Resultados de la cartera de proyectos de extensión e investigación

El DEO examinó los proyectos uno por uno y agrupados por regiones. Evaluó los aspectos institucionales comúnmente considerados como necesarios para contar con organizaciones de investigación y extensión eficaces, eficientes y sostenibles: perfeccionamiento de los recursos humanos; suficiencia de las instalaciones; procedimientos eficaces de organización, gestión, ejecución, examen y evaluación; pertinencia de los servicios para las necesidades de los agricultores; vínculos entre la investigación, la extensión y sus usuarios y, en el caso de la investigación, vínculos entre las entidades nacionales de investigación y fuentes

externas de respaldo tecnológico e institucional; financiamiento adecuado, especialmente para apoyo a las operaciones, e incentivos adecuados para el personal.

A continuación se compararon los resultados obtenidos en estas esferas con las recomendaciones de un examen del subsector efectuado en 1983 por el DEO y, en el caso de la investigación, también con las directrices del documento de política de investigaciones elaborado por el Banco en 1980. En este enfoque se supone que si los mecanismos institucionales y los procedimientos operativos para la prestación de servicios son adecuados, la inversión institucional dará lugar a la generación y al uso de una mejor tecnología y se obtendrá una rentabilidad económica favorable. La bibliografía sobre la evaluación de la investigación y la extensión arriba mencionada, así como los pocos casos en que se emprendieron estudios de programas respaldados por el Banco, confirman este supuesto.

Las partes 1 y 2 de este informe se refieren, respectivamente, a las actividades de extensión y de investigación, e incluyen un resumen de las observaciones y recomendaciones en ambas esferas.

Extensión

Observaciones

No cabe duda de que la magnitud de la cartera de proyectos de extensión del Banco ha atraído la atención de los prestatarios sobre la importancia de la difusión y adopción de la tecnología para acrecentar la productividad y el bienestar de las pequeñas explotaciones agrícolas. Además, la importancia que asigna la mayoría de los proyectos al mejoramiento de la organización y la gestión ha hecho que aumente la cobertura de las pequeñas explotaciones agrícolas en los servicios de extensión públicos. Pese a estos logros considerables, es menester hacer las siguientes observaciones, muchas de ellas negativas:

Sobre el conjunto de proyectos de extensión:

- Un rasgo común fue la insuficiencia de fondos para financiar el funcionamiento adecuado de los servicios; en una elevada proporción (76 por ciento) de los proyectos independientes su sostenibilidad se calificó como incierta o improbable.

- El financiamiento inadecuado de los gastos ordinarios redujo la eficacia.

- La insuficiencia de tecnología pertinente fue un problema frecuente y una importante limitación en casos en que había escasez de recursos.

- En general, los vínculos con la investigación eran débiles, y ni la investigación ni la extensión eran suficientemente conscientes de la necesidad de comprender las limitaciones y el potencial de los diferentes sistemas de explotación agrícola como base para determinar la tecnología pertinente y los requisitos para su desarrollo.

- Salvo pocas excepciones, en el diseño y la ejecución de proyectos se prestó poca atención a la participación sistemática de la comunidad agrícola en la determinación y solución de los problemas y en la programación de los servicios de extensión. Sin embargo, cuando se dio dicha participación (Tailandia y México, por ejemplo), los resultados fueron muy positivos.

- En la mayoría de los países en desarrollo, las instituciones del sector público están muy jerarquizadas: lo mismo ocurrió en la mayoría de los proyectos del Banco, lo que impidió el establecimiento de servicios atentos a las necesidades reales.

- La calidad del personal fue una importante limitación en casi todos los proyectos independientes que requerían un gran número de recursos humanos, tanto a nivel de contacto con los agricultores como de respaldo técnico. Las deficiencias en esta última categoría limitaron el potencial de los programas de capacitación continua en los grandes planes estatales.

- Se detectó una falta de compromiso de los altos cargos públicos en casi la mitad de los proyectos independientes, lo que redujo el apoyo a la ejecución y al financiamiento; además, en casi ningún proyecto se desarrolló suficientemente la capacidad de supervisión para respaldar la gestión y justificar el financiamiento.

Más en concreto, sobre los proyectos independientes de capacitación y visitas:

- El modelo de capacitación y visitas, el más importante del Banco en materia de extensión, merece un gran reconocimiento por los positivos logros obtenidos, pero no está exento de muchos de los inconvenientes de los proyectos independientes. (El modelo de capacitación y visitas se escogió en el 90 por ciento de estos proyectos.)

- En la mayoría de los programas nacionales de extensión realizados en países en desarrollo y que requieren numerosos recursos humanos, cualquiera que sea el sistema administrativo empleado, cabe prever problemas de sostenibilidad y financiamiento de los gastos ordinarios, falta de tecnología apropiada y deficiencias en la calidad y actitud de respuesta del personal. Además, la estructura jerárquica y la "insistencia en el mensaje" del modelo de capacitación y visitas ha hecho poco para modificar la verticalidad tradicional en la formulación de recomendaciones, pese a que uno de los objetivos de ese modelo es tener en cuenta las opiniones de los agricultores para ofrecerles recomendaciones pertinentes.

- El Banco promovió la aplicación del modelo de capacitación y visitas (sobre todo en los primeros proyectos) con un conjunto relativamente uniforme de inversiones y procedimientos de extensión en programas estatales y nacionales de gran envergadura. Debería haber ajustado el diseño de los proyectos en función de las características fiscales e institucionales, los recursos humanos, los sistemas de explotación agrícola y la dotación de tecnología. Con ello habría incrementado las posibilidades de establecer servicios eficientes y a bajo costo, que habrían captado el respaldo financiero y político necesario.

- Pese a estas críticas de los proyectos basados en el sistema de capacitación y visitas, muchos de los principios organizativos incluidos en el modelo están incorporados en la mayoría de los "buenos" servicios de extensión y son incuestionablemente acertados: programación de las actividades; importancia de la tecnología; capacitación continua del personal; supervisión de los programas; estrechos vínculos entre la investigación y la extensión, y consultas a los agricultores para facilitar la adaptación de la tecnología a las circunstancias específicas. Lamentablemente, muchos de estos principios no se aplicaron debidamente en los proyectos.

- En el modelo de capacitación y visitas se identifica un agricultor de contacto, que es el principal beneficiario de las visitas de extensión (y que, luego, transferirá la tecnología a otros agricultores locales); este concepto no fue muy eficaz y a menudo se prefirió escoger un grupo de agricultores (mecanismo adoptado casi universalmente en los proyectos más recientes). Esto se debió en parte a que los agricultores seleccionados como contacto no eran representativos, en el sentido de que su situación no era tan difícil como la de la mayoría de los beneficiarios previstos de los proyectos. Pero tampoco en los proyectos donde se estableció un grupo de contacto se hizo mucho por verificar que los agricultores tuvieran recursos y limitaciones similares. Por consiguiente, no se aprovecharon del todo las posibilidades de conseguir una mayor eficacia mediante la definición de problemas del grupo y la identificación con las soluciones propuestas (ni el personal estaba capacitado para facilitar este proceso).

Sobre otros proyectos:

- En los proyectos de desarrollo rural integrado, los resultados de los servicios de extensión —basados en el modelo de capacitación y visitas u otros de servicios todavía más intensivos— dependían en general de la disponibilidad de tecnología pertinente para los sistemas de explotación agrícola escogidos como meta y de la eficiencia con que se prestaban los servicios de crédito y de suministro de insumos complementarios.

- Los programas de extensión orientados a productos básicos concretos demostraron que pueden proporcionar todos los ingredientes necesarios para que la adopción de tecnologías eleve los rendimientos del producto previsto. Dado que estos programas se refieren por lo regular a cultivos comerciales, deberá preverse algún mecanismo de recuperación de costos. Los servicios públicos especializados con recuperación de costos y los servicios del sector privado pueden complementar los servicios públicos generales de extensión.

- Los pequeños agricultores viven en un nivel de subsistencia o no muy superior a éste, lo que limita su capacidad de pago de los servicios. Sin embargo, el objetivo fundamental debe ser que los agricultores sean propietarios, de alguna manera, de los servicios que reciben, independientemente de los recursos con los que cuentan. En el otro extremo del espectro, se ha confirmado que el sector privado deberá prestar directamente los servicios de alta calidad profesional y capacidad de respuesta para los cultivos especializados de mayor valor (por ejemplo, verduras y frutas y flores de exportación). (Hubo sólo un caso [Chile] de un proyecto que patrocinó [con buenos resultados] los servicios de extensión del sector privado.)

- La extensión adjunta a un programa crediticio generalmente demostró ser un medio eficiente de fomentar la adopción de tecnología por parte de los agricultores. A veces hubo deficiencias en el uso del crédito en programas de producción inflexibles que no siempre estaban en consonancia con las circunstancias de los agricultores. Pero cuando estos servicios se sufragaban con fondos públicos, surgió un problema de equidad, dado que se estaba brindando un servicio intensivo y costoso a una proporción muy reducida del subsector de pequeñas explotaciones agrícolas, y en general sólo a los agricultores con mejores bases de recursos, lo que implicaba una merma de los recursos disponibles para actividades de extensión para la mayoría.

- Las campañas de extensión periódicas en respuesta a una crisis ampliamente reconocida resultaron ser, en general, eficaces porque lograron evitar muchas

de las limitaciones que supone el establecimiento de un servicio eficiente "permanente".

No existe un modelo de extensión que aventaje tan claramente a los demás como para justificar su adopción uniforme en todas las situaciones de las pequeñas explotaciones agrícolas, pero hay varios criterios básicos que determinan la eficacia de los servicios de extensión. El más importante es el principio de que las recomendaciones deben corresponder a las condiciones del beneficiario. Esto, a su vez, exige que los proyectos de extensión tengan en cuenta las características de los sistemas agrícolas a los que se quiere beneficiar y los factores que los afectan, y están cimentados en una capacidad efectiva de generar y adaptar la tecnología.

Una vez satisfechos estos requisitos básicos, las innovaciones metodológicas, como la planificación y programación, pueden mejorar la eficiencia y la eficacia de los servicios para cumplir los objetivos, siempre que la consideración primaria en el diseño y la ejecución del proyecto sea satisfacer las necesidades de los agricultores. No obstante, no se obtendrán los resultados deseados a menos que las inversiones en extensión estén diseñadas con pleno reconocimiento de otras posibles limitaciones, como las restricciones fiscales, institucionales y de recursos humanos. Si bien la inversión en extensión generalmente se justifica como bien público en la mayoría de los países en desarrollo, por exigencias fiscales los programas de extensión deben alcanzar la máxima eficacia posible en función de los costos para reducir al mínimo las demandas de gastos presupuestarios ordinarios y mejorar las perspectivas de sostenibilidad del servicio. La falta de disponibilidad de tecnología nueva y pertinente reduce la rentabilidad de los servicios de extensión; lo mismo ocurre cuando escasean los fondos, porque esto limita las actividades sobre el terreno de los servicios directos que emplean mucho personal. Cuando la eficiencia y la eficacia son manifiestas, es mucho más fácil conseguir financiamiento.

Recomendaciones

En el Anexo 4 de este informe se examinan más detalladamente las recomendaciones para las intervenciones en marcha y futuras del Banco en materia de extensión agrícola. En resumen, se recomienda que el Banco preste considerablemente más atención al análisis previo al proyecto y otorgue asistencia adecuada a los prestatarios para la preparación de los proyectos. Sólo si se hace hincapié en estos aspectos y se adopta un enfoque analítico para definir las circunstancias en que se encuentran las instituciones y los agricultores podrá formularse una estrategia de extensión apropiada y un programa de inversiones que represente la estrategia actual. Es probable que deban aplicarse técnicas de evaluación rural rápida para analizar los sistemas de explotación agrícola existentes. En este proceso es esencial contar con la intensa participación de los prestatarios para que se identifiquen con los objetivos del proyecto y se comprometan a lograrlos.

El diseño del proyecto recomendado deberá, entre otras cosas, dar prioridad a los grupos escogidos como beneficiarios; tener en cuenta los servicios sectoriales públicos y privados; incorporar, según corresponda, los medios de difusión tradicionales y la nueva tecnología de la información; definir la escala, el tipo y la intensidad de los servicios directos en zonas específicas según las necesidades y los recursos; considerar las necesidades de todos los grupos socioeconómicos, incluida la mujer en las unidades familiares agrícolas, y elaborar un programa de capacitación del personal basado en las necesidades y que se centre no sólo en la tecnología sino también en métodos de interacción con grupos de agricultores para fomentar su participación en la definición y resolución de problemas y su apoyo al proceso de extensión.

Además, un programa bien concebido debe complementarse con respuestas apropiadas de los prestatarios y del Banco durante la ejecución. Los prestatarios deberán apreciar que el éxito no se mide por el solo hecho de tener instalada la organización de servicios planeados sino por el grado en que el servicio está suministrando tecnología pertinente, tal como la definen los agricultores en los sistemas de explotación agrícola escogidos como destinatarios. Esto requerirá la institucionalización de una capacidad de evaluación continua para facilitar la toma de decisiones adecuadas por parte de los administradores de las actividades de extensión. Además, los proyectos tendrán que adherirse a los principios de diseño que procuran asegurar la generación y extensión de la tecnología apropiada.

En lo que al Banco se refiere, habrá que hacer más hincapié en supervisar la eficacia del sistema como medio de prestación de servicios eficientes y pertinentes a cada uno de los sistemas de explotación agrícola del programa, y la capacidad de respuesta del servicio cuando cambian las circunstancias.

No obstante, para aplicar estas recomendaciones habrá que abordar los siguientes problemas:

- Las limitaciones en materia fiscal, de recursos humanos, servicios complementarios y dotación de tecnología pueden desaconsejar la inversión en servicios de cobertura estatal que requieren mayor concentración de personal. Cuando éste sea el caso, es posible que algunos departamentos del Banco tengan que modificar su enfoque tradicional de poner en marcha (o seguir apoyando) programas nacionales relativamente uniformes independientemente de las circunstancias locales.

- El Banco deberá tener en cuenta la limitada capacidad de la mayoría de los prestatarios, e incluso de una parte de su personal, para realizar el análisis que requiere el diseño de las actividades de extensión. Pocos funcionarios del Banco cuentan con suficiente experiencia en el diseño y actividades de extensión fuera del Banco. La mayoría de los funcionarios que participan en proyectos de extensión están poco familiarizados con sistemas que no sean el modelo de capacitación y visitas, dada su prevalencia en los proyectos del Banco en los últimos 15 años. La falta de experiencia puede coartar la capacidad de supervisión del Banco. Esto entraña el uso generalizado de consultores experimentados en el diseño de proyectos así como la capacitación dentro del Banco con la asistencia de expertos externos.

- El rápido cambio de las condiciones económicas, comerciales y sectoriales repercutirá en el tipo de servicios de extensión necesarios. Deberán ajustarse también a estas exigencias las funciones respectivas de la asistencia técnica privada y pública. La estrategia nacional debe fomentar mejoras tecnológicas apropiadas a las nuevas circunstancias y, además, todo programa de formación de un grupo de extensionistas debe tener en cuenta la necesidad de contar con personal que satisfaga los requisitos de un servicio (público o privado) más acorde a las necesidades.

Investigación

Observaciones

La cartera de investigaciones del Banco ha tenido un impacto muy positivo sobre los sistemas nacionales de investigaciones agronómicas de los países pres-

tatarios. Sin embargo, como ocurre con las actividades de extensión, persisten varias deficiencias que restan eficiencia al sistema.

Los resultados netos de la inversión han sido los siguientes: mejora de la base de recursos humanos (aunque con algunas incongruencias entre las aptitudes disponibles y las necesarias); ampliación sustancial de la infraestructura de investigación en instalaciones y equipo, junto con algunas dudas acerca de la suficiencia de algunas inversiones; intensificación de los vínculos con entidades externas de investigación; avances en la coordinación entre organismos dentro de los sistemas nacionales de investigaciones agronómicas, pero con cierta desatención a la participación de instituciones académicas; resultados de signo contrario en el mejoramiento de los vínculos entre la investigación, la extensión y el agricultor; escaso desarrollo de la estructura de incentivos para los investigadores y, pese a la importancia que se le ha asignado en la segunda mitad del período que abarca el examen, lento progreso en la búsqueda de mayor eficiencia de la asignación de recursos en las entidades de los sistemas nacionales de investigaciones agronómicas.

Se ha observado que el Banco ha obtenido mejores resultados en la expansión de la capacidad de investigación de entidades específicas de los sistemas nacionales que en el mejoramiento de la gestión y la eficiencia global del sistema. Esto es motivo de preocupación, dada la insuficiencia de financiamiento nacional para las instituciones públicas de investigación y las serias dudas que se plantean en torno a su sostenibilidad. Si bien la expansión y el uso eficiente de recursos no deberían ser incompatibles, la expansión ha demostrado ser un resultado más factible, lo cual pudo incluso dificultar el logro de una mayor eficiencia.

En definitiva, los sistemas nacionales de investigaciones agronómicas y los gobiernos deben asumir la responsabilidad de desarrollar una mejor tecnología y de transferir el conocimiento de ésta a las comunidades agrícolas. No obstante, al Banco, por ser la fuente más importante de financiamiento externo para la investigación agronómica en los países en desarrollo, le compete coadyuvar a:

- mejorar las perspectivas de sostenibilidad de las inversiones en los sistemas nacionales de investigaciones agronómicas;

- dar prioridad a una mejor gestión de dichos sistemas y sus entidades para hacer el uso más eficiente y económico de los recursos y para mejorar la calidad de los resultados de las investigaciones, y

- conseguir que se cuente con mecanismos eficaces y sostenibles para introducir tecnologías apropiadas a las comunidades agrícolas escogidas como beneficiarias.

Las observaciones principales de este examen de la investigación agraria pueden resumirse en tres apartados generales: inversión sostenible y financiamiento de la investigación, gestión y eficiencia de la investigación y uso de la tecnología pertinente.

Inversión sostenible y financiamiento de la investigación

La insuficiencia del financiamiento nacional para la investigación pública es una limitación crucial en la mayoría de los sistemas nacionales de investigaciones agronómicas. La importancia del sector agropecuario, reflejada en su contribución al PIB, el empleo y los ingresos de exportación varía en las distintas regiones y países. Sin embargo, en todos los países donde el Banco está prestando

asistencia a los sistemas nacionales de investigaciones agronómicas, la contribución de la actividad agropecuaria es suficientemente importante como para justificar un fuerte apoyo presupuestario a un sistema eficiente de investigación. El respaldo del gobierno se ha puesto de manifiesto en la voluntad de ampliar las actividades investigativas, aunque en la mayoría de los casos con asistencia en forma de cuantiosos préstamos o donaciones. Lamentablemente, si bien se ha incrementado la dotación de personal en los componentes del sector público de los sistemas nacionales de investigaciones agronómicas, el financiamiento de las actividades de investigación no se ha mantenido a tono con la expansión del personal. En consecuencia, en la mayoría de los países se ha reducido el financiamiento por investigador y los salarios consumen una proporción exagerada del financiamiento de los gastos ordinarios. Esto ha mermado la eficiencia y la eficacia y ha puesto en peligro la continuidad institucional. El Banco y la comunidad de donantes han dado un fuerte respaldo a la expansión y han adoptado incluso medidas excepcionales para apoyar el financiamiento de las operaciones. Sin embargo, la renuencia de los gobiernos a suministrar fondos que permiten utilizar adecuadamente los medios de investigación pone en tela de juicio su compromiso con la investigación de alta calidad. El retraso en el desembolso de los recursos presupuestarios aprobados, práctica muy frecuente, también demuestra que los gobiernos no comprenden plenamente las consecuencias nocivas de las demoras de los programas en la productividad de la investigación ni los posibles beneficios de una investigación agronómica eficiente.

El gasto medio en investigación en proporción del PIB agrícola (intensidad de la investigación agronómica) se ubica en torno al 0,5 por ciento y no aumentó en ninguna región en desarrollo salvo África. El incremento en esta región está directamente vinculado al nivel excepcional de respaldo del Banco y de los donantes y no al financiamiento público; la sostenibilidad está en peligro debido al problema crucial del financiamiento de los costos ordinarios.

Los gobiernos parecen darse cuenta de la necesidad de la investigación agronómica financiada con fondos públicos pero, dada la escasez de recursos, el compromiso no es tan fuerte como para darle prioridad sobre otros usos posibles de los gastos ordinarios. El Banco, a través del diálogo sobre economía con los prestatarios, tiene la oportunidad de destacar los beneficios de la inversión en investigación eficiente y de recomendar niveles de financiamiento adecuados. La demanda de fondos públicos puede reducirse al mínimo (a) transfiriendo el costo de la investigación a los beneficiarios (recurriendo a la investigación privada o a la recuperación de costos); (b) racionalizando la inversión pública en investigación y asegurando la realización del potencial de todos los recursos de investigación, internos y externos, y (c) verificando que en la gestión de los organismos públicos se fomente la producción eficaz y a bajo costo de tecnología. A la larga, el suministro de fondos depende de que el gobierno esté convencido de que el sistema de investigación pública es eficiente y que sus beneficios sociales sean lo bastante elevados como para dar gran prioridad a esos fondos.

Ya se ha mencionado la justificación de la inversión pública en investigación (y extensión) agronómica por el hecho de que es un bien público. Si a ello se suma que una alta proporción de agricultores en muchos países en desarrollo viven en niveles de subsistencia o en torno a ellos (y por lo tanto, es menos probable que tengan la capacidad o la voluntad de pagar por el desarrollo de tecnología), se justifica la inversión continua del sector público en investigación. A pesar de ello, en los proyectos examinados no se abordó debidamente la posibilidad de transferir parte de los costos de la investigación a los beneficiarios directos. Sí hubo transferencias considerables en algunos sistemas nacionales de investigaciones agronómicas, sobre todo en América Latina y el Caribe, y con frecuencia

en el caso de cultivos de productos de exportación en todas las regiones, en este último caso como herencia del período colonial. Además, rara vez ha utilizado el Banco sus exámenes del gasto público para perfeccionar la asignación de recursos con fines investigativos o para promover estrategias que permitan recuperar los costos.

La tendencia del Banco ha sido ayudar a la expansión de las instituciones y no a su racionalización, si bien algunos proyectos recientes han intentado hacerlo reduciendo a la vez la dotación de personal. El Banco, en sus interacciones con gobiernos y donantes, podría haber prestado más atención a la totalidad de los sistemas nacionales de investigaciones agronómicas al definir las esferas de intervención adecuadas. La mayoría de esos sistemas no aprovechan el potencial investigativo ni el personal docente de las instituciones académicas. Una colaboración más directa entre el sector agrícola del Banco y las divisiones de recursos humanos hubiese dado lugar a un tratamiento más integral del tema.

Dada la escasez de recursos, los países podrían beneficiarse de la producción conjunta de tecnología para regiones agroecológicas compartidas. El Banco y los donantes han hecho un esfuerzo encomiable en África al establecer el Programa especial de investigaciones agrícolas para África (SPAAR), pero aún no han explotado plenamente las oportunidades de colaboración en otras zonas. La cooperación regional tiene por objeto racionalizar la investigación y fomentar la cooperación entre los donantes y los sistemas nacionales de investigaciones agronómicas para aprovechar cabalmente las ventajas comparativas y las características sobresalientes de los sistemas individuales de investigación. Al amparo del SPAAR se han iniciado cuatro marcos regionales de acción. Este concepto concuerda con la tesis de que el tamaño reducido de los sectores agropecuarios y la escasez de financiamiento y recursos humanos de muchos países africanos impide una respuesta independiente a todas las necesidades tecnológicas. Pese a ello, los donantes se muestran todavía renuentes a abandonar su respaldo a las esferas investigativas que han patrocinado tradicionalmente. Por otra parte, la voluntad de los gobiernos nacionales de financiar la investigación fuera de los sistemas nacionales de investigaciones agronómicas no es todo lo firme que cabría esperar.

El respaldo directo del Banco y los donantes para cubrir los costos de operación —hasta el 100 por ciento en algunos proyectos recientes para África— refleja el reconocimiento de la necesidad crucial de desarrollo de tecnología. No obstante, existe el peligro real de crear una dependencia excesiva del apoyo externo. La sostenibilidad fiscal debe ser prioritaria; de lo contrario, no será posible mantener ni utilizar eficientemente inversiones elevadas a largo plazo. El Banco y los donantes no deberán ofrecer altos niveles de respaldo sin analizar cuidadosamente el respaldo fiscal del gobierno al sector de que se trate y a la investigación dentro de la asignación sectorial. Deberá demostrarse que existe un compromiso. La estrategia de investigación acordada deberá demostrar claramente la voluntad de adoptar procesos de asignación de prioridades que limiten el número de programas a los recursos disponibles y multipliquen la eficiencia, y el deseo de emprender y respaldar iniciativas legítimas de investigación regional. Lo ideal sería que el marco de política favoreciera la inversión en actividades agropecuarias y el uso rentable de una mejor tecnología agrícola.

La colaboración de los sistemas nacionales de investigaciones agronómicas con el Grupo Consultivo sobre Investigaciones Agrícolas Internacionales (CGIAR) ha contribuido al desarrollo continuado de tecnología apropiada para las comunidades agropecuarias. No obstante, en los documentos de los proyectos del Banco no se especificaba, hasta hace poco, la participación de los centros del

grupo consultivo en las acciones encaminadas a mejorar los sistemas nacionales de investigaciones agronómicas.

En los planes de inversión financiados por el Banco, salvo algunos casos de falta de atención a la racionalización de las inversiones institucionales en Asia meridional y África, el tipo y la escala de las inversiones en infraestructura estaban en gran medida justificados. El equipo científico y de operaciones también contribuyó a la capacidad investigativa. Sin embargo, las necesidades de equipo estaban a menudo mal definidas; los artículos adquiridos no eran los más indicados para los programas o para la capacidad de mantenimiento de las instituciones. Este problema, que debió haberse abordado de manera más vigorosa, era resultado de la falta de atención en la preparación y en la evaluación inicial o de un problema de secuencia por el cual el equipo se solicitaba antes de definir claramente los programas de investigación.

Los proyectos del Banco han respaldado con firmeza la instalación de bibliotecas en los sistemas nacionales de investigaciones agronómicas, aunque su utilidad está en peligro debido a la limitación de financiamiento para la adquisición de publicaciones especializadas en muchos de los sistemas. Recientemente se ha prestado cierta atención (pero no la suficiente) a los sistemas de comunicaciones electrónicas y al establecimiento de redes. Los investigadores deben utilizar con más eficacia las publicaciones científicas, y hay que mejorar el proceso de producción y examen de estudios científicos basados en los resultados de los sistemas nacionales de investigaciones agronómicas.

La investigación en tanto que componente de los proyectos agrícolas puede ser una inversión viable y sostenible si alcanza dimensiones suficientes, está vinculada a una institución investigativa pública o semipública bien organizada y es complementaria del programa de esa institución. No obstante, muchas intervenciones en los proyectos del Banco no reunían estas características en la medida suficiente para generar resultados útiles. Los préstamos para ajuste sectorial otorgados en las regiones de Europa y Asia central y de Oriente Medio y África del Norte tuvieron repercusiones positivas en la reforma de las instituciones de investigación, pero constituyeron parte integrante de un proceso de diálogo continuo sobre la investigación en el sector agrícola, y no intervenciones aisladas. En las demás regiones, el componente de investigación de este tipo de financiamiento con fines de ajuste no tuvo mayores consecuencias.

Gestión y eficiencia de la investigación

A menudo, los proyectos del Banco han introducido una dimensión agroecológica con el objeto de establecer un marco capaz de dar más importancia a la investigación y, en general, han contribuido a la creación o el fortalecimiento de una institución central de coordinación para los sistemas nacionales de investigaciones agronómicas. Cuando esto último no ha sido factible, se ha respaldado la coordinación entre el grupo dominante de instituciones. La adopción de mejores mecanismos de coordinación ha facilitado los esfuerzos del Banco por fortalecer los vínculos —a fin de promover el uso eficiente de los recursos, desarrollar estrategias nacionales de investigación e instituir procedimientos de planificación y examen de programas— aun cuando el resultado de estas medidas no siempre ha sido tan favorable como se había previsto.

Salvo algunas excepciones notables, las universidades efectuaron pocas investigaciones en materia agropecuaria, debido a que el personal docente de ciencias y agronomía se encontraba generalmente con limitaciones de financiamiento e instalaciones. Pese a eso, algunas instituciones investigativas académicas (y pri-

vadas) participaron activamente en los componentes de una estrategia de investigación; en el marco de proyectos del Banco se crearon fondos especiales a los que podían recurrir las instituciones.

Las iniciativas de los proyectos del Banco encaminadas a mejorar la gestión y planificación de las investigaciones han adoptado, por lo general, la forma de asistencia técnica patrocinada por un préstamo o por los donantes. El Servicio Internacional para la Investigación Agrícola Nacional (ISNAR) tuvo una gran participación en este campo. No obstante, el resultado general de este respaldo sólo puede calificarse como "primer paso importante" hacia un proceso más racional de planificación en la mayoría de los sistemas nacionales de investigaciones agronómicas o en sus principales entidades. A nivel global de la estrategia se ha avanzado bastante, pero los resultados no han sido tan satisfactorios en lo que atañe al análisis de la disponibilidad de recursos y al establecimiento de prioridades.

Dadas las deficiencias del proceso de asignación de prioridades, en los documentos se suelen esbozar cursos de acción encaminados a satisfacer la demanda proyectada de mejora tecnológica, pero no se fijan prioridades para el caso en que escaseen los recursos. La experiencia indica que es poco probable que la planificación maestra de la investigación sea muy beneficiosa a menos que se identifiquen con ella los organismos de financiamiento y de ejecución, tenga una cobertura completa de contribuyentes potenciales, adopte firmes procedimientos de asignación de prioridades en una situación de recursos limitados y pueda compaginar las consideraciones macroeconómicas con las necesidades reales de las comunidades agropecuarias.

Algunos sistemas nacionales de investigaciones agronómicas, sobre todo en África, también han tendido a aceptar las políticas sectoriales fijadas por el gobierno sin tratar de influir en el proceso de asignación de prioridades cuando las políticas parecen inadecuadas. Esto, y la frecuente falta de rigor en el proceso general de asignación de prioridades, se puede atribuir en parte a la poca capacidad de análisis económico y de política que caracteriza a la mayoría de los sistemas nacionales.

Para un aprovechamiento óptimo de los recursos disponibles, en el diseño de los programas deberá darse especial consideración a las necesidades de los usuarios de la investigación. La mejor guía para la asignación de recursos es el análisis económico, preferentemente como modelo de superávit económico (es decir, como representación de los nuevos excedentes de consumidores y productores inducidos por la adopción de los resultados de la investigación) en forma global o simplificada, para facilitar la asignación de prioridades entre programas y subprogramas. Inevitablemente, se formularán juicios subjetivos, pero la organización de la información de manera congruente con ese modelo eleva la probabilidad de efectuar evaluaciones convincentes. Como resultado indirecto de este enfoque se puede obtener un conjunto de estimaciones de la tasa de rentabilidad económica, la relación costo-beneficio y el valor actual neto, que pueden utilizarse para justificar las asignaciones presupuestarias.

Pueden emplearse métodos de puntuación simplificados para comparar programas cuando no se dispone de recursos para efectuar un análisis completo, siempre que se ponderen adecuadamente los criterios de evaluación. No obstante, para que estos métodos sean de utilidad, deberán elaborarse al menos índices aproximados de eficiencia económica. Es probable que los métodos informales que formulan juicios estructurados basados en un análisis de los principales factores determinantes del valor actual neto de la investigación sean más fiables

que una aplicación deficiente de métodos de puntuación simplificados y de otros métodos, como las pruebas de "congruencia".

Para la asignación de prioridades entre un proyecto y otro, práctica frecuente en los programas institucionales, no se necesita normalmente una cuantificación económica completa de las repercusiones probables. El examen técnico en comités de pares, combinado con el conocimiento y uso de los principales factores determinantes del valor actual neto de la investigación, puede ayudar mucho a utilizar eficientemente los recursos de los que dispone cada jefe de investigación. No deberá darse por sentada, sin embargo, la eficiencia del proceso de examen de los pares. La aplicación plena de este proceso crucial ha sido especialmente difícil cuando las tradiciones enraizadas en el sector público y en la antigüedad tienden a desalentar el libre intercambio de críticas científicas francas, sobre todo si se dirigen hacia científicos de renombre.

En varios proyectos se ha aplicado provechosamente el concepto de examen independiente de los programas con la asistencia de expertos de otras instituciones locales o internacionales. Este examen intensivo, además de mejorar la capacidad de programación local, complementa los programas de asistencia técnica y capacitación de posgrado que el Banco ha financiado para mejorar la calidad de la investigación científica. No obstante, es necesario prestar más atención a la institucionalización de los procesos de capacitación basados en las necesidades. El establecimiento de relaciones de capacitación e investigación a largo plazo con instituciones educativas e investigativas prestigiosas de países más desarrollados puede ampliarse fructíferamente para perfeccionar la capacidad de investigación científica. Los centros del grupo consultivo también desempeñan un papel muy importante en el examen de programas y en la capacitación práctica.

Como se ha señalado, es necesario corregir la ausencia casi total de capacidad de evaluación ex post. La falta de personal especializado en economía impide la evaluación ex post regular de todos como práctica habitual, pero es necesario analizar los beneficios económicos de ciertos programas o partes de ellos para facilitar la planificación futura de la investigación y para justificar los gastos ante las entidades de financiamiento públicas o privadas. La solidez de cualquier análisis se refuerza en la medida en que permite cuantificar la adopción efectiva de tecnología por los agricultores. Lamentablemente, este aspecto de la gestión de la investigación (supervisión del impacto) se ha soslayado hasta la fecha.

No es posible avanzar en la evaluación a menos que los funcionarios del Banco y las instituciones de investigación cooperen en el diseño y la ejecución de métodos prácticos para medir los resultados y las repercusiones. Si bien el Banco debe asignar más recursos a la evaluación económica ex ante y ex post de la investigación, su objetivo principal no debe ser estimar la rentabilidad económica de los proyectos que respalda. Una evaluación tan estrecha no contribuiría demasiado a aumentar la eficiencia del proceso de desarrollo tecnológico. Sería más conveniente que el Banco se centrara en la institucionalización de la capacidad dentro de los sistemas nacionales de investigaciones agronómicas para utilizar el análisis económico, especialmente al fijar las prioridades programáticas.

La introducción de los sistemas de información para la administración, que puede facilitar la planificación, supervisión, evaluación y responsabilización individual e institucional, fue promocionada por muchos proyectos del Banco en la última parte del período del examen y por los donantes (especialmente la USAID), a menudo con participación del ISNAR. En general, la adopción de esos sistemas ha sido limitada y no ha contado con el pleno respaldo de la adminis-

tración y el personal. Incluso los sistemas contables más simples necesitan grandes mejoras en muchos sistemas nacionales de investigaciones agronómicas.

Las mejoras en las instalaciones, en las oportunidades de formación de posgrado y en los procedimientos de planificación y examen no sólo permiten realizar investigaciones más pertinentes sino que incentivan también a los funcionarios a seguir trabajando en organizaciones públicas de investigación. No obstante, es poco probable que se obtengan los dividendos previstos a menos que haya un sistema acertado de incentivos al rendimiento profesional de los investigadores. La escasez de fondos de operación, que ha provocado una disminución de los salarios, desincentiva fuertemente ese rendimiento. No obstante, mediante acuerdos institucionales autónomos, se han conseguido salarios más atractivos para los investigadores. En cualquier caso, esos acuerdos no han producido resultados tan satisfactorios como para merecer mayor consideración. Tampoco la semiautonomía ha bastado normalmente para introducir sistemas de recompensa y promoción basados en el rendimiento, objetivo que en realidad se logra únicamente en casos excepcionales de autonomía total.

Uso de la tecnología pertinente

Una buena manera de asegurar que la tecnología desarrollada o adaptada sea adoptada por la comunidad agrícola escogida como beneficiaria es constatar que resuelva un problema claramente identificado. La mayoría de los proyectos del Banco han destacado la necesidad de que la investigación responda mejor a las necesidades de los pequeños agricultores, sobre todo en las circunstancias de producción más difíciles. Las intervenciones han incluido ajustes en las asignaciones de recursos para corregir desequilibrios, y una gama de técnicas para mejorar los vínculos entre la investigación, la extensión y los agricultores. Con ello se pretende hacer saber a los investigadores cuáles son las verdaderas limitaciones de los agricultores, y extraer recomendaciones prácticas sobre nueva tecnología para los servicios de extensión y las explotaciones agrícolas. La organización de reuniones periódicas de investigadores y extensionistas para lograr estos objetivos ha dado resultados de signo contrario. Se ha ampliado sustancialmente la capacidad investigativa en la explotación agrícola misma, pese a que se presentaron varios problemas, en particular el hecho de que éste suele ser el primer programa afectado ante una insuficiencia de fondos.

Los proyectos respaldados por el Banco han fomentado ampliamente la adopción de una perspectiva basada en el sistema de explotación agrícola, pero será necesario perfeccionar este concepto hasta integrarlo definitivamente en el proceso de investigación. Puede argumentarse que para aprovechar la escasa experiencia socioeconómica de los sistemas nacionales de investigaciones agronómicas habrá que asignar la más alta prioridad a ayudar a otros investigadores a entender los sistemas de explotación agrícola y sus requisitos. El proceso no estará completo, sin embargo, a menos que se mida la adopción de tecnología, como resultado de la investigación, en las comunidades escogidas como beneficiarias.

Una amplia proporción de unidades familiares agrícolas de muchas regiones están encabezadas por mujeres, que constituyen elementos importantes de la mayoría de los sistemas de explotación agrícola. La insistencia en la institucionalización de esta perspectiva implica asimismo la atención a las cuestiones relacionadas con las desigualdades entre sexos al analizar y responder a las necesidades y oportunidades de las unidades familiares, pero no siempre ha ocurrido así. El examen de esas cuestiones es importante para el diagnóstico eficaz del sistema de explotación agrícola, la planificación y evaluación de la inves-

tigación, y los estudios sobre la adopción de tecnología en comunidades de pequeños agricultores. Los centros del grupo consultivo y algunas ONG han prestado considerable atención al género; el Banco deberá aprovechar estos conocimientos y tratar el tema en sus negociaciones con los prestatarios.

En toda investigación basada en la demanda los beneficiarios previstos (los agricultores y otros interesados) deberán participar en su diseño y evaluación. La expansión de la investigación con fines de adaptación dentro de la explotación agrícola alienta la participación de los beneficiarios, pero no siempre ha ocurrido así en los proyectos, al menos en forma suficiente. Los investigadores deben tomar conciencia de las circunstancias que rodean a los agricultores, ya sea a través de la interacción directa con las comunidades agrícolas y sus representantes, una utilización frecuente de intermediarios en los sistemas de extensión públicos o privados, o la combinación de ambos enfoques (la modalidad más común). Cualquiera sea el método empleado, esta interacción debe ser parte integrante del proceso de investigación.

Recomendaciones

Las recomendaciones de este examen de la cartera de actividades de investigación, detalladas en el Capítulo 10, pueden resumirse de la siguiente manera:

Con respecto a la *función de la investigación*, el Banco deberá prestar más atención al sector agropecuario y, en particular, a la contribución de la investigación en su diálogo sobre políticas, en los estudios económicos y sectoriales y en las estrategias de asistencia a los países. Para fomentar la sinergía entre educadores, científicos, extensionistas, agricultores y otras partes interesadas, el Banco debería considerar la generación, adquisición y adopción de tecnologías como componentes de un único sistema. La relación entre la investigación y la educación en los países prestatarios y en el Banco también merece más atención. El Banco y los prestatarios se verían muy beneficiados con el respaldo continuo de aquel a las investigaciones agrícolas internacionales (CGIAR), activas alianzas con los centros del grupo consultivo y los donantes y vínculos más ágiles entre los sistemas nacionales de investigaciones agronómicas y otras entidades investigativas.

Para fomentar la *sostenibilidad de la inversión*, el Banco debe respaldar el desarrollo global de sistemas de investigación a la vez que insiste en que se ofrezcan amplias oportunidades de financiamiento continuo y que los prestatarios pongan de manifiesto su compromiso. Además, deberá financiar proporciones más elevadas de los costos de operación y de programas concretos de investigación (de manera temporal) sólo cuando los prestatarios hayan demostrado su decisión de respaldar un programa acordado de investigación con las prioridades debidamente asignadas. Según los casos, el Banco deberá racionalizar o complementar los recursos existentes, en lugar de ampliarlos. Deberá asegurar que se cuente con entornos de política y legislación favorables para la adquisición de tecnología y la investigación en el ámbito privado y alentar a los sistemas nacionales de investigaciones agronómicas a introducir sistemas viables de recuperación de los costos de la investigación. Al tomar la iniciativa en la coordinación entre donantes y sistemas de investigación regionales, el Banco puede facilitar el uso más eficiente de los recursos externos. Además se conseguirá una mayor sostenibilidad si el Banco se centra más en la prestación de asistencia a los sistemas nacionales de investigaciones agronómicas para la adquisición oportuna de equipo e instalaciones adecuadas y en la contratación de expertos para especificar las necesidades de equipo. Cuando no sea apropiado brindar respaldo global a un sistema nacional de investigaciones agronómicas, el Banco deberá considerar ofrecer su respaldo a programas de investigación específicos.

El Banco deberá continuar fomentando la coordinación dentro de los sistemas nacionales de investigaciones agronómicas así como el uso de *planes maestros de investigación* y procedimientos de asignación de prioridades. Pero deberá procurar que el personal nacional se identifique con los procedimientos y los resultados y prestar más atención a la calidad y validez de los procesos y su utilización en la asignación de recursos. El proceso de planificación será de poca utilidad si no se cuenta con todos estos elementos y con la participación de los encargados de formular las políticas.

El desarrollo de *capacidad de supervisión, evaluación y análisis macroeconómico* en las entidades de los sistemas nacionales de investigaciones agronómicas merece más atención. El Banco debe esforzarse más en elaborar, junto con los prestatarios, una evaluación económica ex ante de los programas e indicadores prácticos de los resultados de la investigación antes de dar inicio a los proyectos; definir en qué programas de investigación se medirán las repercusiones económicas, y asegurar que se cuente con mecanismos para determinar si se dispone de la capacidad necesaria para dicho análisis. Por último, deberá supervisar directamente la puesta en práctica de mecanismos de observación y evaluación y utilizar las observaciones de las repercusiones de los programas en la evaluación ex post de los proyectos.

El Banco no deberá dejar de prestar atención a los intentos por mejorar la *calidad de la investigación científica,* sobre todo mediante la capacitación basada en las necesidades, la asistencia técnica, vínculos más eficaces con los centros del Grupo Consultivo, el examen externo de los programas y proyectos de investigación y el establecimiento de redes científicas locales e internacionales.

La investigación, para ser eficaz, deberá basarse en las necesidades expresadas por los clientes y *responder* a ellas. Si bien el Banco promueve invariablemente este concepto, podría hacer más por orientar a los prestatarios sobre la manera de conseguir que los usuarios participen en el diseño y evaluación de la investigación, y sobre la influencia de las cuestiones relativas a la diferencia entre sexos en la planificación y realización de la investigación.

Con respecto al *desempeño,* el Banco deberá insistir en sostener diálogos con los prestatarios y entidades de investigación para persuadirles de que deben fomentar la eficiencia ofreciendo al personal incentivos adecuados para aumentar su rendimiento. Para mejorar los resultados de la cartera de proyectos de investigación, el Banco tendrá que establecer un núcleo básico de personal con aptitudes de investigación especializada, que pueda mantener vínculos con la comunidad internacional de investigaciones agronómicas y asistir, informar y capacitar al personal menos especializado que se encarga de dirigir los proyectos de investigación.

Dado que algunas de las recomendaciones representan una desviación de las prácticas actuales y otras entrañan un cambio de orientación, el examen recomienda la elaboración de un *documento sobre cuestiones estratégicas* para orientar a los jefes de proyecto y al personal que participa en el subsector de la investigación agraria.

Respuesta del Banco

En el examen se concluye que el Banco ha efectuado una contribución significativa al desarrollo de sistemas nacionales de investigaciones agronómicas y de mecanismos encaminados a elevar la tasa de adopción de tecnología apropiada.

Pero si se tienen más en cuenta las cuestiones planteadas en el examen, las repercusiones podrían ser mucho mayores. Dada la importancia de la tecnología en el proceso de desarrollo, el Banco deberá continuar fomentando la investigación y extensión agrícolas en los países menos adelantados sin perder de vista lo que ocurre en el mundo más desarrollado.

La administración del Banco ha respondido favorablemente a las recomendaciones del examen y ha formulado planes de acción para abordar las principales cuestiones en materia de investigación y extensión. La región de África no tuvo desacuerdo alguno con los principios de extensión básicos destacados en el informe, incluida la recomendación de que la ubicación y el ritmo de las nuevas inversiones en actividades de extensión deberán ser congruentes con las circunstancias locales. No se mostró de acuerdo, en cambio, en la forma en que esto último deberá interpretarse en la práctica; en el Capítulo 5 de este informe se tratan con más detalle esas diferencias.

El Banco y la comunidad internacional pueden contribuir al desarrollo de servicios pertinentes de tecnología agropecuaria, pero la tarea principal sigue en manos de los prestatarios y de las instituciones de ejecución. Si los prestatarios están dispuestos a establecer los niveles de compromiso adecuados y sostenibles, y a cumplirlos, existen grandes oportunidades de mejorar sustancialmente la capacidad institucional a fin de incrementar la eficacia, la eficiencia y la pertinencia de los servicios cruciales de investigación y extensión.

Résumé

Le présent rapport fait le bilan de l'action menée par la Banque mondiale pour appuyer le développement des systèmes nationaux de recherche et de vulgarisation agricoles dans les pays en développement dans les années 80 et au début des années 90. Il formule des recommandations quant au soutien que la Banque devrait apporter à l'avenir à ce sous-secteur agricole. Les principales bases de données ont été les séries détaillées de rapports sur les projets qui ont été exécutés et achevés durant la période considérée. Cet examen a couvert toutes les régions opérationnelles de la Banque, bien que l'Asie orientale et centrale (à l'exception de la Turquie) n'aient guère été représentées du fait du caractère limité des activités subsectorielles qui y ont été menées durant la période considérée.

Cet examen conclut que les interventions de la Banque ont eu un impact nettement positif, mais il en ressort également que de sérieuses lacunes persistent dans la plupart des systèmes nationaux auxquels la Banque a apporté son appui. Une meilleure planification et des instructions appropriées au stade de l'exécution auraient pu atténuer une grande partie de ces problèmes. La question de le viabilité des institutions et des systèmes mis au point dans le cadre des projets de la Banque est particulièrement préoccupante. À cet égard, il faut qu'à l'avenir les projets tiennent davantage compte de la situation particulière à chaque pays en soutenant un certain mode d'opération sur telle ou telle échelle, dans la mesure où ces projets consistent essentiellement à renforcer les institutions et doivent être considérés comme des investissements à long terme. Il faudra continuer de consacrer des dépenses publiques aux services de recherche et de vulgarisation et d'apporter une aide extérieure aux institutions d'exécution, mais les ressources budgétaires devront être utilisées plus efficacement.

Participation de la Banque

Les objectifs généraux du développement rural sont la croissance, la lutte contre la pauvreté et une meilleure gestion de la base de ressources naturelles. Le développement de technologies et leur adoption rapide dans les systèmes de production agricole et de transformation des produits sont indispensables pour que ces vastes objectifs sectoriels puissent être atteints. La Banque démontre qu'elle est consciente du rôle de la recherche et de la vulgarisation agricoles en accroissant ses engagements en faveur de ce sous-secteur à un moment où le niveau de financement des projets agricoles en général stagne ou diminue en pourcentage de l'ensemble de ses prêts.

Avant la période considérée et pendant la plus grande partie des années 80, la Banque soutenait davantage la vulgarisation que la recherche. Plus récemment, cette dernière a bénéficié d'autant d'investissements de la Banque que la vulgarisation. Durant la période de 16 ans se terminant à la fin de 1992, la Banque a consacré respectivement plus de 3 et 2 milliards de dollars à la vulgarisation et à la recherche et ces dernières années, plus de 200 millions de dollars par an à

l'une et l'autre. Une évolution a également été constatée en ce sens que le soutien de la Banque à la recherche et à la vulgarisation ne prend plus essentiellement la forme de composantes d'autres projets agricoles (appelés « projets à composantes » dans le présent examen) comme dans les années 70, mais consiste à appuyer plutôt des projets autonomes axés sur la recherche ou la vulgarisation, ou bien simultanément sur ces deux types de service. Cette évolution démontre que la Banque a pour but d'aider à mettre en place des institutions qui puissent assurer les services requis, comme le confirment également les fréquents projets répliques qui visent à améliorer encore davantage la performance des institutions ayant bénéficié d'un appui dans le cadre de projets antérieurs.

Les projets de recherche visent généralement à améliorer l'infrastructure de recherche, le perfectionnement du personnel et l'efficacité opérationnelle des principaux éléments des systèmes de recherche agronomiques nationaux (SRAN). À cette fin, les projets s'efforçaient généralement d'améliorer la coordination des recherches (dans le cadre d'organisations-cadres nouvelles ou renforcées) et appuyaient souvent des programmes de recherche et des domaines d'activités prioritaires bien déterminés. Toutefois, les interventions ne visaient généralement pas à modifier la structure fondamentale des institutions. (La structure la plus courante était fondée sur des programmes relatifs à des produits de base appuyés par des services spécialisés dans différentes disciplines scientifiques, et l'on a observé également dans bien des cas une certaine orientation régionale.)

Le mode d'intervention de la Banque dans les projets de vulgarisation a évolué différemment. Dans les années 60 et 70, l'expansion des activités de développement rural a entraîné une augmentation du nombre de vulgarisateurs exerçant de multiples fonctions (transfert de technologies, fourniture et coordination des intrants, octroi ou supervision du crédit). Au sein de la Banque, nombreux sont ceux qui ont estimé que même si ce type de personnel de terrain contribuait utilement au développement, ses multiples fonctions ne permettaient pas d'exploiter toutes les possibilités offertes par les transferts de technologies. On a conçu un système de gestion de la vulgarisation organisé de façon hiérarchique afin de mettre exclusivement l'accent sur la technologie et de transmettre très régulièrement aux exploitants agricoles des messages bien déterminés, et communiqués en temps opportun. Il s'agissait également de fournir aux systèmes de recherche des informations en retour sur les besoins des exploitants, et de maintenir des liens étroits entre recherche et vulgarisation. Ce modèle a été appelé « Système formation et visites » (F&V).

Le système F&V a été introduit pour la première fois en Turquie en 1967 et étendu ultérieurement à la région de l'Asie du Sud au début des années 70. C'est à partir de là que le système F&V a joué un rôle prédominant dans les projets de vulgarisation appuyés par la Banque, en particulier dans les régions de l'Asie du Sud, de l'Asie de l'Est et du Pacifique et d'Afrique. La Banque a continué à apporter son soutien à des services de vulgarisation spécialisés par produit, à fournir une assistance technique correspondant à l'octroi de crédits et à assurer d'autres services intensifs en liaison avec des projets de développement spécifiques. Mais beaucoup de projets se sont efforcés de mettre en place le modèle F&V de gestion de la vulgarisation, impliquant des changements au niveau de l'organisation et des investissements dans l'infrastructure, le matériel et la formation.

La Banque avait une raison économique de mettre l'accent sur la recherche et la vulgarisation agricoles. Bien que nécessitant des calculs difficiles, les estimations économétriques des effets de la mise au point et de la diffusion des technologies sur la productivité, ainsi que les avantages économiques en résultant,

ont généralement justifié ce type d'investissement. La nature de bien collectif des investissements constitue une autre justification du soutien apporté par la Banque à ces institutions publiques — en ce sens qu'un particulier ou un groupe ne peuvent s'approprier la plupart des connaissances générées et diffusées. En outre, l'utilisation des connaissances par ceux qui adoptent les technologies ne réduit pas non plus la disponibilité de la ressource en question pour les autres (bien que ceux qui les adoptent à un stade précoce puissent être en mesure d'en tirer provisoirement des avantages relativement plus importants). Les investissements publics consacrés à ces services ne devraient cependant pas empêcher le recouvrement des coûts auprès des utilisateurs finals de la technologie lorsque cela est possible.

Les investissements consacrés à la mise au point et la diffusion de technologies ne peuvent accroître la productivité que si les parties prenantes opèrent dans un environnement favorable par ailleurs. Des politiques macroéconomiques et sectorielles appropriées, des débouchés favorables, l'accès aux ressources, aux intrants et aux crédits sont autant d'éléments nécessaires pour exploiter pleinement le potentiel des technologies nouvelles. Les engagements de la Banque en faveur de la recherche et de la vulgarisation, qui représentent respectivement 12 et 14 pour cent du volume total de ses prêts au secteur agricole, se prêtent amplement à des investissements complémentaires.

Notation des résultats des projets de la Banque

L'OED considère les résultats de chaque projet de la Banque à son achèvement comme satisfaisants ou non satisfaisants. Malheureusement, de par leur nature, les investissements dans la vulgarisation et la recherche ne se prêtent généralement pas à une évaluation quantitative rigoureuse des résultats obtenus. Le fait que des avantages économiques soient jugés très probables et le caractère par définition subjectif de l'estimation ex ante des avantages pouvant découler des investissements ont amené la Banque à faire une exception pour les projets de recherche et de vulgarisation en n'exigeant pas comme dans les autres cas une estimation de taux de rentabilité économique au stade de l'évaluation du projet. En plus de la capacité limitée d'évaluation rétrospective des projets, cela explique que les données générées sur les résultats économiques aient été limitées. L'évaluation ex post des projets a dû être fondée sur des mesures de performance non quantitatives (comme c'est le cas du présent examen de l'OED) et elle a été en grande partie fonction de la mesure dans laquelle le projet a atteint ses objectifs de développement institutionnel.

Dans l'échantillonnage de projets de vulgarisation et de recherche couverts par le présent examen, on constate que 70 et 72 pour cent respectivement ont été jugés satisfaisants, chiffres supérieurs à la moyenne, qui est d'environ 63 pour cent pour l'ensemble du portefeuille de projets agricoles correspondant à la même période. Toutefois, compte tenu des rôles clés que jouent le développement et la diffusion des technologies pour améliorer la productivité agricole et faire reculer la pauvreté dans les zones aussi bien rurales qu'urbaines, la Banque devrait considérer comme inacceptable ce niveau de performance. La situation devrait être jugée d'autant plus préoccupante que le système de notation est « indulgent » (ou manque de rigueur) et que le même système de notation ex post a révélé que la viabilité des deux tiers des projets de vulgarisation et de près de la moitié des projets de recherche jugés satisfaisants laissaient à désirer.

Résultats du portefeuille de projets de vulgarisation et de recherche

L'OED a réexaminé les projets un par un et sur une base régionale. Elle a évalué les aspects institutionnels communément jugés nécessaires à des organismes de recherche et de vulgarisation efficaces, efficients et viables : à savoir la valorisation des ressources humaines, le caractère adéquat des installations, l'efficacité des procédures d'organisation, de gestion, d'exécution, d'examen et d'évaluation rétrospective, l'adaptation des services aux besoins des exploitants agricoles, les liens entre la recherche, la vulgarisation et leurs clients et, dans le cadre de la recherche, et les liens entre les organismes nationaux de recherche et avec les sources extérieures de soutien technologique et organisationnel. Elle a vérifié par ailleurs si le niveau adéquat des financements, particulièrement pour le soutien opérationnel, était suffisant et si les incitations offertes au personnel étaient appropriées.

Les résultats obtenus dans ces domaines ont ensuite été évalués par rapport aux recommandations d'un examen du sous-secteur effectué par l'OED en 1983, et dans le cadre de la recherche, également par rapport aux directives du document de la Banque de 1980 sur la politique de recherche. Cette approche suppose que si les dispositions institutionnelles et les procédures opérationnelles des services sont appropriées, les investissements institutionnels aboutiront à la création et à l'utilisation de technologies améliorées et seront rentables du point de vue économique. Cette hypothèse est confirmée par les documents mentionnés plus haut et qui portent sur l'évaluation de la recherche et de la vulgarisation, ainsi que par les quelques cas dans lesquels des études empiriques ont été entreprises sur des programmes bénéficiant de l'aide de la Banque.

Les parties 1 et 2 du rapport traitent séparément la vulgarisation et la recherche. On y trouvera un résumé séparé des conclusions et recommandations générales pour chacun de ces deux domaines.

Vulgarisation

Conclusions

Il ne fait pas de doute que le portefeuille considérable de projets de vulgarisation de la Banque a amené les emprunteurs à s'intéresser davantage au rôle de la diffusion et de l'adoption de technologies pour accroître la productivité et améliorer les conditions de vie des petits exploitants. De plus, étant donné que la plupart des projets mettent l'accent sur l'amélioration de l'organisation et de la gestion le taux de couverture des petits exploitants par les services publics de vulgarisation a augmenté. Malgré ces résultats très positifs, les observations suivantes, souvent négatives, s'imposent :

Pour l'ensemble du portefeuille de projets de vulgarisation :

- Il est souvent arrivé que l'on ne dispose pas de fonds suffisants pour assurer les services de façon appropriée, et la viabilité d'une proportion considérable (76 pour cent) de projets autonomes a été jugée comme incertaine ou improbable.

- Le financement insuffisant des charges récurrentes a réduit le niveau d'efficacité.

- L'insuffisance des technologies appropriées a souvent posé un problème et constitué un handicap majeur dans les contextes pauvres en ressources.

- Les liens avec la recherche ont généralement laissé à désirer et pour la recherche comme pour la vulgarisation, on n'a pas été suffisamment conscient de la nécessité de comprendre les contraintes et le potentiel des différents systèmes d'exploitation agricole pour pouvoir déterminer les technologies appropriées et celles qu'il convenait de mettre au point.

- À quelques exceptions près, la conception et l'exécution des projets n'ont guère prévu une participation systématique de la communauté des agriculteurs à la définition des problèmes, à leur solution, et à la programmation des activités de vulgarisation. Toutefois, lorsque l'on a mis l'accent sur leur participation (comme dans le cas de la Thaïlande et du Mexique), les résultats obtenus ont été très positifs.

- Une culture « du sommet à la base » est la norme dans les institutions du secteur public de la plupart des pays en développement. Cette situation a persisté dans le cas de la plupart des projets de la Banque, ce qui est contraire au développement de services adaptés aux besoins.

- Le niveau de compétence du personnel a constitué un handicap majeur dans le cas de la quasi-totalité des projets autonomes nécessitant un personnel nombreux, en ce qui concerne aussi bien les contacts avec les agriculteurs que le personnel d'appui technique. Les lacunes de cette dernière catégorie de personnel ont limité l'impact potentiel des programmes de formation continue dans le cadre de grands programmes publics.

- Dans le cas de près de la moitié des projets autonomes l'engagement des hauts fonctionnaires a été insuffisant, ce qui a affecté l'exécution de ces projets et leur financement, et le suivi nécessaire pour soutenir la gestion et justifier les financements a laissé à désirer dans le cadre de pratiquement tous les projets.

Pour les projets autonomes F&V en particulier :

- En tant que principal modèle de vulgarisation utilisé dans le cadre des projets de la Banque, le système F&V mérite des commentaires très favorables pour les résultats positifs obtenus, mais on ne peut passer sous silence les nombreuses insuffisances des projets autonomes (le système F&V a été le modèle choisi pour 90 pour cent de ces projets).

- Les préoccupations concernant le financement des charges renouvelables et la viabilité des activités, le manque de technologie appropriée, les lacunes du personnel et la difficulté qu'il y a à susciter chez lui l'attitude appropriée sont à prévoir dans le cas de la plupart des programmes de vulgarisation nécessitant un personnel nombreux et exécutés à l'échelon national dans les pays en développement, quel que soit le système de gestion utilisé. De plus, la structure hiérarchique et le mode d'opération du système F&V axé sur les messages n'a guère aidé à modifier le système traditionnel consistant à formuler des recommandations à partir du sommet, bien que le système F&V ait eu pour objectif de tenir compte des commentaires des agriculteurs pour faire en sorte que les recommandations soient adaptées aux besoins.

- La Banque a encouragé le modèle F&V (en particulier dans le cas des projets antérieurs) dans le cadre d'une série relativement uniforme d'investisse-

ments et de pratiques de vulgarisation appliquée à de grands programmes exécutés au niveau des états et des pays. Elle aurait dû modifier la conception des projets pour tenir compte de la situation budgétaire et institutionnelle, des ressources humaines disponibles, de systèmes d'exploitation utilisés et des technologies existantes. On aurait ainsi eu de meilleures chances de mettre en place des services efficaces et d'un bon rapport coût-efficacité qui auraient reçu l'appui financier et politique nécessaire.

- Malgré ces critiques des projets fondés sur le modèle F&V, les principes organisationnels sur lesquels repose ce dernier sont en grande partie internalisés dans la majorité des « bons » services de vulgarisation et sont indiscutablement valables : il s'agit de la programmation des activités, de l'accent mis sur la technologie, de la formation continue du personnel, de la supervision des programmes, des liens étroits entre la recherche et la vulgarisation et enfin, des commentaires des agriculteurs pour permettre l'adaptation des technologies à leur situation particulière. Malheureusement, une grande partie de ces principes n'a pas été suffisamment appliquée dans les projets.

- Le concept F&V de l'agriculteur de liaison considéré comme le principal bénéficiaire des visites de vulgarisation (en vue d'un transfert ultérieur de technologies aux autres agriculteurs locaux) n'a guère donné de résultats et a été souvent modifié en ce sens que l'accent a été mis sur des groupes d'agriculteurs (principe adopté pour la quasi-totalité des projets les plus récents). Cela est dû en partie au fait que les agriculteurs de liaison n'étaient pas représentatifs, la plupart des agriculteurs visés ayant un niveau de ressources inférieur. Et même pour les projets axés sur des groupes, on n'a pas veillé suffisamment à ce que les agriculteurs aient des niveaux de ressources et des contraintes similaires. Ainsi, on n'a pas pleinement exploité les possibilités de gain d'efficacité qui auraient pu être réalisés en définissant les problèmes des groupes et en amenant les intéressés à trouver eux-mêmes des solutions à leurs problèmes (de plus, le personnel n'a pas reçu de formation qui lui permette de faciliter ce processus).

Pour les autres projets :

- Dans le cas des projets de développement rural, les résultats de l'action des services de vulgarisation — qu'il s'agisse du modèle F&V ou bien d'autres modèles de services encore plus intensifs — ont été généralement liés, d'une part, à la disponibilité de technologies appropriées aux systèmes culturaux ciblés, et, d'autre part, à l'efficacité avec laquelle les services complémentaires de fourniture d'intrants et de crédits ont été assurés.

- Les programmes de vulgarisation spécifiques à différents produits se sont avérés capables de fournir tous les ingrédients nécessaires à l'adoption de technologies propres à améliorer la production du produit ciblé. Toutefois, ces programmes portant généralement sur des cultures commerciales, on devrait normalement s'attendre à une certaine forme de recouvrement des coûts. Des services publics spécialisés donnant lieu à un recouvrement des coûts et des services privés peuvent compléter les services publics de vulgarisation à caractère général.

- Dans bien des cas, les petits exploitants ruraux vivent plus ou moins à un niveau de subsistance, ce qui ne leur permet guère de payer des services. Toutefois, l'objectif final, indépendamment des niveaux de ressources disponibles, devrait être de faire en sorte que les agriculteurs aient, sous une forme ou sous une autre, la maîtrise des services dont ils bénéficient. Par ailleurs, les

résultats obtenus ont confirmé que le secteur privé devrait assurer directement les services hautement qualifiés et bien adaptés que nécessitent les cultures spécialisées de plus grande valeur (par exemple, les légumes ainsi que les fruits et fleurs destinés à l'exportation). (Il n'y a eu qu'un seul cas [au Chili] de projet parrainant [avec succès] des services de vulgarisation privés.)

- Les services de vulgarisation assurés en tant que complément d'un programme de crédit ont généralement contribué utilement à l'adoption de technologie par les agriculteurs. On a parfois constaté des déficiences dans l'utilisation du crédit dans le cadre de programme de productions rigides qui n'étaient pas toujours adaptés à la situation particulière des agriculteurs. Toutefois, lorsque ces services étaient assurés au frais de l'état, un problème d'équité se posait dans la mesure où un service intensif et coûteux était assuré à une très faible proportion du sous-secteur des petites exploitations agricoles, et généralement à des agriculteurs disposant d'une meilleure base de ressources, ce qui réduisait d'autant les moyens disponibles pour assurer des services de vulgarisation à la majorité d'entre eux.

- Les campagnes de vulgarisation périodiques face à une crise largement reconnue ont été généralement efficaces dans la mesure où elles ont permis d'éviter une grande partie des contraintes qui implique la mise en place d'un service « permanent » efficace.

Aucun modèle de vulgarisation n'est suffisamment supérieur aux autres pour justifier qu'on l'applique de façon uniforme à toutes les petites exploitations quelles qu'elles soient. En fait, plusieurs principes clés déterminent l'efficacité des services de vulgarisation, le principal étant que les recommandations en matière de vulgarisation doivent être adaptées à la situation du client. Ce principe implique à son tour que les projets de vulgarisation tiennent compte des caractéristiques des systèmes de culture ciblés et des facteurs qui affectent ces systèmes, et que ces projets soient fondés sur une capacité effective de création et d'adaptation des technologies.

Si ces principes de base sont respectés, des innovations méthodologiques telles que la programmation et l'ordonnancement des activités peuvent améliorer l'efficience et l'efficacité des services et atteindre ainsi les objectifs fixés, à condition qu'une considération majeure dans la conception et l'exécution des projets soit le souci de répondre aux besoins des agriculteurs. L'impact souhaité ne pourra cependant être obtenu que si l'on conçoit les investissements destinés à la vulgarisation en tenant pleinement compte des autres facteurs potentiellement limitants tels que les contraintes existant au niveau budgétaire et institutionnel et en matière de ressources humaines. Bien qu'un investissement dans la vulgarisation soit généralement justifié comme un bien collectif dans la plupart des pays en développement, les réalités budgétaires font que les programmes de vulgarisation doivent avoir le meilleur coût-efficacité possible pour minimiser la ponction exercée sur le budget ordinaire et donner au service de meilleures chances de viabilité. De même que si une nouvelle technologie appropriée n'est pas disponible, il en résultera que le service de vulgarisation aura un rendement décroissant, si l'on manque de fonds, cela limitera les activités sur le terrain menées dans le cadre de services à forte intensité de main-d'oeuvre et reposant sur un contact direct avec les clients. Une efficacité et une efficience apparentes aident naturellement à obtenir l'appui financier voulu.

Recommandations

L'Annexe 4 du présent rapport donne de plus amples détails sur les recommandations concernant les interventions actuelles et futures de la Banque dans le domaine de la vulgarisation agricole. Le principe de base de ces recommandations est que la Banque devrait accorder beaucoup plus d'attention à l'analyse préalable aux projets et accorder une aide suffisante aux emprunteurs pour la préparation des projets. C'est seulement en mettant l'accent sur ce point et en adoptant une approche analytique de la définition de la situation en ce qui concerne les institutions et les agriculteurs que l'on pourra mettre au point une stratégie de vulgarisation adaptée aux besoins et un programme d'investissement correspondant à la stratégie actuelle. Des techniques d'évaluation rapide seront probablement nécessaires pour analyser les systèmes de culture existants. Une participation importante des emprunteurs à ce processus est indispensable pour assurer l'appropriation et l'engagement voulus.

Le modèle de projet recommandé consistera notamment à classer les groupes cibles par ordre de priorité, à prendre en compte les services sectoriels publics et privés, à incorporer les médias traditionnels et la technologie moderne de l'information selon les besoins, à définir l'échelle, le type et l'intensité des services assurés en contact direct avec les clients dans des domaines particuliers en fonction des besoins et des ressources, à examiner les besoins de tous les groupes socioéconomiques, notamment des femmes au sein des ménages d'agriculteurs, et à mettre au point un programme de formation du personnel fondé sur les besoins qui sera axé non seulement sur la technologie mais aussi sur les méthodes d'interaction avec les groupes d'agriculteurs pour qu'ils participent le plus possible à la définition et à la solution des problèmes, et apportent un maximum de soutien au processus de vulgarisation.

De plus, une conception appropriée des programmes devra être complétée par des mesures pertinentes de la part de l'emprunteur et de la Banque au stade de l'exécution. Les emprunteurs devraient être conscients du fait que le succès ne se mesure pas à la mise en place de l'organisation de services prévus mais à l'échelle à laquelle ce service fournira les technologies appropriées définies par les agriculteurs dans le cadre des systèmes de culture ciblés. Il faudra donc institutionnaliser des moyens d'évaluation permanente qui permettent aux cadres de la vulgarisation de prendre des décisions adaptées à la situation. La conception des projets devra aussi être guidée par des principes visant à garantir la mise au point et la vulgarisation de techniques appropriées.

La Banque, quant à elle, devra s'efforcer davantage de vérifier dans quelle mesure le système de vulgarisation parvient à fournir des services efficients et utiles à chacun des systèmes agraires du programme, et dans quelle mesure il adapte ses prestations à l'évolution de la situation.

Accepter ces recommandations revient toutefois à s'attaquer à plusieurs problèmes :

- Du fait de diverses contraintes (ressources budgétaires et humaines, services complémentaires et techniques disponibles), il peut s'avérer inapproprié d'investir dans des services dispensés dans tout le pays et qui exigent beaucoup de personnel. Si tel est le cas, certains départements de la Banque devront peut-être modifier leur stratégie traditionnelle, qui consiste à mettre en place des programmes nationaux assez uniformes, indépendamment de la situation locale (ou à continuer d'appuyer pareils programmes).

- La Banque doit tenir compte du fait que ses emprunteurs, et même certains de ses propres agents, sont peu à même de procéder aux analyses nécessaires à la conception de la vulgarisation. Peu d'agents de la Banque possèdent une expérience significative extérieure à la Banque des opérations de vulgarisation et de leur conception. La plupart des agents s'occupant de projets de vulgarisation ne connaissent guère d'autres systèmes que celui de Formation et Visites, car c'est celui qui a été employé le plus souvent dans les projets de la Banque au cours des 15 dernières années. La supervision de la Banque risque aussi de se ressentir des compétences limitées qui existent au niveau des divisions. Tout cela implique de faire abondamment appel à des consultants ayant l'expérience de la conception de projets, mais amène aussi à envisager une formation interne à la Banque, avec l'aide de spécialistes extérieurs.

- L'évolution rapide des conditions économiques, commerciales et sectorielles influera sur le type de services de vulgarisation nécessaire. Les rôles respectifs de l'assistance technique publique et privée devront aussi évoluer en fonction de ces exigences. La stratégie nationale doit non seulement encourager des progrès technologiques adaptés à l'évolution de la situation, mais tout programme de mise en place d'un corps de vulgarisateurs doit aussi tenir compte de la nécessité que ce personnel soit capable de s'adapter à l'évolution des services à fournir (que ce soit dans le cadre du secteur public ou du secteur privé).

Recherche

Conclusions

Le portefeuille de projets de recherche de la Banque a eu un impact positif sensible sur les systèmes nationaux de recherche agricole de ses pays emprunteurs. Toutefois, comme pour la vulgarisation, plusieurs faiblesses persistent, qui nuisent à la performance des systèmes.

Le résultat net de ces investissements est le suivant : une amélioration de la base de ressources (avec parfois un décalage entre les qualifications disponibles et celles qui sont nécessaires) ; un accroissement considérable de l'infrastructure de recherche en termes d'installations et de matériel (avec cependant quelques doutes sur la justification de certains investissements) ; une amélioration des liens avec les institutions de recherche extérieures ; des progrès dans la coordination interorganismes au sein des SNRA, mais un souci insuffisant d'association des établissements d'enseignement supérieur à la recherche ; des résultats mitigés en ce qui concerne l'amélioration des liens recherche-vulgarisation-agriculteurs ; peu d'amélioration de la structure des incitations offertes aux chercheurs ; et, malgré la priorité considérable accordée à cet objectif pendant la deuxième partie de la période étudiée, la lenteur des progrès en ce qui concerne l'efficacité de l'allocation des ressources aux organismes membres des SNRA.

Ce bilan semble indiquer que la Banque a mieux réussi à accroître la capacité de recherche d'organismes donnés au sein des SNRA qu'à améliorer la gestion et l'efficacité globale du système. Cela est préoccupant, vu l'insuffisance du financement national des établissements de recherche publics et la gravité des doutes qui pèsent sur leur viabilité. Expansion et utilisation efficace des ressources ne devraient pas être incompatibles, mais l'expansion s'est avérée le résultat le plus facile à obtenir, et il se pourrait que cela ait contribué à la faible amélioration de l'efficacité.

En fin de compte, c'est aux SNRA et aux gouvernements dont ils dépendent qu'il appartient d'assurer la mise au point de techniques améliorées et le transfert de connaissances aux communautés agricoles. Toutefois la Banque, en sa qualité de première source de financement extérieur de la recherche agricole dans les pays en développement, a un rôle clé à jouer en contribuant à :

- améliorer les perspectives de viabilité des investissements des SNRA ;
- établir une priorité en faveur de l'amélioration de la gestion des SNRA et des organismes qui en font partie, afin d'assurer l'utilisation la plus économique possible des ressources et l'amélioration de la qualité des produits de la recherche ; et
- assurer la mise en place de dispositions efficaces et viables en vue de l'introduction de techniques appropriées dans les communautés agricoles ciblées.

Les principales conclusions du présent examen de la recherche agricole peuvent être résumées sous trois grandes rubriques : investissement viable et financement de la recherche, gestion de la recherche et efficacité, et utilisation de technologies appropriées.

Investissement viable et financement de la recherche

L'insuffisance des crédits de fonction alloués par l'état à l'établissement de recherche agricole public est l'une des difficultés essentielles dans la plupart des SNRA des pays en développement. L'importance du secteur agricole en termes de contribution au PIB, à l'emploi et aux recettes d'exportation varie naturellement selon les régions et les pays. Mais, dans tous les pays où la Banque apporte un concours aux SNRA, la contribution de l'agriculture justifie un appui budgétaire vigoureux à un système de recherche efficace. L'appui des gouvernements s'est manifesté par leur désir d'agrandir l'établissement de recherche, même s'il leur a fallu, dans la plupart des cas, une aide substantielle sous forme de prêt ou de don. Malheureusement, alors que le personnel des composantes publiques des SNRA a augmenté, le financement des activités de recherche n'a pas progressé au même rythme. Aussi les crédits par chercheur ont-ils diminué dans la plupart des pays, les salaires absorbant une part excessive des dotations de fonctionnement, d'où une baisse de l'efficacité et de la productivité, et une incertitude sur la viabilité de l'institution. La Banque et la communauté des bailleurs de fonds ont vigoureusement soutenu cette expansion et même pris des mesures exceptionnelles de contribution au financement du fonctionnement. Mais le peu d'empressement mis par les gouvernements à allouer les crédits nécessaires à la bonne utilisation des actifs de la recherche amène à s'interroger sur leur volonté de promouvoir une recherche de qualité. Le non-respect des échéances de déblocage des budgets approuvés, comme c'est trop souvent le cas, montre aussi que les gouvernements ne sont pas suffisamment conscients des conséquences dommageables du retard pris par les programmes sur la productivité de la recherche et des avantages que peut générer une recherche agricole efficace.

En moyenne, la part des dépenses de recherche dans le PIB agricole (intensité de la recherche agricole), qui est généralement d'environ 0,5 pour cent, n'a augmenté dans aucune région en développement, sauf en Afrique. L'augmentation constatée sur ce continent est directement liée au niveau exceptionnel de l'aide consentie par la Banque et les bailleurs de fonds, plutôt qu'au financement des états concernés, et la viabilité de la recherche y est compromise par un problème majeur de financement des charges récurrentes.

Les gouvernements sont apparemment conscients de la nécessité d'une recherche agricole financée par l'état, mais, vu la pénurie de ressources, pas au point de lui accorder la priorité par rapport à d'autres utilisations possibles des crédits de fonctionnement. Le dialogue économique que la Banque entretient avec ses emprunteurs lui donne l'occasion de souligner les avantages qui découlent d'investissements dans une recherche efficace et de recommander des niveaux appropriés de financement. On peut minimiser la demande de fonds publics en : (a) faisant assumer les coûts de la recherche par ses bénéficiaires (recherche privée ou recouvrement des coûts) ; (b) rationalisant l'investissement consacré à la recherche publique et en veillant à ce qu'il soit tiré le meilleur parti possible de toutes les ressources intérieures et extérieures allouées à la recherche ; et (c) en faisant en sorte que la gestion des organismes publics permette une production aussi économique que possible de technologie. À long terme, il y aura des crédits pour la recherche si les gouvernements sont convaincus que le système de recherche public est efficace et que les avantages sociaux qu'il génère justifient de lui accorder un rang élevé de priorité dans l'allocation des crédits.

Que le caractère de bien public de la recherche (et de la vulgarisation) justifie l'investissement public qui lui est consacré, on l'a déjà affirmé. Ajouté à ce premier argument, le fait que, dans de nombreux pays en développement, un pourcentage élevé des agriculteurs opèrent au niveau de subsistance ou de quasi-subsistance (et, par conséquent, ne sont sans doute guère capables ou désireux de financer le développement technologique agricole) justifie que le secteur public continue d'investir dans la recherche. Il n'en reste pas moins que les projets étudiés n'ont pas envisagé, comme il convenait, la possibilité de faire assumer une partie des coûts de la recherche par ses bénéficiaires directs. Mais on constate que certains SNRA ont opéré ce transfert dans des proportions non négligeables, notamment en Amérique latine et dans les Caraïbes, et souvent pour les cultures d'exportation dans toutes les régions, ce dernier cas de figure étant habituellement un legs de l'époque coloniale. Par ailleurs, la Banque a rarement utilisé ses examens des dépenses publiques pour renforcer l'allocation de ressources à la recherche ou pour promouvoir des stratégies permettant un recouvrement des coûts.

La Banque a plutôt contribué à l'expansion des organismes de recherche qu'à leur rationalisation, même si certains projets récents se sont efforcés de rationaliser et de réduire les effectifs. Dans le cadre de ses relations avec les gouvernements et les bailleurs de fonds, la Banque aurait pu s'intéresser davantage à l'ensemble du Système national de recherche agricole pour définir les domaines d'intervention appropriés. La plupart des SNRA ne s'appuient pas sur le potentiel de recherche du corps enseignant agricole des établissements universitaires. À la Banque, une collaboration plus étroite entre les divisions agricoles et celles des ressources humaines aurait permis de traiter cette question de manière plus approfondie.

La pénurie de fonds conduit à penser que les pays voisins auraient intérêt à produire conjointement les techniques utiles à leurs régions agroécologiques communes. Pour la région Afrique, la Banque et les bailleurs de fonds ont fait un effort louable pour instituer un Programme spécial pour la recherche agricole en Afrique (SPAAR), mais ils n'ont pas encore pleinement tiré parti des occasions de collaboration qui s'offrent ailleurs dans le monde. La collaboration régionale a pour objet de rationaliser la recherche et d'amorcer une coopération entre bailleurs de fonds et SNRA, qui permette d'utiliser pleinement les forces et les avantages comparatifs de chaque système de recherche. Quatre plans d'action régionaux ont été institués sous l'égide du SPAAR. Cette démarche cadre avec la thèse selon laquelle l'échelle modeste des secteurs agricoles et la pénurie de

crédits et de personnel expérimenté dans de nombreux pays de la région empêchent de mettre au point, à l'échelle d'un seul pays, toutes les technologies nécessaires. Néanmoins, les bailleurs de fonds hésitent encore quelque peu à modifier leur mode d'intervention en s'écartant des domaines de recherche qu'ils ont traditionnellement subventionnés. Par ailleurs, les autorités nationales ne sont pas aussi disposées à financer des recherches extérieures à leur SNRA qu'elles pourraient l'être.

Si la Banque et les bailleurs de fonds contribuent directement au financement des charges de fonctionnement — jusqu'à 100 pour cent récemment pour certains projets de la région Afrique — c'est parce qu'ils reconnaissent qu'il est absolument indispensable de développer la technologie. Toutefois, on introduit ainsi un réel risque de dépendance excessive de l'aide extérieure. La viabilité budgétaire doit être une priorité ; sinon, des investissements, qui sont considérables, ne seront pas entretenus, ou ne seront pas utilisés efficacement à long terme. La Banque et les bailleurs de fonds ne doivent pas offrir une aide d'un montant élevé sans analyser soigneusement l'apport du budget de l'état au secteur et à la recherche, dans le cadre de l'allocation sectorielle. L'adhésion des autorités doit être manifeste. La stratégie de recherche convenue doit clairement témoigner d'une volonté d'adopter des processus de hiérarchisation des priorités qui limitent les programmes aux ressources disponibles et maximisent l'efficacité, et d'un désir de participer à des initiatives de recherche régionale légitimes et à leur financement. Idéalement, la politique générale adoptée doit être propice à l'investissement agricole et à une utilisation rentable de technologies agricoles améliorées.

La collaboration des SNRA avec les centres du groupe consultatif pour la recherche agricole internationale (CGIAR) a permis, au profit des uns et des autres, le développement continu de techniques répondant aux besoins des communautés agricoles. Toutefois, les documents de projets de la Banque ne spécifient que depuis peu que les centres du groupe consultatif doivent être associés aux opérations visant à renforcer les SNRA.

S'agissant des programmes d'investissement financés par la Banque, hormis quelques cas, en Asie du Sud et en Afrique, où l'on ne s'est pas suffisamment préoccupé de rationaliser l'investissement, le type et l'échelle des investissements d'infrastructure retenus étaient, pour l'essentiel, justifiés. L'apport de matériel scientifique et de matériel de terrain a aussi amélioré les capacités de recherche. Mais les besoins de matériel ont souvent été mal définis ; les matériels achetés étaient souvent mal adaptés aux programmes ou aux capacités d'entretien des institutions. Ce problème, qui aurait du être traité plus énergiquement, est lié à une attention insuffisante aux stades de la préparation et de l'évaluation ou à un problème de définition des étapes, le matériel étant commandé avant que les programmes de recherche aient été clairement définis.

Les projets de la Banque ont contribué amplement à l'équipement en bibliothèques des SNRA mais, dans bien des cas, l'utilité de celles-ci est compromise à terme par l'insuffisance de crédits pour l'achat de revues spécialisées. Dernièrement, les projets ont commencé à s'intéresser (mais pas assez) aux systèmes de communication électronique et aux équipements de réseaux. Outre que les chercheurs devront utiliser plus efficacement les travaux scientifiques existants, le processus de production et d'examen des études basées sur les résultats de la recherche des SNRA devra être amélioré.

Introduire une composante recherche dans un projet agricole peut constituer un investissement viable et soutenable si son échelle est suffisante pour qu'elle

présente un intérêt, si elle est coordonnée avec un établissement de recherche existant, public ou privé, bien organisé, et complète le programme de ladite institution. Toutefois, de nombreuses interventions intégrées à des projets de la Banque ne possédaient pas assez de ces caractéristiques pour donner des résultats utiles. Les prêts à l'ajustement sectoriel consentis en Europe et Asie centrale, et au Moyen-Orient et en Afrique du Nord ont eu un impact positif sur la réforme des institutions de recherche, mais cela parce qu'ils s'inscrivaient dans le contexte de dialogues permanents sur la recherche dans le secteur agricole, au lieu de constituer des interventions isolées. Ailleurs, les composantes recherche de ce type d'opération d'ajustement n'ont guère eu de conséquence.

Gestion et efficacité de la recherche

Dans ses projets, la Banque a souvent introduit une dimension agroécologique pour assurer une plus grande pertinence de la recherche, de même qu'elle a encouragé la création ou le renforcement d'une institution faîtière de coordination du SNRA. Lorsque la réalisation de ce deuxième objectif s'avérait impossible, elle a généralement apporté son concours à la coordination de l'action du groupe dominant d'instituts de recherche. L'amélioration de mécanismes de coordination a facilité les efforts entrepris par la Banque pour encourager l'établissement de liens — en vue d'une utilisation efficace des ressources, du développement de stratégies de recherche nationales et de l'instauration de procédures de planification et d'examen des programmes — même si les résultats de ces mesures n'ont pas toujours été aussi positifs qu'espéré.

À quelques notables exceptions près, les universités ont mené peu de recherches agricoles, les facultés de sciences et d'agronomie en étant généralement empêchées par une affectation impérative des crédits et des locaux. Toutefois, certains instituts de recherche universitaires (et privés) ont été associés avec succès à des composantes d'une stratégie de recherche ; des fonds d'affectation spéciale, dans lesquels ils pouvaient puiser, ont été créés dans le cadre de projets de la Banque.

Les efforts de planification et d'amélioration de la gestion de la recherche déployés dans le cadre des projets de la Banque ont généralement impliqué une assistance technique fournie en vertu du prêt ou par les bailleurs de fonds. Le Service international de la recherche agronomique nationale (SIRAN) a été particulièrement actif en ce domaine. Toutefois, le bilan de cet appui ne peut être qualifié que « d'amorce non négligeable » d'un processus plus rationnel de planification dans la plupart des SNRA, ou dans les principaux organismes rattachés aux SNRA. À l'échelon stratégique, on constate des progrès considérables, même si les résultats ont été beaucoup plus faibles en matière d'analyse des ressources disponibles et d'établissement de priorités.

En raison des faiblesses du processus de hiérarchisation des priorités, les documents des projets décrivent souvent les dispositions à adopter pour répondre à la demande prévue d'améliorations technologiques, mais ne traitent pas des priorités à fixer face aux contraintes de ressources. L'expérience indique qu'un plan directeur de la recherche n'est guère susceptible de porter véritablement des fruits si les organismes de financement et d'exécution ne le font pas leur, si ce plan ne prend pas en compte toutes les contributions possibles, s'il n'instaure pas des procédures solides d'établissement de priorités face aux contraintes de ressources et s'il ne parvient pas à lier les considérations macroéconomiques aux besoins réels des communautés agricoles.

Certains SNRA, notamment dans la région Afrique, ont aussi eu tendance à accepter les politiques sectorielles prescrites par les autorités sans essayer

d'influer sur le processus de hiérarchisation des priorités lorsque ces politiques semblaient inappropriées. Cet état de fait, ainsi que le « flou » qui caractérise souvent le processus global d'établissement de priorités, tient en partie à la faiblesse des capacités d'analyse décisionnelle et sectorielle de la plupart des SNRA.

Pour tirer le meilleur parti possible des ressources disponibles, les programmes doivent être conçus avant tout en fonction des besoins des usagers de la recherche. Pour éclairer les décisions d'allocation des ressources, il semble que rien ne puisse remplacer l'analyse économique, de préférence à l'aide d'un modèle du surplus économique (c'est-à-dire de représentation de la modification des surplus du consommateur et du producteur induite par l'adoption des résultats de la recherche), sous forme développée ou simplifiée, qui aidera à hiérarchiser les priorités entre programmes et éléments de programmes. Il y aura inévitablement une part de jugement subjectif, mais organiser l'information d'une manière qui soit cohérente avec pareil modèle augmente la probabilité de parvenir à une évaluation valable. Cette approche permet aussi, accessoirement, de générer un ensemble d'estimations (taux de rentabilité interne, ratio coûts/avantages et valeur actuelle nette) utiles pour la discussion des dotations budgétaires.

On peut avoir recours à des méthodes de notation simplifiée pour comparer les programmes lorsqu'on ne dispose pas des ressources nécessaires à une analyse complète, à condition d'utiliser des coefficients de pondération appropriés pour les critères d'évaluation. Toutefois, il faut au moins calculer des indices approximatifs d'efficience économique pour que ces méthodes vaillent la peine d'être utilisées. Des méthodes informelles faisant appel à des jugements rationnels basés sur une analyse des principaux déterminants de la valeur actuelle nette de la recherche seront probablement plus fiables que des méthodes de notation simplifiée mal utilisées, ou que d'autres méthodes telles que les tests de congruence.

Pour évaluer la priorité à accorder à tel projet par rapport à un autre, ce qu'il faut souvent faire dans le cadre des programme d'un institut, il n'y a généralement pas lieu d'effectuer une mesure économique quantitative complète de son impact probable. Un examen technique par des comités d'évaluateurs experts, allant de pair avec la connaissance et l'utilisation des principaux déterminants de la valeur actuelle nette de la recherche, peut grandement contribuer à une utilisation efficiente des ressources dont dispose chaque gestionnaire de la recherche. L'efficacité du processus d'examen par les pairs ne doit pas cependant être tenue pour acquise. Il est particulièrement difficile que ce processus critique aboutisse à un exposé entier de conclusions lorsque les traditions de service public et de respect des supérieurs tendent à décourager un libre-échange de critiques scientifiques franches, surtout quand ces critiques s'adressent aux chercheurs les plus renommés.

Plusieurs projets ont fait appel avec succès à des experts d'autres institutions locales ou internationales pour procéder à un examen indépendant des programmes. Ce type d'examen approfondi renforce non seulement les capacités locales de programmation, mais il sert aussi de complément aux programmes de formation de troisième cycle et d'assistance technique que la Banque a financés pour améliorer la qualité de la recherche scientifique. Toutefois, il faudra se préoccuper davantage d'institutionnaliser des processus de formation basés sur les besoins. Le développement de relations à long terme de formation et de recherche avec des établissements d'enseignement et de recherche réputés de pays développés peut être intensifié avec profit pour renforcer les capacités de recherche scientifique. Les centres du groupe consultatif ont également un rôle majeur à jouer, tant en matière d'examen des programmes que de formation pratique.

Comme on l'a vu, il est indispensable de remédier à la quasi-inexistence de capacités de postévaluation. La pénurie de compétences économiques interdit l'évaluation ex post systématique de tous les programmes, mais il faudrait analyser les avantages économiques de certains d'entre eux, ou de certains éléments d'entre eux, à titre de contribution à la planification de la recherche future et pour justifier les dépenses encourues auprès des organismes de financement publics et privés. La solidité de toute analyse est confortée par la mesure des taux d'adoption effective des technologies. Malheureusement, cet aspect de la gestion de la recherche (suivi de l'impact) a été cruellement négligé jusqu'à aujourd'hui.

Aucun progrès en matière d'évaluation ne sera possible tant que les agents de la Banque et les organismes de recherche ne coopéreront pas pour concevoir et appliquer des méthodes pratiques de mesure des résultats et de leur impact. La Banque doit consacrer davantage de ressources à l'évaluation économique ex ante et ex post de la recherche, mais elle ne doit pas axer son attention sur l'estimation de la rentabilité économique des projets auxquels elles apporte son concours. Se limiter à cela ne contribuerait guère à améliorer davantage l'efficacité du processus de développement de la technologie. La Banque doit plutôt s'attacher à institutionnaliser, au sein des SNRA, les capacités d'utilisation de l'analyse économique, surtout pour la fixation des priorités des programmes.

L'introduction de systèmes d'information de gestion, qui peuvent faciliter la planification, le suivi, l'évaluation de la recherche et la responsabilité des individus et des services, a été encouragée par de nombreux projets de la Banque au cours de la deuxième partie de la période étudiée et par les bailleurs de fonds (surtout l'USAID), souvent en relation avec le SIRAN. D'une manière générale, l'adoption des systèmes informatiques de gestion a été limitée et n'a pas bénéficié du plein appui du personnel et de la direction des instituts. Même les systèmes comptables simples de beaucoup de SNRA ont besoin d'être considérablement améliorés.

L'amélioration des équipements, les possibilités de formation de troisième cycle et le perfectionnement des procédures de planification et d'examen permettent non seulement des recherches plus pertinentes, mais constituent aussi pour le personnel des incitations à rester employé dans les organismes de recherche publics. Mais il est peu probable que ces facteurs produisent les avantages prévus si l'on n'offre pas aux chercheurs un ensemble d'incitations à être efficaces. La pénurie de crédits de fonctionnement a un effet démobilisateur absolu sur le comportement professionnel. On est parvenu dans une certaine mesure à offrir aux chercheurs des rémunérations plus attrayantes dans le cadre d'un statut d'autonomie pour l'institut, mais cela n'a généralement pas été suffisant. Et l'adoption d'un statut semi-autonome n'a habituellement pas permis d'instaurer des systèmes de promotion et de rémunération au mérite, ce qui, en fait, n'est sans doute réalisable que dans le cadre de dispositions d'autonomie complète — cas rare.

Utilisation de la technologie appropriée

Si l'on veut qu'une technologie nouvellement mise au point ou adaptée soit rapidement adoptée par la communauté agricole ciblée, il faut faire en sorte qu'elle constitue une solution à un problème clairement identifié. La majorité des projets de la Banque ont mis en évidence la nécessité de rendre la recherche plus utile aux besoins des petits exploitants, surtout lorsque les conditions de production sont particulièrement difficiles. Les interventions ont notamment consisté à adapter les allocations de ressources pour remédier à des déséquili-

bres et ont fait appel à toute une gamme de techniques destinées à renforcer les liens recherche-vulgarisation-exploitants. Ces dernières ont été conçues pour informer les chercheurs des contraintes concrètes des agriculteurs, et pour aboutir à des recommandations pratiques sur les techniques nouvelles à mettre à la disposition des services de vulgarisation et des exploitants. L'organisation de rencontres périodiques entre chercheurs et personnel de vulgarisation pour y parvenir a donné des résultats divers. Les capacités de recherche sur l'exploitation ont été considérablement accrues, malgré un certain nombre de problèmes, dont le plus grave est le fait que ce programme est souvent le premier amputé en période de pénurie de crédits.

Les projets financés par la Banque ont, dans une large mesure, encouragé l'adoption d'une optique de système d'exploitation, mais il faudra faire davantage pour que cette approche devienne partie intégrante du processus de recherche. Aider les autres chercheurs à comprendre les systèmes d'exploitation et leurs exigences est, peut-on penser, une priorité absolue si l'on veut utiliser au mieux les rares compétences socio-économiques des SNRA. Mais ce processus n'est pas mené à son terme tant que le taux d'adoption des technologies issues de la recherche n'a pas été mesuré dans les communautés ciblées.

Dans de nombreuses régions, une proportion élevée des ménages agricoles ont à leur tête une femme, et celle ci joue un rôle important dans la plupart des systèmes d'exploitation. L'accent mis sur l'institutionnalisation d'une optique système agraire implique qu'on envisage la variable sexe lorsqu'on analyse les besoins des ménages et les opportunités qui s'offrent à eux, et qu'on s'emploie à y répondre, mais cela n'a pas abouti à la prise en compte nécessaire de la question de parité entre les sexes. Or, ces considérations sont importantes si l'on veut véritablement établir un diagnostic du système d'exploitation, planifier et évaluer la recherche, et faire des études sur l'adoption des techniques dans les communautés de petits exploitants. Les centres du groupe consultatif et certaines ONG se sont intéressés de très près à cette dimension ; la Banque devrait s'appuyer sur les connaissances acquises et aborder cette question dans ses relations avec les emprunteurs.

Pour que la recherche soit pilotée par la demande, il faut associer les bénéficiaires visés (agriculteurs et autres parties prenantes du secteur) à sa conception et à son évaluation. Le développement de la recherche adaptative à l'exploitation encourage la participation des bénéficiaires, mais tous les projets ne se sont pas intéressés à ce développement, ou ne l'ont fait que dans une mesure limitée. Les chercheurs doivent être informés de la situation des exploitants, que ce soit dans le cadre de relations directes avec les communautés ou leurs représentants, en faisant largement appel à des intermédiaires relevant de systèmes de vulgarisation publics ou privés, ou grâce à une combinaison des deux méthodes (ce qui est le cas le plus fréquent). Quelles que soient les méthodes utilisées, cette interaction doit faire partie intégrante du processus de recherche.

Recommandations

Les recommandations issues de cet examen du portefeuille de recherche, recensées au Chapitre 10, peuvent être résumées comme suit :

S'agissant du *rôle de la recherche*, la Banque doit porter une attention accrue au secteur agricole, et notamment à la contribution de la recherche à son dialogue avec les pays, à ses travaux économiques et sectoriels, et aux stratégies d'assistance-pays. Pour favoriser les synergies entre éducateurs, chercheurs, agents de vulgarisation, agriculteurs et autres parties prenantes du secteur, la Banque doit consi-

dérer la production, l'acquisition et l'adoption de technologies comme étant les éléments d'un seul et même système. Les rapports entre recherche et enseignement, dans les pays emprunteurs et au sein de la Banque, méritent davantage d'attention. La poursuite du soutien que la Banque apporte à la recherche agricole internationale (CGIAR), des alliances actives entre les centres du groupe consultatif et les bailleurs de fonds, et la facilitation de liens entre les SNRA et d'autres organismes de recherche seront fort utiles à la Banque et aux emprunteurs.

Pour favoriser la *viabilité d'un investissement*, la Banque doit apporter son concours au développement de l'ensemble du système de recherche, tout en s'assurant que l'investissement a de très bonnes chances de continuer à bénéficier des ressources nécessaires et que la détermination des emprunteurs ne fait pas de doute. En outre, elle financera un pourcentage élevé des frais de fonctionnement et de programmes de recherche précis (temporairement) uniquement si les emprunteurs ont fait la preuve de leur volonté d'appuyer un programme de recherche convenu, assorti de priorités. Le cas échéant, la Banque devra rationaliser les ressources existantes au lieu d'agrandir les installations (ou en plus de cela). Elle devra veiller à ce que le contexte législatif et réglementaire soit favorable à la recherche privée et à l'acquisition de technologies, et encourager les SNRA clients à instaurer des dispositifs réalistes de recouvrement des coûts de recherche. En assumant un rôle moteur dans la coordination régionale entre bailleurs de fonds et SNRA, la Banque est à même d'encourager une utilisation plus efficace des ressources extérieures. La viabilité de l'investissement serait aussi accrue si la Banque s'efforçait davantage d'échelonner son appui aux SNRA de manière à permettre l'achat, au moment approprié, du matériel et des installations voulues, et de faire appel à des spécialistes pour préciser les besoins de matériel. Lorsqu'il ne convient pas d'apporter un appui global à un SNRA, la Banque devra envisager d'apporter un concours à des programmes de recherche donnés.

La Banque devra continuer à encourager la coordination entre SNRA et le recours à des *plans directeurs de la recherche* et à des procédures de fixation de priorités de recherche. Mais elle doit se préoccuper davantage de la prise en charge par le personnel national des procédures et des produits, ainsi que de la qualité et de la validité des processus et de l'utilisation qui en est faite pour l'affectation des ressources. Si tous ces éléments ne sont pas en place et si les décideurs ne sont pas associés à la démarche, le processus de planification risque fort de ne pas servir à grand-chose.

La Banque doit se préoccuper davantage de la mise en place de *capacités de suivi, d'évaluation et d'analyse socio-économique* au sein des organismes membres des SNRA. Elle doit s'efforcer davantage de concevoir avec les clients une évaluation économique ex ante des programmes et des indicateurs concrets de performance de la recherche avant le démarrage des projets ; de définir quels programmes de recherche feront l'objet d'une mesure d'impact économique ; et de faire en sorte que des dispositions appropriées permettent d'établir si les compétences nécessaires à pareille analyse existent. Enfin, elle devra superviser étroitement le déroulement du suivi et de l'évaluation, et avoir recours à des évaluations de l'impact des programmes lors de l'évaluation ex post des projets.

Méritent aussi que la Banque continue de s'y intéresser les efforts déployés pour améliorer la *qualité de la recherche scientifique*, notamment au moyen d'une formation axée sur les besoins, de prestations d'assistance technique, de liens plus efficaces avec les centres du groupe consultatif, d'examens externes des projets et des programmes de recherche, et de réseaux scientifiques nationaux et internationaux.

Pour être efficiente, la recherche doit être pilotée par les clients et *adaptée* à leurs besoins précis. La Banque a beau ne pas cesser de promouvoir cette idée, elle pourrait jouer un rôle plus actif en conseillant les emprunteurs sur la manière d'associer davantage les usagers à la conception et à l'évaluation de la recherche, et en leur montrant en quoi les rôles joués par les hommes et les femmes affectent la planification et la conduite de la recherche.

S'agissant du *comportement professionnel*, dans le cadre de son dialogue avec les emprunteurs et les organismes de recherche, la Banque doit insister pour qu'on offre au personnel des incitations propres à encourager l'efficacité. Pour améliorer les résultats du portefeuille de recherche, la Banque devra mettre en place un noyau d'agents possédant des qualifications scientifiques spécialisées, capable d'entretenir des liens avec la communauté internationale de la recherche agricole, d'aider, d'informer et de former des agents moins spécialisés qui assumeront les fonctions de chefs des projets de recherche.

Certaines de ces recommandations représentant un changement d'orientation par rapport aux pratiques actuelles et d'autres impliquant une évolution des priorités, le présent examen préconise la rédaction d'un *document stratégique* à l'intention des cadres et agents de la Banque intervenant dans le sous-secteur de la recherche agricole.

Action de la Banque

Le présent examen arrive à la conclusion que la Banque a contribué de manière considérable au développement des SNRA et de systèmes visant à élever le taux d'adoption de techniques appropriées. Mais, en prêtant une attention plus minutieuse aux questions soulevées dans le présent examen, elle pourrait avoir un impact bien supérieur. L'importance du rôle joué par la technologie dans le processus de développement impose à la Banque de continuer sans relâche à stimuler la recherche et la vulgarisation agricoles au profit des pays en développement.

La direction de la Banque a accueilli favorablement les recommandations de l'examen et a conçu des plans d'action pour traiter des principaux problèmes de la recherche et de la vulgarisation. La région Afrique n'a pas contesté les principes de vulgarisation de base mis en avant par le rapport, y compris la recommandation que le lieu d'implantation et le taux d'introduction des investissements de vulgarisation soient adaptés aux situations locales. Elle n'est cependant pas d'accord sur l'interprétation à donner à cette dernière recommandation dans la pratique. Le Chapitre 5 du présent rapport explicite davantage ces divergences.

La Banque et la communauté internationale peuvent aider au développement de services techniques agricoles adaptés, mais l'essentiel du travail incombe aux emprunteurs et à leurs agences d'exécution. S'ils sont disposés à définir des niveaux d'engagement appropriés et viables et à les respecter, les emprunteurs ont là une occasion superbe d'améliorer sensiblement la capacité des institutions en vue de renforcer l'efficacité, la productivité et la pertinence de services de recherche et vulgarisation essentiels.

PART 1: AGRICULTURAL EXTENSION: ACHIEVEMENTS AND PROBLEMS IN NATIONAL SYSTEMS

1. The extension subsector and an overview of Bank lending

The term agricultural extension means different things to different people. The common elements of the World Bank's[1] extension project portfolio suggest that extension might be described as the process of helping farmers to become aware of and adopt improved technology from any source to enhance their production efficiency, income, and welfare. Such a simple definition, however, belies the complexity of a process that involves changing farmers' behavior and, often, institutional behavior. Nor does it reflect the changing approaches that governments and donors have used and continue to use in attempts to provide or improve extension services.

The development of extension programs

The Bank's publication, *Agricultural Extension: The Next Step*, reviews historical approaches to extension and donor involvement in these developments (World Bank 1990, Chapter 2 on approaches and Chapter 3 on donor involvement). Before most developing countries gained their independence, the colonial powers and dominant private firms advised farmers, tenants, and workers on the production of commodities in which the colonial power or firm had a particular commercial interest. When national interests took over the colonial systems after independence (often as parastatals), they usually retained their predecessors' strong, hierarchical commodity orientation. These commodity-specific programs, which often provide an array of services, including technical advice, input supply, credit-in-kind, and market arrangements, still exist (or have been created) in all regions, and are especially common in traditional estate crops such as industrial tree crops, beverage crops, sugarcane, and cotton.

The advantages of commodity-specific services were that they were relatively intensive, comprehensive services whose potential for increasing the output and quality of particular commodities was high. The commercial nature of the services also allowed cost recovery through deductions in prices paid for the commodity or through another form of payment.[2] Their disadvantage, however, was that they advised only a narrow range of farmers, and even then usually ignored the traditional food crops that provided sustenance to many of them.

National extension services emerged in the 1950s as governments sought to bring new knowledge and techniques to more farmers

In the 1950s, governments became aware of a need to bring new knowledge and techniques to a broader spectrum of farmers, and new national extension services began to emerge. Deficiencies in overall sectoral services led to most of the public extension programs adopting not only a technology transfer function, but also services associated with input supply, and often with credit and product marketing. Furthermore, realization of the need for capital investment in rural infrastructure and for other social services to support smallholder farmers led to the evolution of multipurpose rural development projects and programs

in the 1960s and 1970s. This often resulted in field staff taking on a more diverse set of responsibilities, even, in some cases, census taking and providing selected human health services.

The broad responsibilities of field staff and the lack of incentives to encourage them to be effective in their technology transfer function led to inadequate extension performance. This encouraged the persistence of many commodity-specific services and the adoption in some countries of technical assistance linked to state credit institutions. The main outcome, however, was the evolution from the mid-1970s of more specialized public sector extension that tried to limit advice largely to technical agricultural matters. Ministries of agriculture, which may or may not have been separate from livestock, fisheries, and forestry agencies, usually developed the programs. The technical extension services tended to focus on annual food crops, but some did cover other aspects of farming. In many countries, however, a large public extension service for food crops emerged, alongside smaller extension organizations for nonfood crop activities that often operated under a different management system. (See Axinn 1988 for a review of different extension approaches, their evolution, and the advantages and disadvantages of each.)

The Bank's role

The Bank's move to a highly managed extension system—training and visit—marked a significant change in its extension interventions

This report reviews the performance of the Bank's extension portfolio in the period from fiscal year 1977 to fiscal year 1992. Some historical information, however, facilitates an understanding of the rationale for Bank extension interventions. The Bank's initial support for extension was through commodity-specific services, namely, the Kenya Tea Development Authority in 1964. Subsequently, it also assisted many state credit organizations with technical services that were linked to development investment. With the move to integrated rural development projects, the Bank supported a variety of extension methods. Most significant in the evolution of the Bank's extension interventions, however, was the initiation and widespread adoption of a highly managed form of extension organization that became known as the training and visit (T&V) system. T&V was initiated in Turkey in 1967, was subsequently used in Bank projects in other Asian countries, and spread to all the Bank's operating regions. T&V became the main management system used in services that specialized in technical agricultural extension.

T&V was a hierarchically organized method of managing extension that was designed to deliver selected and timely technical messages to farmers with strict regularity, working through selected "contact farmers." The system encouraged links with agricultural research institutions, emphasized a professional approach to extension, and required an exclusive devotion to extension work. In principle, T&V systems were to avoid all extraneous activities, such as those related to the physical handling of inputs and credit applications (Benor and Baxter 1984; Benor and Harrison 1977). The Bank developed these concepts to address the deficiencies that staff perceived to be limiting the effectiveness and efficiency of public extension services. These deficiencies included extension workers being charged with many nonextension tasks that limited the attention they could give to technology transfer. They reported to more than one authority in many cases, were usually poorly trained, had little incentive to perform their extension role effectively, and had little contact with the applied research system. Moreover, extension workers were poorly supervised, relied often on development or input subsidies to encourage adoption, tended to have a narrow crop focus, tended to work with farmers who had more resources rather

than with poorer households, and relied heavily in many instances on large demonstrations of complete input packages that were beyond the resources of most farmers.

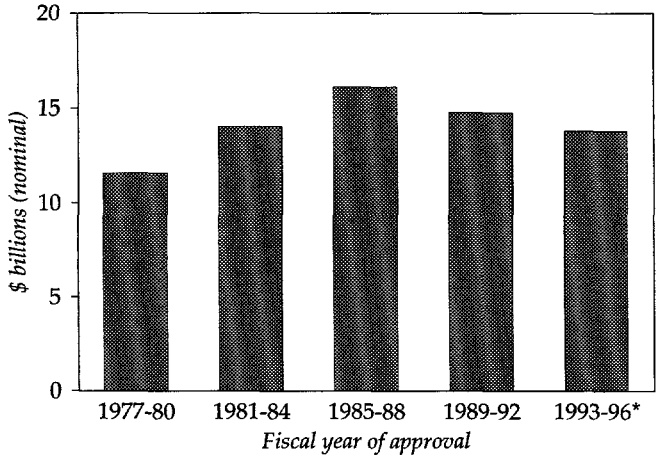
Although T&V has dominated Bank projects directed at improving the effectiveness of public sector extension services during the last 15 to 20 years, assistance to other forms of extension has continued. Chapters 2 and 3 of this report, which review completed Bank projects, reveal the range of extension activities supported. These include free-standing extension projects that are characterized by their institution-building nature, in which the development of an effective extension delivery system is often the primary objective, and "component" extension projects, in which extension is included to complement and enhance the benefits to be obtained from other major development investments. The latter include rural development and irrigation projects; comprehensive services (advice, inputs, credit or credit-in-kind) directed at specific commodities; integrated services to farmers with packaged advice and inputs linked to investment and/or production credit; private sector consultants to provide subsidized technical services; and, in rare cases, extension in which farmers' participation in defining and resolving problems has been maximized. A Bank review (Baxter, Slade, and Howell 1989) of 361 agricultural projects with extension components indicated that 38 percent had some form of T&V extension, 15 percent were commodity-specific services, and 46 percent used "other methods" for extension investments.

Despite this move, the Bank has continued to support other forms of extension

Bank lending for extension

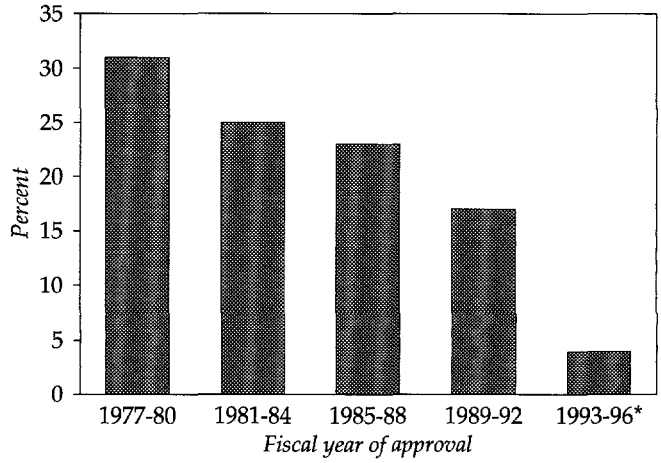
Bank lending to the agricultural sector during fiscal 1977 through fiscal 1992 amounted to $56,430 million (Figure 1.1). This includes directly productive agricultural investment and supporting infrastructure, services to facilitate access to production inputs and markets, human resource development, and improvements in agricultural research and extension services. In the 1980s the Bank also

FIGURE 1.1: TOTAL BANK COMMITMENTS TO AGRICULTURE, FISCAL 1977–96



*Estimates.
Source: Annex Table 5.3.

FIGURE 1.2: AGRICULTURE AS A PERCENTAGE OF TOTAL BANK LENDING, FISCAL 1977–96



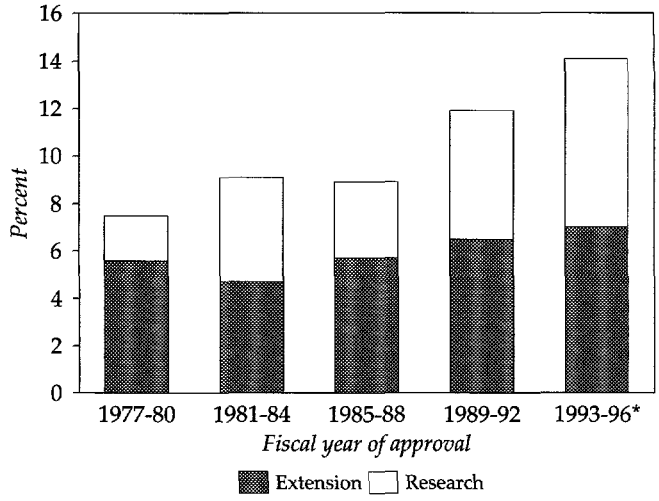
*Estimates.
Source: Annex Table 5.3.

Because the Bank does not have an agricultural extension policy, this study measures progress against the findings of an earlier OED report

embarked on structural adjustment lending to help borrowers make macroeconomic and sectoral policy changes appropriate for sustained sectoral growth. As a percentage of total agricultural lending, the allocation to extension was 5.6 percent in fiscal 1977–80, 4.7 percent in fiscal 1981–84, 5.7 percent in fiscal 1985–88, and 6.5 percent in 1989–92, but agriculture assumed a declining share of the Bank's portfolio in the review period (Figure 1.2). The total commitments to extension were approximately $3 billion in nominal terms, and close to $1 billion more was committed in the quadrennium following fiscal 1992 (Figure 1.3).[3] This represents substantial support for extension, but at the same time its relatively low percentage of total sectoral funding indicates it is usually less capital intensive than most other agricultural development projects, and that the Bank appreciates that extension is only one of a number of factors that contribute to farm productivity (Cernea, Coulter, and Russell 1983).[4] (See Box 1.1.)

The Bank's commitments in free-standing extension projects as a percentage of total extension commitments during the period under review averaged 55 percent and ranged from 41 to 62 percent in the four four-year periods (Figure 1.4). The emphasis on free-standing projects, however, has evolved differently in the Bank's operating regions (Figure 1.5). Whereas East Asia and Pacific (EAP) and South Asia (SAS) had a preponderance of this type of project in the late 1970s compared with the other regions, SAS was most active in the early and mid-1980s, and the Africa (AFR) region assumed dominance at the end of the 1980s. Relatively large commitments to Latin America and the Caribbean (LAC) in the 1977–80 and the 1985–88 periods were due to large loans to Brazil, rather than to a large number of projects in LAC countries. The significant intervention in the Europe and Central Asia (ECA) region in 1981–84 was linked to a large project in Turkey. Activity in the Middle East and North Africa (MNA) region was negligible until 1989–92.

FIGURE 1.3: RESEARCH AND EXTENSION COMPONENTS AS A PERCENTAGE OF THE BANK'S AGRICULTURAL COMMITMENTS, FISCAL 1977–96



*Estimates.
Source: Annex Table 5.3.

Benchmark for extension performance in the 1980s

The Bank does not have an agricultural extension policy against which one can measure the implementation and performance of agricultural extension investments. However, a 1983 Operations Evaluation Department (OED) report examined, among other things, extension investments in the 1970s and does provide a frame of reference for assessing progress in the 1980s.

The 1983 OED report recognized the positive impact of extension programs that the Bank had supported. The interventions had served to increase the attention borrowers gave to technology transfer to smallholder agriculture, and projects had broadened coverage of the smallholder subsector by extension services. By the end of the 1970s, T&V was the major method used in free-standing extension projects, so progress in implementing this concept figured prominently in the OED analysis.

Despite the overall positive assessments, the report identified a number of serious impediments that detracted from project performance and substantially reduced the realization of potential benefits. They pertained not only to the immediate outcome of the extension investments, but also to their sustainability in a given country. The problems were as follows:

- In preparing extension projects, Bank staff paid limited attention to analysis of agricultural production constraints in sectoral analysis, and to analysis of the real needs of major farming systems.

- In promoting and introducing extension methods, Bank staff did not take sufficient account of the public sector culture, the personnel situation, and the funding capacity, and this was often associated with little input into project preparation by the country concerned.

Problems such as insufficient analysis of production constraints affected both project outcome and sustainability of extension

BOX 1.1: AGRICULTURAL EXTENSION HAS AN IMPORTANT, BUT LIMITED, FUNCTION

Regardless of their resource and socioeconomic status, farmers will adopt new technologies and modify their resource use when they believe that a proposed change is relevant to their circumstances and can help them achieve their objectives. An extension service can play an important role in increasing the rate of adoption of measures that can enhance producers' productivity and welfare.

The rate of adoption of a technology (using technology adoption as a proxy for any desirable change in resource use) by a farming population will depend on the following:

- The characteristics of individuals' production circumstances (land, labor, and capital resources; climatic and other production uncertainties; and access to inputs and markets)
- The characteristics of the technology itself, namely,
  - The extent to which it contributes to cost reduction, risk reduction, and production increase
  - Its benefit/resource-cost ratio (degree of profitability) at acceptable levels of risk
  - The skills needed to adopt it
  - The level of infrastructure and resources needed to adopt it
  - The degree of complexity of introducing it to the farming system
- The sociocultural characteristics of individual farmers (for example, their education and attitudes) and of the farming community (for instance, their cohesiveness, values, and attitudes toward change), which can influence the perception of the relevance of technology
- The speed with which the population is made aware of the technology and its application to local production systems.

Consequently, extension has the potential to increase the rate of adoption by being directly involved in increasing awareness, in facilitating skill acquisition, and in helping farmers to understand a technology and its relevance to

- Although the concentration on technical messages in T&V services had advantages in introducing a degree of professionalism to the advisory process, this concentration and the emphasis on organization and management aspects of T&V often led to the provision of technical farm advisory services in circumstances where other factors, such as lack of access to resources or markets, were limiting production. Thus in designing and implementing extension programs, all factors that affect farmers' decisionmaking need to be considered.

- Relatively intensive and programmed services were often expanded into areas for which little technology was available to improve productivity. This was particularly true for rainfed, resource-poor environments.

- A dearth of appropriate technology was exacerbated by generally poor linkages between applied research and extension, and by weak development of feedback from farmers about their problems and needs through extension workers to the research complex.

(Box 1.1 continued)

their circumstances. Extension can also play an important role in feeding back information on farmers' constraints and potentials to the technology generation system to encourage relevant research. In addition, extension can introduce the research system to appropriate innovations introduced by farmers to enrich the technology development and adaptation process. Finally, provided that extension staff have adequate basic training and skills, they can work with farmers and researchers in on-farm development of solutions based on indigenous knowledge as well as on externally generated technology (Rajasekaran, Martin, and Warren 1993).

Extension cannot, however, create an attractive economic environment for production and technological improvement and is unlikely to be useful unless it is supported by an effective institutional capacity for technology generation and adaptation, as the potential for local development of indigenous knowledge is limited. Nor can it hope to achieve desirable changes if other ingredients for change are more limiting, for example, access to resources, inputs, markets, or credit.

This emphasizes the importance of having a technology generation system along with an appropriate macroeconomic, sectoral, and market environment if intended extension benefits are to be realized. To the extent that complementary services are needed to enable technology adoption, these must also be in place.

The array of factors influencing the rate of adoption implies that the extension process must be able to take into account farmers' circumstances and constraints in a large number of different farming systems and environments. As resources diminish and production uncertainties increase, not only do farmers' decisionmaking processes become more complex, but also the demands placed on an extension service to respond to farmers' expanded information needs for sound decisionmaking increase (Ravenborg 1993). Similarly, more commercially advanced farming systems are likely to require comprehensive and up-to-date information to select the best opportunities for resource use. This does not imply a limitation of the potential impact of extension, but indicates the limitations of extension that relies on general messages.

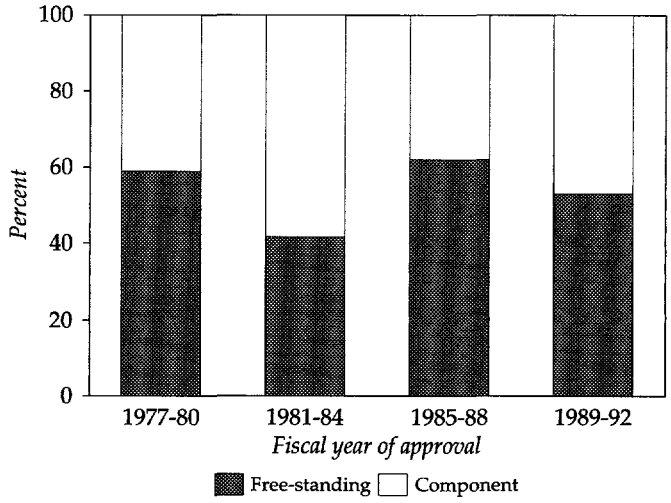
- Project designers often overestimated the capability of existing extension staff. As a result, provisions to upgrade the education level of extension staff were inadequate and in-service training in the practical aspects of technology was insufficient.

- Extension programs did not take account of the important role of women in smallholder agricultural production.

- In monitoring extension programs, activity usually concentrated on implementing the extension method and the programmed activities, rather than on measuring the level of technology adoption or of agricultural output that might be linked to extension to assess its impact and justify investment expenditures.

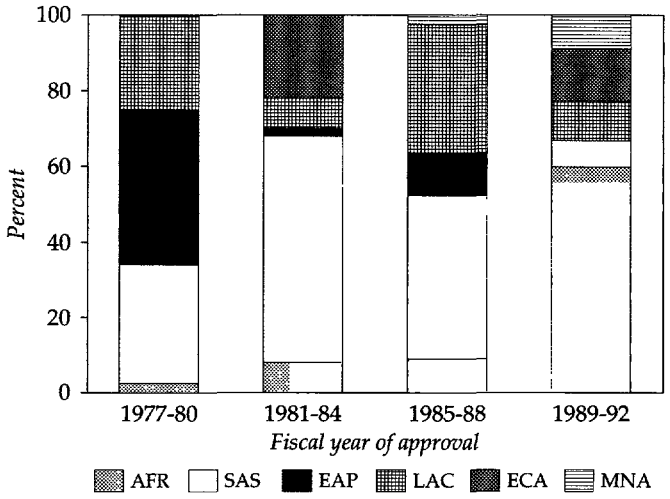
Overall, the OED review concluded that extension investment was justified, but that any extension program must be tailored to the circumstances prevalent in each country, state, or region if it is to make the best use of the resources individ-

FIGURE 1.4: FREE-STANDING EXTENSION LENDING RELATIVE TO TOTAL EXTENSION LENDING, FISCAL 1977–92



Source: World Bank data.

FIGURE 1.5: REGIONAL DISTRIBUTION OF COMMITMENTS TO FREE-STANDING EXTENSION PROJECTS, FISCAL 1977–92



Source: World Bank agriculture database.

ual governments allocate to extension. The review also noted that the use of highly programmed extension systems (exemplified in T&V) at the national or state level appeared to be better suited to situations where a preponderance of smallholders in relatively homogenous circumstances were operating at a significantly lower level of technology than was possible in the production

environment, and where a large number of staff in the rural civil service were underutilized.

Notes

1. Hereafter, the World Bank is referred to as the Bank and pertains to the World Bank Group.
2. A good example is the Compagnie Française pour le Développement des Textiles, which the French government created in 1949 to develop cotton in the French colonies. After independence the organization promoted the establishment of national companies and provided technical assistance. It currently operates in 24 African and five Asian countries.
3. The database on extension commitments in free-standing projects is reliable. In the case of extension component projects, however, the databases are imperfect, and upward adjustments to the extension commitment had to be made based on a sample of individual cases.
4. This publication reported on the results of a symposium, held in Thailand in late 1982, that reviewed nearly 10 years of experience with T&V in Asia. It pointed out that improved technology, the resources and inputs needed to use the technology, and attractive benefit-cost ratios for its use at an acceptable level of risk were essential ingredients for agricultural improvement before extension could be effective.

2. Impact of extension investments

The sample of projects included in this review is restricted to completed and evaluated projects. It includes all free-standing, evaluated extension projects approved and implemented from fiscal 1977 through fiscal 1992 (33 projects) (Annex Table 1.1), as well as 74 component projects (Annex Table 1.2). The preponderance of free-standing extension projects in East Asia and Pacific and South Asia in the late 1970s and early 1980s (Figure 1.5) means that the sample of completed free-standing projects is heavily weighted toward these regions. This is balanced by including many more component projects for review in Africa, Europe and Central Asia/Middle East and North Africa, and Latin America and the Caribbean. In relation to the value of extension commitments, the number of component projects from AFR is increased because of the region's emphasis on extension in the second half of the 1980s and the smaller loan size, while the LAC sample number is reduced because of the high proportion of large loans extended to Brazil.[1] The component projects were initially selected by identifying those completed and evaluated projects that had extension components in excess of $7.5 million, and progressing to projects with lesser extension components until the required numbers were obtained in each Bank region.

The differences between free-standing and component extension projects are often substantial (Box 2.1), which creates some difficulties in the use of common assessment criteria for the extension investment.

Difficulties in measuring outcomes

The hardest part of measuring outcome of extension investments is in linking cause and effect in quantitative terms

Regardless of the extension method used, quantification of the impact of extension investments in economic terms is normally not undertaken in either ex ante or ex post analysis. The collection of reliable data to indicate outcome (such as production or income benefits) is a constraint, but the main difficulty lies in linking cause and effect in quantitative terms. Numerous factors contribute to a specific production response and to farmers' decisions about the use of resources available to them. Many of these factors are exogenous to the extension investment, for example, changes in gross margins between crops or in the profitability of using a particular input because of policy interventions or market forces; changes in rural infrastructure through private or public investment and accessibility to that infrastructure; improvements or declines in the provision of complementary services for input supply, credit, or marketing; improvements in the production and risk environment through expanded private or public irrigation; or processing investments that create new market opportunities.

Despite these constraints to analyzing impact, a number of empirical studies on extension have been attempted with the assistance of econometric techniques. In nearly all cases these represent research studies by external entities rather than assessments by implementing agencies. Two 1991 reviews of published studies (Birkhaeuser, Evenson, and Feder 1991; Evenson 1991) on the economic

Box 2.1: Differences between extension investments in free-standing and component projects

Common characteristics of free-standing extension projects

- The emphasis is on developing an institutional capacity to provide effective public sector extension services.
- Area coverage is extremely large, often on a state or national scale.
- Most smallholder farmers are targeted.
- Projects are dedicated to technology transfer, although in many cases complementary production services are also supported.
- A state or national extension agency is responsible for execution.
- The intensity of service is commensurate with scope and/or coverage, usually in the range of one extension worker for every 500 to 1,500 smallholder households.

Common characteristics of component projects

- Most components have institutional development objectives for the implementing agency, but the emphasis was often on providing technical services to ensure that the benefits of the project's development investments were not constrained by a lack of technology.
- Area coverage is more limited than in free-standing projects.
- Target groups are specific, ranging from most people in a project area (for example, many irrigation projects), to those individuals receiving credit or investment assistance, to producers of a specific commodity.
- While the emphasis is on technology transfer, extension staff are used to a much greater extent than in free-standing projects for complementary functions (for example, input supply, credit).
- A special extension unit in a project management entity, a parastatal agency, an extension wing of a credit agency, or sometimes the regular agricultural extension agency of the ministry of agriculture, with special project support, is responsible for execution.
- The intensity of service is designed to ensure satisfactory benefits from the other project investments, so that intensity is often higher than that of the general state services.

impact of extension investments showed that most had a significant and positive extension effect. The reviews also pointed out, however, that many of the studies could have econometric deficiencies, and stressed that empirical results from applied econometric analysis must be treated in a circumspect manner to avoid overstatement of the economic impact of extension investments.

In the absence of quantifiable measures of outcome, analysts examine a program's relevance, efficacy, and efficiency

Studies of extension have often suffered from serious data constraints and from an inability to include all the contributing variables in production equations (see Box 2.2). Two recent ex post studies of Bank-supported T&V extension projects in Burkina Faso (Bindlish, Evenson, and Gbetibouo 1993) and Kenya (Bindlish and Evenson 1993) illustrate the limitations of econometric techniques. In Kenya, serious limitations were associated with suitable baseline data on preproject farm performance and extension activities and with the comprehensiveness of the factors that could be included in the econometric analysis.[2] Nevertheless, accepting these limitations, the study estimated that further investments in the current T&V extension system would result in high rates of return at the margin. While the Burkina Faso study provided some interesting

BOX 2.2: APPLIED ECONOMETRICS AND THE EVALUATION OF EXTENSION

There are many ways to try to link investment and extension in a causal manner to outcomes in the target agricultural sector. One approach that has been widely used is to specify a production function, in which a measure of production, perhaps at the level of an individual farming household, is related to measured inputs of conventional factors of production, such as land, labor, capital, purchased inputs, and so on. This function will also include additional explanatory variables related to variation in the natural environment; the particular agroecological circumstances; and other service variables, such as extension expressed on an extension input per farm basis. Many difficulties are inherent in measuring all such inputs into a model of production. One of the most significant difficulties relates to the lags in causal effects between a service input and the flow of supposed productivity effects. The productive impacts of extension may be apparent not only in the immediate accounting period of, say, an agricultural year, but because of the long-term effects of added knowledge, an evaluation should try to capture the effects of knowledge provided by extension over the life of that knowledge in the farming enterprise. This entails not only immediate measurement problems, but the conceptual difficulties of dealing with the "depreciation" of knowledge as new information comes to hand. At best, such complex processes can only be represented rather crudely in the algebraic models used in applied econometrics.

The difficulties do not stop here, however. Even if analysts can gather representative farm-level data, can obtain the funding to collect it, and can take samples that are sufficiently rich in the sense that there is enough variation in the explanatory variables to identify a relationship, they must then introduce specific functional forms to represent the processes they are modeling. The functional forms used in most practical applications are greatly simplified

observations, it was subject to measurement and recall errors in farm-level data and a number of biases in the analysis that the investigators could not address adequately. The study showed that adoption of technology was greater in T&V extension groups. It then inferred, however, that a doubling of the number of farmers entering T&V groups would have a similar marginal impact on benefits in this expanded population, without taking account of the differences in predisposition to adopt between those who had already participated and those who had not participated.

One of the more robust studies was one Bank staff undertook in India (Feder, Lau, and Slade 1985). This compared the effects of extension on productivity in two similar, heavily irrigated districts, one of which used T&V and the other of which used a traditional extension system. Of the two main crops, high-yielding varieties of wheat and rice, the study found no significant difference in impact on rice yields, but attributed a productivity gain of 6 to 7 percent for wheat to T&V (with the aid of econometric analysis). Subsequent cost-benefit analysis showed that an internal rate of return of at least 15 percent was highly likely.[3] However, even this study was unable to capture the possible effects of reduced irrigation reliability in the non-T&V district on farmers' attitudes toward expenditure on production inputs.

The difficulties inherent in attempting to obtain robust estimates of economic benefits have resulted in the use of alternative, less rigorous, but more practical

(Box 2.2 continued)

representations of reality that are used primarily because of analytical convenience and parsimony in the number of parameters to be estimated. Readers of such results must recognize that every simple functional form used implies some algebraic restrictiveness, and is thus an additional qualification to the interpretation of the results. One of the most commonly used functional forms is the so-called Cobb-Douglas form, which features constant partial elasticities of production of all factors of production included. At best this is an extremely stylized view of agricultural production. More general specifications may involve many more variables that must be included in estimating equations and, therefore, incur difficulties with having insufficient degrees of freedom for the estimation to proceed satisfactorily.

Choosing among the large number of econometric specifications that analysts use requires a high degree of subjectivity and judgment. Analysts must be particularly careful to emphasize the possible biasing and the uncertain implications of various econometric judgments. Some arbitrary assumptions may tend to bias the returns up, while others may work in the opposite direction. If, for example, an analyst includes extension but not research in the list of services in a farm-level production function, to the extent that research is an influential source of productivity gains and is statistically highly associated with any investments in extension, that effect will tend to be picked up by extension as the included variable, and thereby may contribute to overstatement of the positive effects of investment in that particular service.

Given the many possible sources of bias along with subjective interpretation, empirical results from applied econometric analysis of extension investments must be viewed with caution to avoid overstatement of past effects of the investments, and thus bias in anticipated returns and distortions in implied priorities for subsequent investment activities that may be influenced by such findings.

methods to assess the impact of extension investments. As already noted, measuring the outcome of the extension investment represents an assessment of the program's impact on accelerating the rate of adoption of technology or of the decisionmaking by farmers to use their resources in a more productive way. The inherent difficulty lies in estimating what the situation would have been without the extension investment. Major improvements in production and income can be achieved without any significant contribution from public extension services. In the absence of a quantifiable measure of attributable outcome, analysts can examine three elements that have major impacts on outcome to estimate the worth of the investment, namely, the program's *relevance* to the situation of the borrower and the intended extension clientele, its apparent *efficacy* in meeting its objectives, and the *efficiency* with which the program has used its resources. As virtually all free-standing extension projects and many component projects have a major institution-building objective, analysts must view these three elements in relation to building a capacity to deliver appropriate services in a sustainable system.

Once loan disbursements are complete, Bank staff undertake an ex post evaluation of a project and rate its performance as satisfactory or unsatisfactory in meeting its objectives. (No attempt is made to isolate the impact of the Bank's contribution.) The regional office that supervised the project's implementation initially does this based on a project completion report (PCR). Subsequently, a proportion of projects is subject to an independent implementation audit (PAR)

by OED (but note that before fiscal 1983, OED audited all projects). In recent years OED has consistently used the above elements in evaluating extension projects in its PARs. In many PCRs, however, efficacy has received more attention than relevance and efficiency.[4]

Performance ratings of completed projects

OED reviews find that agricultural research and extension, on average, performed better than the agricultural sector as a whole

In OED's annual reviews of project performance, agricultural research and extension has, on average, performed better than the agricultural sector as a whole. Of the 33 free-standing extension projects included in this review, the PCRs or PARs rated 70 percent as having a satisfactory outcome (Annex Table 1.1). The author rated the 74 extension components of agricultural development projects based on observations recorded in ex post evaluations of projects and on any complementary data available. While allocating projects to the unsatisfactory category could be done with confidence, the reports' lack of specificity on the extent to which all extension objectives had been met necessitated two satisfactory categories for the extension components: marginally satisfactory and satisfactory. This resulted in 30 percent of component projects being rated as unsatisfactory, 43 percent as marginally satisfactory, and 27 percent as satisfactory (Annex Table 1.2). Among the component projects, which included area development (rural development and settlement), credit (agricultural and agroindustrial), commodity-specific, and irrigation projects, area development dominated the sample and also had the highest proportion of unsatisfactory extension results (38 percent). Thus overall, 70 percent of free-standing and extension component investments met at least some of their major objectives. This compares with an average satisfactory rating of 63 percent for agricultural sector projects in OED annual reviews in the 1980s.

The difficulties in assessing the outcome or net benefits of extension investments discussed earlier inevitably raise a question about the robustness of the relatively favorable results indicated by the performance ratings. Although the ratings are largely subjective assessments, they do represent judgments on the extent to which projects met their objectives. All the free-standing projects and most of the component projects, especially those that used the T&V method (30 of the 33 free-standing projects and 26 of the 74 component projects used some form of the T&V method), had a strong institution-building objective. This was usually expressed in attempts to improve the quantity and quality of the extension agency's output.

Actions to improve quantity usually included the following:

- Adopting a well-defined extension method that mandated expanded and regular farmer coverage and identified clear expectations and responsibilities at all levels in the bureaucracy
- Providing supporting facilities and transport to enable better farmer coverage and an increased proportion of time in contact with farmers
- Avoiding (or substantially reducing) those service functions of field staff that were not associated with agricultural technology transfer
- Ensuring that the number of staff at various levels in the institution was adequate to permit the intended farmer coverage and implementation of the method by recruiting new staff, reorganizing existing public sector staff, or both.

Actions to improve quality generally included the following:

- Improving the human resource base of the institution by regular technical training of field staff and by technical backup for field staff.
- Improving linkages between research and extension to ensure the continued availability of relevant technology.
- Obliging field staff to feed farmers' concerns back into the extension and applied research system.
- Increasing the number of technology demonstrations in small plots in farmers' fields.

The institution-building goals common to most projects were often a means of improving the quantity and quality of extension output

The ultimate objective of most of these institution-building projects was to increase production and farmers' income and welfare, with an explicit or implicit goal of alleviating poverty. However, the absence of reliable data and the inability to link cause and effect in assessing net benefits have placed heavy reliance on institutional development as a final measure of outcome.[5] The favorable 70 percent satisfactory rating in the free-standing projects, which represent the most complete expression of projects designed to improve institutional performance, can be linked to the following:

- Governments' investment in projects of this nature implied that they were willing to increase attention to technology transfer, which was a positive outcome in itself.
- Project design was implemented to an extent that was at least reasonable, which meant that the quantity of output from the implementing agency was improved relative to the preproject situation, that is, farmer coverage was enhanced, the focus on technology was greater, and management and supervision to maintain the improved service were stricter.
- Projects invariably expanded staff training and introduced programs of small demonstration plots to support technical recommendations, both of which were mechanisms with the potential to improve the effectiveness of the extension staff, that is, the quality of output.

Thus projects with major institution-building objectives generally had the intended impact on the quantity of output from the extension institutions, and introduced at least some mechanisms to improve the quality of service. In a system that rated projects simply as satisfactory or unsatisfactory, evaluators usually considered these achievements sufficient to rate projects as satisfactory, despite lesser achievement of many of the quality improvement objectives. Hence, the relatively favorable overall ratings are "soft," and are not based on empirical evidence of net benefits brought about by the extension investment. The project ratings can be considered legitimate, but should not be allowed to disguise the qualitative deficiencies.

Chapter 3 analyzes the reasons for unsatisfactory ratings of free-standing projects. Note, however, that five of the eight unsatisfactory T&V projects (Loan 2150-PER, Loan 1626-PHL, Credit 690-IND, Credit 761-IND, and Credit 1669-RW) were sufficiently delinquent in the quantity of institutional output alone to warrant an unsatisfactory rating. In the other projects, poor performance in qualitative aspects and/or a lack of apparent real benefits resulted in the unsatisfactory rating.

TABLE 2.1: PROBLEMS RAISED IN EX POST EVALUATION REVIEWS OF FREE-STANDING PROJECTS AND THEIR FREQUENCY

Problems	*Of 23 satisfactory projects (%)*	*Of 8 unsatisfactory projects (%)*	*Of 31 total projects (no.)*
Funding			
■ Recurrent cost funding problems during and subsequent to the project that seriously inhibited field operations	87	100	28
Basis for recommendations			
■ Inadequate research-extension linkage to ensure that the technological needs of some of the major farming systems are defined and addressed (especially for resource-poor and less predictable environments)	74	100	26
■ Insufficient technology available to enable a major and progressive program to improve production in some important farming systems	39	63	12
■ An entrenched, top-down approach in developing recommendations, despite objectives of continuous feedback from farmers	48	75	17
■ Little or negligible consideration of production economics, risks, and different degrees of access by farmers to resources	39	50	13
Human resource capacity			
■ Training programs unable to ensure that front-line extension staff had sufficient practical knowledge of production systems (and their constraints and potentials) and of relevant technology to provide the desired level of interaction with farmers	43	88	17

The softness of the overall judgments is evident on closer examination of the major constraints to effective services cited for both the satisfactory and unsatisfactory projects. Table 2.1 summarizes the frequency with which PCRs and PARs of the free-standing projects mention serious problems. The main problems arise in connection with the funding of operations, the basis for technical recommendations, the human resource base, the responsiveness to country and farming conditions in project design and implementation, and the ownership of programs. Although these problems are more frequently highlighted in unsatisfactory projects, they are also of serious concern in projects rated as satisfactory. Note also that two-thirds of the satisfactory projects had "uncertain" or "unlikely" sustainability ratings.

The project ratings indicate that, on average, extension investments in AFR fared worse than those in EAP and ECA/MNA, while those in LAC and SAS performed better than in other regions (Table 2.2). This observation, however, is

(Table 2.1 continued)

Problems	*Of 23 satisfactory projects (%)*	*Of 8 unsatisfactory projects (%)*	*Of 31 total projects (no.)*
■ Specific mention of low education level of front-line staff, which limited the potential for a more analytical and responsive service	22	38	8
Selection of methodologies			
■ The adoption of a methodological "blueprint" approach over a large area (region, state, nation) did not permit a desirable adoption of services to the circumstances of each area; greater resources should have been allocated in the preparation phase to make the project more responsive to specific fiscal, institutional, and farming system conditions	35	50	12
■ Contact farmer system was not very effective, or reference was made to better results from working with farmer groups	43	75	16
Commitment-ownership			
■ Government or implementing agency management or staff not fully committed to all the principles and procedures of the extension program	48	50	15
■ Monitoring activities weak, or, if developed, not effectively used for responsive management	35	38	11
Sustainability of the system[a]			
Likely	33	0	na
Uncertain	58	60	na
Unlikely	8	40	na

a. Of only 12 satisfactory and five unsatisfactory projects (evaluated from 1989) for which this assessment was made.
na = not applicable.
Source: Project completion and performance audit reports.

TABLE 2.2: PERFORMANCE RATINGS FOR EXTENSION INVESTMENTS

Category	*AFR*	*EAP*	*ECA/MNA*	*LAC*	*SAS*
Free-standing					
Satisfactory	3	5	1	1	13
Unsatisfactory	2	3	0	1	4
Component					
Satisfactory	2	4	3	9	2
Marginally satisfactory	11	6	3	7	5
Unsatisfactory	12	4	3	3	0
Total number of unsatisfactory projects	14	7	3	4	4
Total number of projects	30	22	10	21	24
Percentage of unsatisfactory projects	47	32	30	19	17

Source: Annex tables 1.1 and 1.2.

not particularly useful for the analysis, as the variety of objectives and approaches used could influence the ratings, apart from any difficulties inherent in agricultural development in particular countries. The sample was more suited to an analysis of factors within projects rather than to comparisons of single, bottom-line ratings. Chapter 3 makes such an analysis of investments in each region.

Notes

1. Sample of free-standing projects: 17 in SAS, eight in EAP, five in AFR, two in LAC, and one in ECA/MNA (Annex Table 1.1). Sample of component projects: seven in SAS, 14 in EAP, 25 in AFR, 19 in LAC, and nine in ECA/MNA. The last group represents the region known as Europe, Middle East, and North Africa for most of the period under review (Annex Table 1.2). Overall sample number: 24 in SAS, 22 in EAP, 27 in AFR, 21 in LAC, and 10 in ECA/MNA.
2. In addition to econometric interpretation of the project's impact, this study provided interesting operational data, including information about the importance of women in agricultural production and their responsiveness to working with extension staff in women's groups.
3. Note that obtaining a satisfactory rate of return on the incremental extension investment made in most Bank-supported projects would not be difficult. This is because the projects commonly rely heavily on reorganizing and strengthening an existing extension structure. The incremental cost is low relative to the total cost, so the additional benefits compared to preproject performance need not be very high. This, however, is distinct from the economics of the total extension system, in which all costs and benefits would have to be considered, and would normally be considerably lower if they could be calculated reliably.
4. A limited interpretation of efficacy prevailed in many judgments. This was partly associated with a frequent narrow focus on the extent to which the infrastructural and equipment support and program organization and methods included in the project design were implemented. The evaluations usually did not attempt to judge the legitimacy of the project design and how more efficient use of resources could have been programmed.
5. Many PCRs claim the achievement of substantial production increases based on area production statistics, surveys, or even extrapolation of demonstration plot responses. This report has not relied on these assertions in making the rating assessment for the OED database because of the impossibility of linking cause and effect. To the extent that production, income, or yield changes did occur over time, this represented a response to a large number of factors, of which the extension service was only one.

3. Performance in each region

This section of the report presents the analysis of individual projects grouped regionally. The analysis provides the basis for the findings in Chapter 4.

South Asia

SAS was most active in adopting the free-standing T&V project model in the late 1970s and early 1980s and has 17 projects in the sample, all based on T&V (Annex Table 1.1). Projects included were located in Bangladesh, India, Nepal, Pakistan, and Sri Lanka. Thirteen of the 17 projects had satisfactory ratings, while four were unsatisfactory: projects in the states of Bihar and West Bengal in India (credits 761 and 690-IND), in the hill area of Nepal (Credit 1101-NEP), and in the state of Baluchistan in Pakistan (Credit 1533-PAK).

In the nine state extension projects in *India,* evaluators considered that all but the Bihar and West Bengal projects had effectively introduced the T&V organization and management system into the state services. The state services improved their coverage of farmers; removed many ancillary functions to permit greater focus on extension of technological improvements; adopted the use of small technology demonstration plots on a wider scale; provided field staff who had relatively low education levels with frequent technical training;[1] and established formal linkages with the state agricultural universities (the centers for agricultural research), which were to generate relevant technology assisted by the gradual adoption of an agroecological zone approach in research programming. Chapter 2 has already reported the positive results obtained in the empirical study undertaken in Haryana, in which T&V was supported under Credit 862.

Although the research-extension linkages were generally established, the PARs noted a persistent deficiency in the extent to which projects addressed technology problems in the less favorable environments. This was further reflected by references to inadequate relevant technology to meet farmers' needs in five of the projects. In many cases project staff were dissatisfied with the results obtained by the contact farmer principle, and states made various adjustments in this and in other aspects of the T&V method to try to accommodate local conditions without rejecting the system's basic framework.[2] These adjustments included working with groups rather than with contact farmers, adjusting the frequency of visits and training, maintaining some service functions in addition to technology transfer, and in some cases developing greater organizational and programming discretion at the district level. Some services also attempted to move away from the emphasis on basic food crops to also cover other aspects of the farming system, such as soil conservation and the production aspects of livestock. The projects had generally been developed around a standard T&V model and involved the transfer of large numbers of staff from existing community development programs to be village extension agents (EAs). Adequate political and administrative support to facilitate this process was not forthcoming in

In South Asia, where the training and visit model prevailed, states tried and sometimes succeeded in adapting project design to local needs

many states (with a consequent need for recruitment and additional funding), and this was a major contributor to poor implementation in Bihar and West Bengal. The tendency to use a blueprint approach to design without adequate preproject analysis was also apparent in six projects, which reported that construction of staff housing was overdone and occupancy rates were low because not occupying government housing was financially more attractive for EAs.

Staff effectiveness was compromised by insufficient funds for operational expenses

Although insufficient budgetary support hindered implementation in some projects, a more serious concern was states' willingness to continue to finance the large recurrent-cost extension budgets. While staff salaries were paid, staff could not be effective unless supported by sufficient operational expenditure, and constraints in this area were evident in most projects. Other major problems were poor capability of the subject matter specialists to convey practical knowledge to EAs and provide an economic orientation during their training, and EAs' lack of responsiveness to farmers' problems (associated with low education levels, limited experience, and inadequate training).

Evaluators rated two of the three projects in *Pakistan*, located in the states of Punjab (approved in 1978) and Sindh (approved in 1979), as having satisfactorily established T&V despite initial reluctance by state governments to accept this model. The evaluators did, however, express concerns about the funding of recurrent costs, the insufficiency of appropriate technology, the poorly developed research-extension linkage, the unwarranted repetition of many technical messages, the need for more flexibility in the system so as to respond better to farmers' needs and to reduce costs, and the excessive construction of staff housing (as in many of the Indian projects). The Bank approved the third project (Credit 1533-PAK) in 1984 for four districts in Baluchistan that contained more than 60 percent of the state's irrigated land (only 6 percent of crops were rainfed). The project eventually met most of its physical implementation targets, and a T&V extension system was installed and provided better farmer coverage. However, there was little evidence that the changed system was having any influence over farmers' uptake of new or improved technologies, and a number of serious problems became evident to the extent that the Bank rated the project as unsatisfactory. Coordination of research and extension improved initially, but subsequently worsened, and the specific adaptive research program financed under the loan did little more than repeat trials from the research system on the project farms; technology for new extension messages was scarce; staff training was not effective; EAs' low education level hindered the development of more responsive services; and the contact farmer concept did not function well. The PCR criticized the lack of attention in the project design to the existing institutional, infrastructural, and farming conditions and to the potential use of mass media. It also queried the system's sustainability because of its high recurrent costs and apparent inefficiencies.

In *Bangladesh*, an initial extension and research project (Credit 729-BAN) was followed by a second project (Credit 1215-BAN) that expanded coverage from the productive northwest to most of the country. PCRs rated both projects as satisfactory, as they did improve the organization and professionalism of extension, increase farmer coverage, and improve somewhat the linkages between research and extension. The PCRs assumed that extension probably increased the use of high-yielding varieties, fertilizer, and methods of plant protection, although the expansion of the area under water control (with its associated incentives for using higher technology) could largely explain the significant production increase in rice, the major crop. However, the PCRs also identified many serious problems in the service: top-down recommendations, demonstrations with limited relevance, poor-quality subject matter specialists, lack of attention

to economics and farming constraints, poor use of mass media, and poor results with the contact farmer concept. The funding of recurrent costs was also a serious concern, although this was temporarily alleviated by a follow-on project that is also attempting to address some of the service's other problems and to improve its responsiveness.

In *Sri Lanka,* the statewide project was similar to the earlier T&V extension and adaptive research projects developed in India, but also attempted to integrate livestock services with food crop extension, although in the end, the government did not approve the inclusion of livestock services with food crops. The Bank rated the extension part of the project as barely satisfactory, as it did establish a T&V system of extension throughout the country. Funding support was deficient during the project, and even more serious subsequently. The funding problem, along with major administrative changes that devolved extension responsibility to the provinces in late 1988 and a perception in the government that the T&V system could not respond efficiently to the needs of diversified farming, led to dissolution of the program and the creation of a new system in a new project. The PAR noted that the top-down characteristic of regular message delivery using poorly educated EAs appeared to have been associated with a positive effect when the main focus was improved rice culture, but was not effective when more analytical and responsive services were required.

In *Nepal,* one extension project focused on selected provinces in the lowlands (Terai-Credit 1100-NEP) and another focused on the hill area (Credit 1101-NEP). The Terai project resulted in improved coverage of farmers, at least in food crops, and the Bank rated it as satisfactory. Some evidence indicated that a rice yield response might be linked to the project, but this was not the case for wheat yield. Access problems in the hill area made implementation more difficult, and this, combined with a lack of evidence of any significant impact, led the Bank to rate the project as unsatisfactory. The importance of agriculture to the economy prompted the government to provide reasonable funding support during most of the projects' implementation periods, but fiscal constraints subsequently led to declining extension budgets. The problems of the frequent lack of relevance of recommendations to farmers' circumstances, the top-down message formulation, and the limited effectiveness of contact farmers and of contracted farmer-EAs were also serious constraints.

The sample includes seven *component* projects from SAS. Two irrigation projects (Credit 736-IND and Credit 1316-NEP), a sugar development project (Credit 1399-BD), and a second commodity-specific project toward the end of its implementation period (Credit 765-BD) used T&V. The other three projects had intensive commodity-specific services. All met at least some of their extension objectives satisfactorily, although the impact of T&V in the sugar development project was debatable.

Annex 2 reviews the characteristics and outcomes of SAS component projects. The major observations are as follows:

- Intensive commodity-specific extension supported by credit is likely to be effective in increasing production of the commodity (credits 1012 and 1034-IND and Credit 765-BD). The commodity must have a comparative advantage in using farmers' resources, however, to achieve widespread support (Credit 1399-BD). The program should also at least be aware of how the commodity interacts with other components of the farming system, so that the commodity program can take farmers' concerns into account (Credit 1012-IND).

- When commodity-specific services are provided to farmers engaged in significant commercial production of the commodity, clients should pay for technical services through fees or a market cess (Credit 1034-IND).

- A favorable production environment created by irrigation investment is conducive to a satisfactory outcome from T&V extension (Credit 1316-NEP). Even though appropriate technology is more likely to be available in these circumstances, this is not always the case, and its absence can limit results (Credit 736-IND).

East Asia and Pacific

This review examined eight free-standing projects in EAP (Annex Table 1.1). T&V was used in two national projects in Indonesia (Loan 1267 and Credit 996-INS), two in Thailand (loans 1393 and 1752-TH), one in Malaysia (Loan 1493-MAY), and one in the Philippines (Loan 1626-PH). The Bank rated all but the Philippines project as satisfactory.

In East Asia and Pacific, which shared some of the problems common to South Asia, almost all projects were rated satisfactory

In *Indonesia*, following earlier experience with T&V in some irrigation command areas, an initial national project (Loan 1267-INS) concentrated on food crop extension in 13 provinces that covered 80 percent of the farming population. This project successfully organized T&V food crop extension services, but the focus was mainly on rice cultivation. Most extension was closely linked to a special program that provided subsidized production inputs, credit, and guaranteed markets for rice and, to a lesser extent, for selected other crops. The PAR was concerned about continued budgetary support for the large organization and the inherent cost inefficiencies in having separate services for food crops, tree crops, livestock, and fisheries. A second project (Credit 996-INS) attempted to expand the T&V service to cover all subsectors throughout the country using generalist EAs. The Bank rated the project as satisfactory, but the PAR noted the need for substantial improvements and modifications to attract continued budgetary support. The problems common to many SAS projects were also apparent here, namely, a lack of appropriate technology in many rainfed environments, which severely limited impact in new transmigration areas; a top-down formulation of recommendations; the poor performance of contact farmers; the inefficient use of demonstrations; and the low education level of EA staff combined with poor support from subject matter specialists, which limited the service's responsiveness to farmers' needs. The relevant agencies were not fully committed to the generalist EA concept, which was not well implemented and was abandoned in 1992. The PAR concluded that imposing a uniform extension method in a country like Indonesia, with its wide range of production and socioeconomic circumstances, was unlikely to be the most cost-effective use of public extension investments.

In *Thailand*, an initial project that covered 33 of the country's 72 provinces (Loan 1393-TH) evolved from earlier use of T&V in irrigation projects. Political pressure led to a second project (Loan 1752-TH) to cover the remaining provinces only two years after the start of the first project. The projects established a T&V model throughout the country and the Bank rated them as satisfactory. The overlap of the projects caused budget funding problems and delayed implementation of the key training components and of the recruitment of subject matter specialists. Nevertheless, budgetary support subsequent to completion of the projects was reasonably good, although the decline in the operating support to salary expenditure ratio was a concern. As for most other T&V projects, monitoring surveys indicated that contact farmers were not effective, and problems

occurred in ensuring that relevant technology was available for many common farming systems. Farmers were aware of most recommendations, but nonadoption was due to the recommendations being inappropriate for their production circumstances. The government modified the original format somewhat by using farmer groups, changing the frequency of training, and putting EAs "on call" for one day per fortnight, but retained the programming concept and regular visit schedule. More recently, the government has insisted on a more responsive and participatory approach, and considerable extension staff time is now allocated to working with farmers to help them define their needs.

The national extension project in the *Philippines* (Loan 1626-PH) aimed at establishing T&V to promote integrated services for both food crop and livestock production. The Bank rated this project as unsatisfactory. The concept lacked the commitment of senior Ministry of Agriculture staff, an administrative reorganization also hindered progress, and fiscal constraints limited implementation. The intended integration of services did not occur, and only a loose form of T&V programming and staff training concepts was introduced.[3] Concentration on the government's rice and maize production programs meant that only a small proportion of farmers were contacted.

The *Malaysian* project (Loan 1493-MAL) followed up on earlier research and extension projects. After some delays and reticence on the part of officials, a substantially modified form of T&V was eventually adapted to Malaysian conditions. The government's emphasis on tree crops and high-value crops (as opposed to the food crops on which T&V programs traditionally focus at first) called for modifications that were developed with capable consultant support. Thus the frequency and timing of service varied depending on farming activities; farmers in relatively formal groups were the recipients of service; and attendance incentives were provided initially through tree crop subsidy programs, subsequently through marketing information, and finally by means of coordinated group marketing. These modifications were such major departures from the typical T&V model that the Malaysian approach could not be considered T&V.

T&V was not used in an agricultural research and extension project in *Vanuatu* (Credit 1407-VAN) or in an agricultural support services project in *Papua New Guinea* (Loan 2276-PNG). The Bank rated both projects as unsatisfactory. The Vanuatu project had design faults in that it did not cater adequately to the extremely traditional nature of most of the farming clienteles, and it overestimated the absorptive capacity of the implementing institution in a small island state. The Papua New Guinea project overestimated the political commitment and the institutional capacity to implement the project, and also suffered from poor management and only partial implementation.

The EAP sample includes 14 *component* projects: four rural development, three irrigation and drainage, four perennial crop, and three settlement projects. In Indonesia, the three settlement projects used T&V implemented by the national extension service, but two tree crop projects used intensive commodity-specific services. In Thailand, the national form of T&V was used for a rural development project, but not for a tree crop project. The projects in Myanmar (irrigation) and the Philippines (rural development) used a T&V model, but those in China (irrigation) and Papua New Guinea (rural development) did not.

The main observations drawn from the overview of EAP component projects in Annex 2 are as follows:

- Regardless of the extension method, having technology that is relevant to the targeted farming systems is essential (Loan 1227-PNG). A deficiency in technology is more likely in the less predictable environments for rainfed annual crops (as in annual cropping in loans 1499 and 1604-INS and in the Indonesian transmigration projects) than in irrigated or other high-potential environments.

- In more difficult production environments, the constraints farmers face are not only more limiting, but also are not as obvious to outsiders and not as uniform as in better circumstances. Services must be aware of and responsive to these circumstances in developing recommendations and must be adequately supported operationally if they are to be effective (credits 919, 2288, 1958, and 1898-INS).

- Irrigation investments usually represent a favorable production environment, enhancing the likelihood that an extension program will be associated with increased production. As benefits in these circumstances often depend on a relatively high use of production inputs, however, farmers must have access to these inputs (Loan 815-PH, Credit 838-BA, Credit 1261-CHA).

- Intensive integrated services for smallholders that provide all the requirements for improved production should be effective, but the problem lies in the cost per recipient, and so raises issues of replicability and sustainability (Credit 946-INS). Intensive (and relatively costly) services may, however, be judged necessary for particular disadvantaged groups, who often warrant some form of government investment as well as service assistance. In these circumstances, ensuring that this intensive support is as effective as possible is essential, which implies emphasis on involving the community and meeting its perceived needs (Credit 929-TH).

- A high degree of community involvement in the development process is conducive to effective adoption of technology (Credit 1261-CHA).

- Commodity-specific services that provide the required crop improvement package are usually effective in improving production of that crop (see also SAS experience); however, these services are often provided without any attention to the remainder of the production system (Loan 2078-TH). This lack of knowledge of the total farming system can be especially problematic in promoting a specific commodity after the investment phase (which is often the primary focus of a commodity package), when management of the commodity has to be integrated with the demands of other components of the system (loans 1499 and 1604-INS).

Africa

Five free-standing projects were evaluated in AFR (Annex Table 1.1). A Somali project (Credit 905-SOM) was implemented in the early 1980s, while the remaining projects (Credit 1387-KEN, Loan 235-ZIM, Loan 2765-IVC, and Credit 1669-RW) were implemented from the mid-1980s. The Bank rated the three projects in Kenya, Somalia, and Zimbabwe as satisfactory.

In *Somalia,* the extension project envisaged introducing T&V in three regions with favorable natural or irrigated conditions and did so effectively in the irrigated zones, but less so in the rainfed areas. The system suffered from a poor research linkage and limited relevant technology, especially for rainfed crop production. The government initially tried to expand the T&V coverage into a

wider area, but had to abandon this attempt because of a lack of technology, of trained staff, of supervision capacity, and of adequate infrastructure.

In *Kenya*, the national extension project followed an earlier T&V pilot scheme in two districts. It successfully introduced T&V into the intended 30 districts in a phased program and achieved a limited integration of crop and livestock production extension. A major concern was the difficulty in funding the program's recurrent costs. This was exacerbated by an unanticipated government policy of employing all agricultural school graduates, which increased the salary load in the service and reduced operational support allocations. A serious constraint to effective operations was poor linkages with research that affected the availability of relevant technology. The initial project design was modified to focus on farmer groups, and a positive development was that the service progressively incorporated women farmers, especially through women's groups. The Bank commissioned an impact study on the extension investment in Kenya (Bindlish and Evenson 1993). Although this study had significant data and analytical constraints, it maintained that T&V extension had made a substantial positive impact. The survey undertaken as part of the study indicated a mostly favorable reaction of farmers to the service, but also indicated that the main reason for nonadoption of the recommended technologies was poor access to production inputs (especially through credit) rather than lack of awareness of the technologies. This implies reducing marginal returns for a staff-intensive service with high recurrent costs that cannot overcome these more limiting production constraints. New, useful technology that is relevant to farmers' circumstances must be forthcoming to warrant continued, regular visits.

Three out of five extension projects in Africa met with success

In *Zimbabwe*, a national extension and research project was intended to improve productivity in communal farming areas (Loan 2335-ZIM) and was to complement the government's program of improved credit, input supply, and marketing assistance in this previously poorly serviced area. While the project did not use the T&V model, it was to improve staff housing, transport, training, and technical assistance and ensure more systematic programming of staff visits to farms with enhanced supervision and technical support. The Bank rated the project as satisfactory in transferring extension resources from commercial farming to the poorer, smallholder communal areas. At the outset in 1983, however, a top-down approach that promoted technology applicable to the commercial farming areas met with little success, because it tended to be inappropriate for local circumstances. This subsequently (in 1987) evolved into an improved approach that involved working more closely with farmers' groups in setting technology targets in accordance with different resource levels. In some areas, by 1989 a farming system diagnostic approach was being introduced as a basis for defining technology requirements. This desirable development, however, had not been introduced into staff training programs, and at project closure hardly any technology was relevant to the poorest 30 percent of farmers, especially those with limited labor or draft power. A major problem the extension system (with approximately 1 EA per 700 farm households) faced was serious difficulty in meeting its recurrent costs, despite the government's strong commitment to extension in communal areas.

The *Rwanda* project (Gitarama Agricultural Production—Credit 1669-RW) was to develop a T&V system in the Gitarama prefecture as a national model. This was not successful. During implementation major modifications were made to the appraised design in the use of existing team leaders at community development centers to train other farmers under "development contracts." This could not be considered as an example of T&V. Smallholders lost interest in this scheme, and management erroneously responded by concentrating its packaged

technology on an even smaller number of farmers organized in "cells." This top-down approach was accompanied by weak linkage with research, relative ignorance of farming practices and constraints, and inappropriate technology. The project's successful propagation of improved cassava and sweet potato varieties and their dissemination with the help of the extension service in the face of a famine threat demonstrated that even relatively poor institutions can be effectively organized for specific campaigns during crisis situations when everyone appreciates the problem and all parties are mobilized to avert the crisis (see also Brazil). A follow-on project hopes to build on the lessons from the Gitarama project.

The *Côte d'Ivoire* project (Loan 2765-IVC) was designed to upgrade extension in the regional extension agencies by introducing T&V and improving research-extension linkages. The agencies adopted T&V, but the Bank rated the project as unsatisfactory. The training of EAs, who were generally poorly educated, was substantial, but insufficient to permit services that were sufficiently responsive to farmers' needs. Improved arrangements for adaptive research and linkages with extension were adopted, but funding constraints hindered their implementation and insufficient relevant technology was available to suit farmers' circumstances. Farmer coverage through contact groups increased from about 25 percent before the project to a peak of 64 percent, but subsequently declined to preproject levels. Evaluators did not quantify the degree to which various factors were responsible for this deterioration, but contributing factors were a significant reduction in funding that affected the regularity of services; the reduced financial viability of some of the targeted crops (the focus was on coffee, cocoa, cotton, and food crops); an insufficiency of new, relevant messages; and the coordination problems introduced by organizational changes.[4]

Of the 25 component projects reviewed, 22 were in rural development

Rural development projects formed a major part of the agricultural portfolio in AFR in the late 1970s and 1980s. Consequently, 22 of the sample of 25 *component* projects were in rural development. Two others concerned perennial crops and one involved irrigation and drainage. Half of the 22 rural development projects used the T&V method, while the others used less programmed, but more intensive, services. One of the rural development projects was in Kenya, which also had a free-standing T&V project. This project started with intensive traditional services, but subsequently moved to a T&V method.

Based on the description in Annex 2, the main observations about AFR component projects are as follows:

- Regardless of the extension system used, institutional commitment and a reasonable level of management capability are essential if the system is to obtain worthwhile results (Credit 776-CAM, Credit 1193-ZAM, Loan 1667-NIG, Loan 1854-NIG).

- T&V extension used to complement other production services usually appeared to be associated with some positive effects; however, the outcomes were limited by budgetary support constraints (the Nigerian area development projects, Credit 959-KEN, Credit 1343-MAL, and Credit 1128-SIL), weak research-extension linkage, poor appreciation of farming system characteristics with consequent problems with the relevance of recommendations (the Nigerian area development projects and the Burundi projects), and often a top-down orientation of the services offered.

- The same sorts of constraints—budgetary deficiencies, ignorance of the farming systems, lack of attention to economics, unavailability of appropri-

ate technology—often affected the non-T&V, intensive extension programs to an even greater extent, so that their impact was markedly reduced by failure to reach the majority of the smallholder population (the earlier Nigerian area development projects, Credit 1193-ZAM). A particular problem in some cases was that reasonably good services were offered to a small number of creditworthy clients who had better resources and were atypical of the majority, while the majority received negligible extension services (credits 823, 857, and 1183-MAL).

- Experience with commodity-specific programs was consistent with that in EAP and SAS, that is, a comparative advantage in producing the commodity is needed, along with appreciation of how the commodity interacts with other components of the farming system (Credit 786-LIB). Where commodity staff are expected to provide an expanded technical advisory service, intensive training is likely to be required to give them theoretical and practical knowledge of farming other than of the specific commodity with which they have been dealing (Credit 1013-Burkina Faso, Credit 946-TOG, Credit 1127-BEN).

Latin America and the Caribbean

This review includes two free-standing projects in LAC, one in Peru (Loan 2150-PER) and the other in Brazil (Loan 1568-BR).

The *Peruvian* project was well designed and attempted to combine research and T&V extension into integrated services provided by a single institution. The project was unsatisfactory, however, because of a breakdown in the system associated with waning government commitment, major funding problems in the context of a deteriorating economic environment, and political change. Before this occurred, however, the T&V system faced relevance problems in its technical messages for many areas, a top-down orientation, and poor results with the use of contact farmers to spread technical messages. The change in institutional arrangements did not provide the opportunity to see if these constraints would be overcome through system changes and progressive improvement in integrating research and extension services.

The *Brazilian* project was designed to support the national extension service through which federal and donor funds flowed to individual state extension services. The idea was to develop extension methods that would expand services to more smallholders in the north, northeast, and center west than was possible under typical supervised credit projects (as in northeast Brazil). Twenty-five state services were involved. The Bank rated the project as satisfactory: infrastructural investment to support extension was successfully completed, vehicle procurement reached 80 percent of its target and mass media equipment purchase was substantial, preservice and in-service training were extensive, and about 3,700 additional staff were recruited to expand extension coverage in the states. The project did not use T&V, but the national extension service encouraged the development of a group approach to extension and heavy use of small demonstrations.[5] Impact was reduced by limited state budgets to support recurrent costs (despite support through the national extension service), inadequate research-extension linkages, lack of relevant technology in many of the resource-poor farming systems, and EAs' lack of understanding of the socioeconomic factors that influence farmers' decisions.

The review looked at a sample of two stand-alone and 20 component extension projects in Latin America and the Caribbean

The LAC sample had 20 *component* projects. Brazil dominated with 11 rural development projects, followed by Mexico with five credit and three rural

development projects, and Chile with one credit project that used subsidized private sector extension services to commercial smallholders. None of the projects used a formal T&V model, although the Brazilian rural development projects that commenced in the early 1980s had programmed activities and used some of the extension principles that T&V uses, as promoted under the national free-standing project. All were personnel-intensive schemes.

The overview of LAC component projects in Annex 2 can be summarized as follows:

In LAC's component projects, as elsewhere, scarce resources tended to go to a limited number of more progressive farmers

- Integrated and intensive technical assistance that complements input supply and adequate investment and production credit in appropriate production programs is likely to be effective in improving the incomes of recipient clientele; however, such services are relatively costly per smallholder client. In addition, as apparent from experience in other regions, smallholder technical assistance/credit programs tended to be directed at the more progressive farmers with better resources. This meant that in public sector schemes, the normally scarce resources are concentrated on a limited number of farmers and often detract from attention to households with fewer resources (Mexican credit projects, loans 1553 and 1945-MEX, and earlier northeast Brazil rural development projects).

- In expanding intensive technical services from a limited clientele to a broader, less intensive coverage, satisfactory results are unlikely without knowledge of the targeted farming systems to define technology requirements; effective linkages with research to ensure the development or adaptation of appropriate improved technology; enough staff trained in not only the theoretical, but also the practical, aspects of production; and adequate funding to support operations (later Brazilian rural development projects and Loan 2016-BR).

- Environments with a higher production potential (existing or created through the investment) are conducive to good results from integrated services that include extension (loans 1553 and 1945-MEX). At the other end of the production potential spectrum, however, the severity of constraints may warrant consideration of using public funds in poverty reduction programs other than agricultural extension, unless public investment that can substantially improve the production environment can be justified (later northeast Brazil projects).

- Well-organized campaigns to address widely recognized problems can avoid many of the constraints "permanent" services face and be an effective use of public sector resources (OED study of northeast Brazil area development projects, 1993).

- Private sector provision of extension services can have the advantages of being highly professional, attaining good results, and reducing costs for the public sector service. The clientele, however, must have the financial resources (that is, be in commercial production and have a significant cash income) to pay for such services, although governments can provide subsidy incentives to promote the development of such schemes (Loan 2481-CH).

Europe, Central Asia, Middle East, and North Africa

The ECA/MNA region had only one completed free-standing project (Credit 1557-YEM).[6] It used a T&V model and the PCR rated it as satisfactory. It did face constraints in support for recurrent cost funding and its impact was reduced by problems with supplying farmers with fertilizer. The project was unusual in that it had a high proportion of university graduates working as extension agents. The

PCR made no reference to any problems of poor linkage or communication between research and extension staff.

Five credit and four rural development projects made up the *component* sample. Four of the credit projects involved intensive public sector extension and credit to producers of high-value export crops in Cyprus, Greece, Morocco, and Turkey. The Bank judged that extension was unsatisfactory in the Cyprus and Turkey projects and was only partially effective in Morocco. Extension under a fifth credit project (Loan 1603-POR) was directed at large collectives as well as at medium and small private farms and was not very effective. The four rural development projects in Morocco, Portugal, Turkey, and Yemen used T&V, and in each of these the Bank considered that extension had met at least some important objectives.

In ECA/MNA, only the component projects that used the training and visit method met some important goals

The following are the main observations about ECA/MNA component projects based on the description in Annex 2:

- In commercial farming systems based on high-value export crops, farmers must take advantage of the most up-to-date technology and practices in commodity production, processing, and marketing if they are to be competitive. This requires a highly professional, economically-oriented service, which the private sector is better able to provide as individual consultants or as specialists from producer marketing organizations. Rarely is the use of scarce public sector funds for this purpose justified (loans 1988-CYP, 1588-GR, 1967-TK, and 1757-MOR).

- The potential impact of a T&V extension investment cannot be fully realized unless staff are competent in practical production technology, are supported by an effective technology generation system, and are adequately funded to enable planned field operations (Loan 2094-TK, Loan 2175-POR, and Credit 1067-YEM).

Notes

1. Most field staff had a secondary school education, and most eventually acquired some kind of agricultural certificate.
2. Evaluators generally considered those developments to be favorable ones that represented an evolution of practices under the T&V system.
3. D. Benor, a consultant to the Bank on T&V, does not consider the systems in the Philippines to be T&V.
4. A subsequent project attempts to address many of these issues, including restructuring the responsible agencies, reducing the number of staff, and adopting a farming system perspective in formulating technical recommendations. Bank staff have reported that the new project has made significant progress in agreeing to retrench staff and merge some services, and attributes this to experience gained during the earlier project.
5. A follow-on project (Extension II in 1986) also promoted the use of a programmed schedule of visits to groups; however, because of the dissolution of the national extension service and the transfer of implementation responsibilities to the Brazilian Agricultural Research Corporation and, subsequently, to the Ministry of Agriculture, this project made limited progress.
6. In April 1994, regional staff produced a draft PCR on the Agricultural Extension and Applied Research Project in Turkey (Loan 2405-TU). Sixty-six percent of sampled farmers in the project area reported that they considered extension had improved under the project (with a T&V model). There was some casual association between increases in production and extension, especially in horticultural crops, which offered attractive economic opportunities. However, no significant difference was apparent between project and nonproject provinces in the rate of change of wheat yields and in the reduction in fallow area, which were probably the two most important changes in field crop agriculture in Turkey in the 1980s. The draft PCR questioned the sustainability of the T&V system in view of budgetary limitations and the heterogeneity of production systems in Turkey.

4. Findings

The performance of the extension investments, according to ex post evaluations as described in chapters 2 and 3, permits a number of conclusions to be drawn not only about the outcome of these projects, but also about the factors involved in performance. The following paragraphs describe the main findings.

The ex post findings

An increase in the number of farmers receiving extension services has been associated with an increase in the adoption of significant technology

The Bank's support for extension in free-standing and component projects has substantially increased the *attention* governments give to agricultural extension services, especially among the smallholder farming population. Accepting the premise that effective extension services can accelerate the adoption of improved technology, this is consistent with the Bank's and the commonly expressed borrowers' strategy of improving agricultural productivity as a way to contribute to economic development and to alleviate poverty.

The focus of most investments on smallholders and on improvements in the organization and programming of services has enabled public sector extension services to increase their *coverage* of smallholders. Although scant empirical evidence documents the extent to which this increased contact has contributed to any observed production increases over time, observations support the conclusion that the improved farmer coverage has been associated with an increased rate of adoption of a number of significant technologies.

The effectiveness of an extension service was markedly reduced if its operational support costs were not adequately funded. Although extension budgets were not high relative to agricultural gross domestic product (GDP)—0.2 to 0.4 percent of agricultural GDP in most countries—most borrowers encountered serious difficulties in meeting the *recurrent cost expenditures* of national extension services, to the extent that in many cases the sustainability of the instituted systems was in doubt. Fiscal realities and competition for limited funds meant that public extension that relied on a relatively staff-intensive system to provide what is usually not considered as a priority service suffered financially; this, despite a recognition in the extension literature that sound extension investments usually yield positive economic returns.[1,2]

Insufficient technology relevant to farmers' circumstances was a major constraint in many services, and was particularly prevalent in resource-poor environments. Regardless of the extension system used, a supply of appropriate technology is essential if extension investments are to be worthwhile. This assumes even greater importance when the investment aims to establish a "permanent" public sector extension service with the consequent substantial overhead in salary and other support costs. In these circumstances, without a continuous supply of technological improvements, the marginal returns on the cost of continued service quickly decline as the available technologies reach a reasonable

degree of acceptance in farming communities and new, relevant technologies are not forthcoming. [3]

The lack of available relevant technology was associated with an inability of applied research institutions to develop or adapt technology that was appropriate for many of the common farming systems.[4] This was associated in most cases with poor understanding by researchers and extension staff of the circumstances of farm households (that is, the lack of a *farming system perspective*) and *poor linkages* between researchers, extension staff, and farmers.

For smallholders in rainfed annual crop farming where *production conditions* are extremely unpredictable, in many instances extension services performed more poorly in attaining adoption of recommended technologies.[5] This was linked to various factors: the available technology being more suited to more favorable (less risky) production conditions; a strong sense of risk aversion by smallholder farmers in these conditions, in which production of most of their subsistence food requirements was often a primary concern; and a lack of access to resources to adopt technology, which was partly associated with farmers' marginal economic status in a difficult environment. The reporting of poor adoption of recommended technologies under these circumstances implies, of course, that technologies relevant to the farmers' circumstances were not being recommended, which represents a failing of the service. If farmers become aware of technologies or modifications in the use of resources that are relevant to their circumstances and can improve their farm production, and thus their welfare, they will most likely adopt these changes.

The concentration on face-to-face contact in most services was associated with increased *participation* by farmers in extension activities, and on-farm technology demonstrations similarly promoted participation. Little attention, however, was given to involving farmers in defining and solving problems and in programming extension. In the rare cases where participation was emphasized, the results were positive (Annex 2).

The top-down culture that is typical of most developing countries tends to thwart reliable feedback from farmers

Most developing countries have a traditional *top-down culture* in interaction between public servants and the rural population. Extraordinary measures are necessary to change this culture. Without its resolution, services cannot obtain reliable feedback from farmers and extension tends to be based on standard recommendations that cannot satisfy the information needs of all farmers. This characteristic was prevalent in Bank projects and had special significance in large programs that catered to diverse clientele. When a top-down attitude is combined with poor appreciation of the interactions within farming systems and of production economics and risks, the relevance problem is exacerbated. Farmers adopt messages that happen to be relevant, but legitimately reject irrelevant messages, which represents a wasted extension effort.

Staff quality was a major constraint in nearly all the free-standing projects and in others that required large numbers of staff. Most of the free-standing projects provided for continuous *technical training* for EAs, which was especially important given their usually low *level of education* and basic agricultural training. However, serious difficulties occurred in having insufficient *subject matter specialists* who had adequate technical and practical experience to participate effectively in regular staff training in the statewide programs, so that training was often overly theoretical or general. Training in communication theory and techniques was also usually deficient. In about one quarter of free-standing project reports, the evaluators specifically referred to the EAs' relatively low level of basic education as an impediment to the adoption of a more analytical and

responsive service. The large number of personnel with limited capabilities was partly a consequence of services adopting a staff-intensive program over a large area (state, nation). In five free-standing projects, evaluators recommended that an improved extension program (with its associated costs per operating unit) should only be expanded at the rate at which suitably trained personnel became available to implement it efficiently.

Unless senior officials of central and implementing agencies were solidly committed to implementing the improved service, operational problems were likely, not only in funding support, but also in approvals for recruiting staff, procuring necessities, and establishing satisfactory terms of service. The evaluators noted problems of less than full commitment in nearly half of the free-standing projects.[6]

Many of the principles of the training and visit system are good practice

In general, *monitoring* was weakly developed in the free-standing projects. Most, however, had some way to monitor the mechanics of implementation of the extension methods. Fewer had survey systems to assess awareness and adoption of recommended technologies. Even when project staff did carry out adoption surveys (for example, many of the Indian state projects), project management made little use of the results apart from the move from working with contact farmers to working with farmer groups.[7] For component projects, with rare exceptions monitoring tended to be no more than required for the mechanics of system operation, whether in credit, investment, or input delivery.

More than 50 percent of all the projects reviewed, including 90 percent of the free-standing projects, used the *T&V management system*. This model was, therefore, a major factor in the enhanced attention given to extension and to coverage of smallholders. It cannot, however, be divorced from many of the serious concerns about program efficiency and sustainability, which are summarized in Table 2.1. The following are specific problems with T&V:

- Although governments incurred significant recurrent costs for extension systems before the introduction of T&V, the projects increased the operational support cost per extension unit and maintained or increased the number of units. The additional unit cost was usually justified to make the unit more effective. The large number of units meant, however, that the system as a whole made substantial demands on the recurrent budget.[8]

- T&V exacerbated deficiencies in situations where appropriate technology was lacking, because its scale and intended coverage meant that extension systems had to cater to a large array of production systems and circumstances, including the more difficult production environments.

- T&V increased participation in the limited sense of farmer contact and through farmers' test plots, but its scale and traditional message-centered format was not proven conducive to intensive involvement by farmers in problem definition and resolution. Similarly the hierarchical framework of T&V suited the top-down nature of most public services, and extension systems had insufficient incentives to depart from this culture in formulating recommendations. (As Table 2.1 indicated, evaluators specifically highlighted the top-down problem in more than half of the free-standing T&V evaluations.)

- The scale of state or national T&V programs also necessitated the use of a large proportion of field staff and, more importantly, technical support staff who did not have appropriate experience and were not easily trained to provide responsive technical services.

- The degree to which so many countries accepted T&V as an extension system was remarkable. It did fit in well with the public service culture in most countries (see Box 4.1). However, in projects that relied on massive staff transfers from other programs, a lack of commitment to the T&V technology-focused, programmed, and supervised mode of operation often occurred at the level of middle management and field staff, at least in the initial phases of a project (especially in some of the Indian states).[9]

- In the earlier, completed projects reviewed in this report, the T&V project designs were frequently of a *blueprint* nature. They commonly paid exclusive attention to face-to-face public sector extension services and relatively standard staff to farmer ratios, staff hierarchical systems, visit frequency, and so on. Nearly 40 percent of ex post reports emphasized the need for much greater attention to individual area and country circumstances at the project design stage and noted that those involved in formulating extension components and approaches should have taken fiscal, institutional, technology stock, and farming system conditions into account.[10]

- Despite these criticisms of the T&V projects, many of the *principles of the T&V management system* are widely accepted as good practice in any face-to-face extension services, namely: programming activities, focusing on technological improvement, ensuring continuous training of staff, including provisions for supervision and accountability, striving for effective research-extension linkages, and seeking feedback from farmers. Some projects, however, did not implement these principles adequately (training was poor, linkages with research were weak, feedback was ineffective). As already noted, this deficiency is partly due to the large scale of programs that involve large numbers of staff with limited abilities and experience. In the case of weak linkages with research, however, an additional factor was frequently an established research culture that was not accustomed to being responsive to farmers' needs when planning research programs.

Projects that had limited success failed to implement these principles adequately

- *Other T&V practices*, such as limiting recommendations to a number of predetermined messages and using contact farmers to spread messages, have been more widely criticized. The criticisms of a predetermined message program were not related to the concept of having a limited focus for each visit, but to the system's inability to adjust recommendations to the circumstances of particular farmers or farmer groups. This problem was related to the top-down characteristic of most services and the poor development of a farming system perspective.[11] Half of the ex post reports criticized the ineffectiveness of the contact farmer concept, and many projects changed to working with farmer groups. The contact farmer concept probably performed poorly because of the selection of farmers whose resource circumstances were not the same as those of the farmers they were supposed to influence. Thus criticism is aimed not at the contact farmer concept, but at the lack of understanding by extension staff of the importance of resource and other socioeconomic and cultural circumstances in farmers' interactions and decisions. Unfortunately, in most cases this same ignorance carried through to the use of farmer groups. Extension staff generally made few efforts to identify groups of farmers who might be able to relate to each other in terms of their objectives, resources, and potentials (often known as reference groups), or patron-client and other community relationships that could influence decisionmaking. (See Annex 3 and FAO Investment Centre 1992.) This reduced the potential to use common characteristics and interests to enhance effectiveness through technological innovations or changed resource use and to achieve group ownership of demonstrations.[12]

BOX 4.1: REASONS FOR WIDESPREAD USE OF T&V IN BANK PROJECTS

The Bank's relatively broad acceptance and continued use of the T&V management system and its promotion among borrowers in preparing extension projects can be related to the following factors:

- Earlier projects using T&V were associated with favorable production conditions (usually irrigation) and were able to capitalize on the spectacular benefits of high-yielding varieties and higher input (especially fertilizer) use in these environments. Although the extent to which extension systems accelerated the adoption of these technologies (which, for example, was well under way before T&V in India) was not documented, the Bank assumed that extension contributed to the relatively high rate of adoption and to the productivity gains obtained.
- The Bank assumed that an unsatisfactory rate of adoption of improved technology was substantially linked to poor performance by existing public extension services, which implied that substantial improvements could and should be made to permit better use of public extension funds.[a] T&V appeared to be addressing many of the identified problems, and the early projects did show that it could result in increased government attention to technology transfer.
- Bank staff assumed that appropriate technology that was not being adopted was always available, and that a better organized delivery service would remove a key constraint to increased agricultural productivity.
- The T&V system offered an apparently convenient vehicle for Bank intervention by means of supporting public infrastructure, vehicle purchase, training and technical assistance and rather mechanical preparation based on farming population service ratios, hierarchical staff ratios, and a set training/service method that could be monitored. Bank staff assumed that

The relevance of technology was sometimes a problem in rural development projects, which often had difficult production environments

Integrated *rural development projects* sometimes used the regular state extension services, but in most cases provided for extension services that were more intensive than statewide programs using T&V or other methods. They usually also tried to ensure the provision of production inputs and credit to facilitate the adoption of recommended technologies. Where relevant technology was available and complementary services were provided, extension results were apparently favorable, as could be expected. Many of these projects, however, were in difficult production environments where problems of relevant technology arose. Sometimes they were also negatively affected by complementary services that were deficient because of poor coordination of other public agencies and reliance on these agencies, thereby removing any potential advantage over general extension services.

Most rural development projects assumed that extension services would continue after project completion. This often resulted in major funding difficulties when the services were even more staff-intensive and more demanding in terms of operational support funds than regular public extension services. Although this might lead to the conclusion that using sustainable service intensities in this type of project would be better, particular circumstances should dictate requirements. For example, the effective "Plan Puebla" model in Mexico (Annex 2) had an intensive service for targeted communities, but it was intended to move progressively from one community to another with well-trained staff. Similarly, in the hill tribe area in Thailand (Annex 2), the intensive (and effective) participa-

(Box 4.1 continued)

all types of smallholder communities, farming systems, and production conditions would be more responsive to the T&V method than to existing services, and thus they did not need to look further into the different farming situations or into the method's efficacy in meeting production and welfare objectives in these situations.

- In the early 1980s in AFR, major problems became evident in the widespread program of area development projects, and Bank staff saw extension projects using T&V as an alternative for supporting agricultural sector growth, especially if aligned with economic and sectoral structural adjustment to create an improved economic production environment.
- A prominent and influential long-term consultant to the Bank vigorously promoted the T&V concept among Bank management and borrowers, convincing them of its benefits. The progressive spread of T&V from EAP and SAS to AFR coincides with the promotional efforts of this remarkable individual.

Acceptance by borrowers can be partly related to T&V promotion by the Bank and to the borrowers' own perceptions concerning the first two factors above. Another important reason for borrower acceptance of T&V, however, is likely to have been its hierarchical, organized structure, which was compatible with the directed, top-down mode of operation in most public services. This factor may not only be associated with its acceptance, but also with the difficulties in developing national T&V into a service responsive to farmers' needs.

a. As early as 1983, however, in a World Bank / United Nations Development Programme symposium held to review Asia's experience with T&V (Cernea, Coulter, and Russell 1983, 143), the conveners cautioned that "extension is only one of a number of factors that contribute to increased farm productivity, and not one of the essential ingredients—improved technology, available inputs, and attractive markets."

tory service could be justified as a "permanent" service because of the government's specific development objectives with this marginalized target group.

Commodity-specific extension programs were staff-intensive and attempted to ensure that the programs provided the package of inputs needed for improved production. They were usually effective in attaining their objective with the targeted commodity, which was often a perennial crop linked to established marketing or processing outlets. Observers noted, however, that farmers must have a comparative advantage in producing the commodity if the service is to obtain the desired response. They also pointed to the need for the specialist services to be aware of the interaction of the commodity with other components in the smallholder production system. Where a project expected a specialist service to expand into providing general extension advice for the total farm operation, training to enhance the competence of specialist staff and the overt support of service management are required if this expanded role is to be effective.

These findings would support the use of an integrated, commodity-specific service when the prospects for farmers having access to all the inputs and technology required to produce a priority commodity are poor. (The priority could relate to a government program to enhance exports, or a private or public processing and/or marketing investment may "require" the commodity.) As the growing of such commodities usually implies commercial production conditions, if a public or parastatal entity provides these specialized services, then

cost recovery in some form should be anticipated. As the farm commodity becomes more specialized, more technologically advanced, and of higher value (for example, vegetables and export fruits and flowers), the technology transfer function should move to the private sector.

In the coming decade, public extension services should be ready to move to a system of payment for services

Apart from systems in which parastatals made deductions from commodity payments or credit agencies included an interest rate spread to obtain some cost recovery for services, there was only one successful example of *private sector services* by consultants being used to provide subsidized extension to commercial small farmers (in Chile, see Annex 2).[13] Few would disagree that private technical assistance is likely to provide highly professional, economically oriented, relatively intensive, and largely effective service, nor would most people disagree with the desirability of passing the cost of technical service to the farmer clientele to reduce the frequently unsustainable fiscal burden of supplying public services. One could also argue that relevant advice, by definition, means that it has an attractive benefit-cost ratio, and that payment for the information or skill acquisition is therefore justified. Potential clients must, however, have sufficient cash resources and be willing to pay for such services, which implies that they must be engaged in commercial farm production. This is still not the case in the poorer smallholder subsector of many developing countries, so that some public services for the private good of smallholder families is likely to be needed and to be justified in the foreseeable future on economic and poverty alleviation grounds. Poor resource circumstances, however, should not prevent attempts to encourage farmers to contribute in noncash terms so that their demands on, and expectations from, the service are increased. Change in the agricultural sector is likely to be rapid in the coming decade, especially in the middle-income developing countries, so public extension services should be responsive to the need to move to a system of payment for services as this capacity develops. This will reduce fiscal costs and improve the effectiveness of technical services through client ownership.

Extension services provided as an adjunct to projects with an *agricultural credit* focus were usually effective for the clients who received the service. (This type of project usually ensured the delivery of the required inputs, at least to the clientele.) There was a strong tendency, however, for participation only by those smallholders with better resources, so that most farmers were not served (for example, Malawi). This occurred whether the credit agency was private or public, as any serious financial institution must be interested in making loans of a reasonable size (to allow cost coverage through interest rate spread) to clients with an adequate resource base to reduce the risks of repayment delinquency.

The northeast Brazil projects demonstrated that special *extension campaigns* to address widely appreciated problems, such as a disease or pest outbreak, in a limited time frame can be extremely effective, assuming that the technology required to address the problem is available. This is probably associated with an ability to avoid many of the factors that often negatively affect extension, namely, lack of relevant technology, funding constraints, lack of direction and a measurable output, lack of support for the extension objectives by other public agencies and political representatives, and complex extension tasks that require reasonably skilled personnel. Special, short-lived campaigns, however, depend on the availability of suitable public sector personnel to respond to the crisis, and do not substitute for the development of a public sector institutional capacity to deliver effective extension services, should they be deemed necessary to enhance productivity in the smallholder subsector.

During preparation of the projects under review, the importance of the role of *women in farming systems* and associated implications for extension programs were not given special attention. Consequently, evaluation reports have generally not highlighted this issue. However, the growing awareness of the need for special attention to women in farming households did elicit mention of this issue in some of the more recent reports, and there were some cases of extension beginning to work with women's groups (for example, Kenya, Thailand). The need to cater specifically to women is receiving attention in most of the extension projects appraised during the last few years (although the extent to which new programs cater to women is often linked to a country's religious and other cultural values).

Most recent projects are paying attention to the role of women in farming—an issue only modestly addressed in the projects reviewed

Environmental issues also were not given special attention during project preparation. Evaluators assumed that environmental concerns were covered within the objective of promoting sustainable agricultural development, and were not a significant subject in the reports. Similarly, in most instances, project design and implementation, along with evaluation reports, paid little attention to the use of *nongovernmental organizations* (NGOs) to complement public services. Realization of the need to address farmers' perceived problems more effectively, however, has led to some current projects (for example, in Bangladesh and Zaire) attempting to use NGOs to increase farmers' participation in determining the content of extension programs.

The findings cited do not support the contention that a single extension model is available that has sufficient superior features to justify its uniform adoption for technology transfer in all smallholder farming situations. Rather, they demonstrate that certain key principles determine the effectiveness of extension services. Paramount among these is the principle that extension recommendations must be relevant to the client's circumstances, regardless of the extension model used. This, in turn, means that the service must understand the characteristics of the targeted farming systems and the factors that impinge on these systems and must have access to appropriate technology and to an effective capacity for generating and/or adapting technology. (See Antholt 1991; Birkhaeuser, Evenson, and Feder 1991; and Sims and Leonard 1990, in which the authors emphasize that awareness of new technologies is often not the primary constraint to adoption of the technology by smallholders.) Having met this basic tenet, methodological innovations such as programming and scheduling activities can improve services' efficiency and their efficacy in meeting objectives, as long as a primary consideration in their design and implementation is to be responsive to farmers' needs.[14] Public sector extension services will not achieve their desired impact, however, unless the investment is designed with full recognition of possible fiscal, institutional, and human resource constraints. Fiscal realities in most developing countries dictate that the authorities must give priority to containing recurrent costs, so that a service should be not only economic in the true sense of representing the most cost-effective means of achieving a particular result, but its costs should be such that it can be fiscally and politically supported in the future. Just as the unavailability of a supply of new, relevant technology will lead to diminishing returns on continuation of an extension service, so too will a scarcity of funds that limits staff-intensive, face-to-face services in the field.

In comparing the performance of completed projects in the 1980s with the findings and recommendations of the 1983 OED report, one can make the following observations:

- The earlier contentions that the Bank's projects have increased the attention governments give to technology transfer and increased the coverage of the smallholder farm sector were confirmed.

- The concern that project designers were not taking sectoral, farming system, fiscal, institutional, technology stock, human resource, and complementary service characteristics sufficiently into account was not heeded significantly in project design and implementation in the 1980s. The principle of ensuring that an extension system was relevant to existing and anticipated circumstances also was not emphasized enough.

- The deteriorating fiscal situation of many developing countries in the 1980s exacerbated the problem of the fiscal sustainability of supported extension systems, so that this issue is even more serious now than in the 1983 report.

- The concern that the T&V method, despite its many sound principles, was being used without adequate preproject situation analysis was generally not addressed in the 1980s. This has led to a widespread adoption of T&V on a state or national scale without sufficient consideration of the scale of services, of different methods, or of major modifications to suit particular circumstances. Box 4.1 postulates some reasons for the initial and continued widespread use of the T&V model in large, national programs.

- The specific concerns in the 1983 report about developing cost-incurring extension networks where technology was insufficient; about having extension without sufficient research backup and linkage; and about establishing large, national programs based on staff with limited capabilities were not adequately addressed.

- The recommendation to give more attention to the important role of women in smallholder agriculture was gradually adopted in the late 1980s.

- The recommendation to concentrate monitoring activity on production results to link them to impact was generally not heeded. In view of the difficulty in linking cause and effect for extension investments, using a large amount of scarce resources on measurements designed to provide data for ex post evaluation would have been inappropriate. The use of survey data for ongoing evaluation to enable responsive management, however, could have been developed more extensively.

More recent developments

Reviews of more recently approved projects and ongoing extension programs indicate considerable variation in approaches being taken across the Bank's regions, as described in the subsequent paragraphs.

Efforts to adapt the training and visit model to local needs continue in South Asia and East Asia and Pacific

In *EAP* and *SAS*, the attempts initiated in the 1980s to make the dominant T&V model more suitable to local conditions have continued, including changing training and visit frequency,[15] further emphasizing farmer group contact, making adjustments for tree crops in farming systems, broadening subject matter coverage, and experimenting with different degrees of linkage with or participation in input supply services. Most countries have maintained some form of programmed services in their state or national systems and appreciate the need for close research-extension linkages (although this linkage still has many imperfections in nearly all countries). The scarcity of recurrent cost funding is

the most widespread, serious, and persistent problem, followed closely by poor quality of specialist support staff. Programs to upgrade EAs' education level are also under way in many countries in attempts to improve staff capacity to provide more responsive services. Some countries are attempting to reduce recurrent costs, while others are trying to introduce greater farmer participation (for example, India and Thailand) or to adopt a more educational approach to technology transfer (for example, Indonesia).[16] The government of Sindh in Pakistan is in the process of trying to make major changes to provide different types of services to different categories of farmers with a reduced number of better qualified staff and greater use of mass media and collaboration with NGOs. (In Sindh 80 percent of farmers are sharecroppers on land for which landowners make many production decisions. This was not taken into account in imposing a standard T&V model.) China did not adopt T&V and has continued its concept of having extension staff accountable to groups of client farmers. The ongoing Agricultural Support Services Project (Credit 2462-CHA) is expanding the use of farmer associations to link farmers more closely to the technology development and transfer process.

China did not adopt the training and visit method; nor is it widely used in LAC, where the private sector is taking a more active role

The T&V model is not widely used in *LAC*, although the programming of services is common in Brazil. The region has seen more progress in involving the private sector in extension for commercial production by smallholders and in governments contracting the private sector to provide services to marginalized farmers (for example, Chile), and in determining some degree of payment for public service at the individual or community level (for instance, Colombia). The provision of services by farmers' associations is also widely developed among smallholders in commercial production, often along commodity lines, with deductions from commodity prices paying for technical services.

In *ECA/MNA*, Bank staff appear to realize that recurrent public sector costs must be contained, that an effective farming system diagnostic capacity must be developed, and that project design must be responsive to local conditions (Zijp 1991).The extent to which these principles are translated into actual practice, however, remains to be seen, although both Hungary and Romania have tried to introduce a more analytical approach to project design.

AFR is currently the most active region in extension activities (Figure 1.5). Here, the T&V model dominates. A two- to three-year pilot phase is common in African countries before they embark on national programs, thus in 1993 sub-Saharan Africa had 20 large-scale, free-standing T&V projects in addition to extension components in other projects. The Bank's support has continued to (a) focus borrowers' and donors' attention on the need for improved technology development and transfer in this region, which has more production constraints than other regions; (b) encourage the rationalization of many fragmented extension services within countries; and (c) increase coverage of smallholders by national extension systems. In 1987 Bank staff realized the need to broaden the emphasis from an extension focus to cover complementary services, and adopted an Agricultural Services Initiative. The Bank also appointed extension service specialists in 19 countries to assist in project implementation. Recently, some projects in the Sahel have moved toward linking natural resource management operations with extension, which would introduce a more decentralized and participative approach in dealing with farmers. Rapid rural appraisals by joint research and extension teams to examine production constraints and potentials in production of specific commodities have commenced in Ghana, and nongovernmental organizations are involved in Zaire. All these developments reflect a massive effort within the Bank to address poor agricultural sector performance through investment in services, especially extension.

The AFR extension portfolio, however, faces many serious problems. Bank staff and borrower representatives have highlighted these problems in a number of seminars and reports, including regional workshops in Malawi (1991), Ghana (1993), and Côte d'Ivoire (1993); a review of the adequacy of staff appraisal reports on extension projects (1991); and a report on East African projects (1992). Annex 3 summarizes these reviews. The problems are not new or peculiar to AFR. They are, however, exacerbated by generally more difficult fiscal, political, production, and human resource conditions than occur in other regions. Most staff appear to accept that the T&V programs have brought some rationalization into the use of existing extension resources in many countries in the region (although the focus on T&V has meant that any alternative models using similar resources have not been tried).[17] Yet despite ongoing attempts by dedicated field advisors to improve efficiency, with some obvious successes, serious difficulties in making nationwide extension services efficient and sustainable in the circumstances of individual AFR countries have not yet been overcome.

Conclusion

Overall, Bank staff and borrowers appear to be aware of the major constraints to increasing the adoption of improved technology through sustainable public sector extension services, and most borrowers are trying to adjust their extension systems to reflect at least some of these constraints. However, plausible solutions are difficult to realize in the large, national T&V programs predominant in Bank-supported projects. This is evidenced by experience in SAS, where after 15 to 20 years, major efforts are still under way to overcome the problem of services' poor responsiveness to the needs of many farming systems. Deficiencies and inefficiencies in the extension systems themselves, as well as factors exogenous to the extension systems, limit the extent to which extension services can achieve their ultimate objectives of increasing productivity and alleviating poverty. This is of special significance in the case of AFR—where problems include scarce relevant technology, limited staff quality, severe fiscal limitations, weak development of the private sector in providing complementary services, a poor credit delivery system to smallholders, and often political and/or economic instability—as the Bank is relying on extension investment as an important component of its sectoral support strategy. Such constraints severely limit the potential for large, national programs using uniform extension practices to be efficient users of public funds in attaining technological change in the targeted smallholder communities.

Notes

1. Uncertainties about sustainability usually involved reluctance on the part of central funding authorities to support the service adequately, rather than its rejection by management of the implementing institutions or by central authorities. Nearly all the national or state extension systems supported under the Bank projects have continued to date, albeit with major modifications in some cases, and with continued external support in most cases. There is usually no question about eliminating the extension service: the extension services existed before the Bank projects and governments generally consider them to be a necessary public service for smallholders; the commonly used T&V management system suits most public sector institutions in which it has been introduced; and the T&V system is usually considered an improvement on earlier models, which were widely regarded as poor performers. The pressure on governments is to reduce recurrent costs substantially and to make the extension service much more efficient and cost-effective.
2. This is not to suggest that an awareness among funding authorities of published accounts of extension benefits would automatically generate more favorable funding. Even

in a technocratic planning environment, an inability to quantify all benefits and costs in economic terms for competing programs usually means that other, more tangible, factors affect decisionmaking, for example, the degree to which a program is "essential," the political or social consequences, or the implications for continued recurrent cost financing.

3. Assuming that extension has been associated with increased knowledge and/or skills in the community, much of the accelerated adoption will have resulted from farmer-to-farmer contact. This process occurs continuously at no public sector cost. When technologies become widely established, the incremental benefits to be obtained by an extension service promoting those technologies are markedly reduced. The impact of the farmer-to-farmer diffusion process must be enhanced as the proportion of those with knowledge to those without knowledge increases. Continued frequent visits to promote standard technologies that are not relevant would not, of course, be cost-effective.

4. Although linkages were usually planned and, to varying degrees, regular meetings between research and extension staff and joint on-farm trials were organized, rarely did this lead to a better understanding of many of the major farming systems by research and extension personnel.

5. The converse of this observation is that extension performance appeared to be better in higher-potential environments. What has been observed, however, is that adoption of technology has been greater, but the extent to which this might be due to extension or other factors has rarely been measured (see Chapter 2).

6. In two unsatisfactory projects (Loan 1626-PHL and Credit 1669-RW), evaluators cited the lack of commitment to the improvement program as a major cause of the poor performance.

7. Evaluators reported that monitoring was weak in Bangladesh, Kenya, and elsewhere despite major T&V programs and was weakly developed in most other countries (for example, Nepal, Pakistan, and Somalia). They noted, however, that awareness and adoption surveys were the main reason a number of projects changed from a contact farmer to a group approach (for example, Somalia, Sri Lanka, Thailand, and some of the Nigerian states). In India, all projects established monitoring and evaluation units, which represented a significant investment. Where state departments of agriculture were well managed and appreciated the potential of monitoring and evaluation, they have continued to provide funding support to these units, with some benefits in extension service management (for example, Gujurat, Haryana, Karnataka, and Rajasthan), but elsewhere the units were not very useful.

8. Although these demands and the funding deficits raised questions about sustainability, this does not imply that T&V projects were less sustainable than many of the more intensive, localized projects. The issue is that the national T&V projects were designed as institution-building projects, so institutional sustainability expectations were high.

9. In many cases where staff were transferred from a role in which they controlled inputs to a strictly technology transfer function, they reacted negatively to their apparent loss of importance and prestige (and possibly, "rent"). Projects could have anticipated this problem, as convincing all staff of the worth of a new system before it was implemented would have been virtually impossible.

10. Despite the relatively standard design format, significant modifications were often made during project implementation, such as changing from the contact farmer principle to working with groups, adjusting visit and training session frequencies, and broadening subject matter coverage, although all retained the principles of programmed farmer visit schedules and regular training (see Chapter 3). These developments should not be seen as a criticism of T&V, but as expected adaptations of procedures in line with experience. More recently, designers of T&V projects have paid more attention to local circumstances in formulating projects, but most still adhere to the concept of having a nationwide program with only minor deviations from a uniform set of practices.

11. Although not highlighted in ex post reports, the combination of a simple message and top-down orientation has meant that in most T&V services farmers' education in the more complex aspects of farm operations, such as integrated pest management or soil and water management, has been limited. Recently in AFR, T&V systems have tried to promote soil conservation, reportedly with some success. In Indonesia, the government has adopted a more intensive educational approach for integrated pest management in villages in a departure from the traditional T&V system.

12. Quite often groups that did form could be classed as reference groups, but this was usually more by accident than by design. Even then, there was no attempt to use structured interactions techniques to improve effectiveness (nor training to do so).
13. None of the projects reviewed elaborated on the use of services from private commercial input suppliers or marketing agents. It is obvious, however, that every effort should be made to maximize the contribution of these agencies to technology transfer, preferably in close interaction with public services to afford some protection to relatively uneducated smallholders against inappropriate commercial advice. This offers an opportunity to reduce public sector costs while improving farmer coverage, that is, increasing extension efficiency.
14. The apparent benefits of many T&V programs in successful irrigation schemes during the period of proliferation of high-yielding varieties in Asia and the associated greater use of inputs occurred when the systems adhered to these principles: the farming systems were relatively well defined, technology was available that had a high benefit/resource-cost ratio, and resources and complementary services were available to make the recommended technologies relevant to a large number of farmers in the irrigation scheme.
15. The model of regular fortnightly visits over a number of years evolved in irrigated and higher potential production environments with smallholders in annual (seasonal) cropping systems, for which a stock of improved technology was available or was likely to be made available. In more marginal environments, for which a smaller pool of appropriate technology is usually available or being produced, and in circumstances of poor access to complementary services (credit, inputs, markets), relevant measures to improve performance are limited. Similarly, a dominance of perennial crops or livestock in the farming system dictates that adjustments must be made in the programmed services.
16. A review by the Bank's Country Department for India (Macklin 1992) of Indian extension investments since 1977 maintained that they had registered a worthwhile production response and had been appropriate for Indian conditions, but also highlighted most of the problems indicated in OED audits of Indian projects. The review recommended improving coverage of all socioeconomic groups and the quality of services and adopting methods to reduce recurrent expenditure demands and improve farmer participation. In 1993 the government began a study (with Bank project funding) of both the extension and research systems to develop pilot schemes that would try to address the key constraints of both systems in terms of poor responsiveness to farmers' needs.
17. This is undoubtedly one of the positive influences of national T&V programs in AFR. This region, more than any other, has been subject to the proliferation of numerous localized projects supported by a large array of donors. Although many of these projects had a positive result in their area of influence during implementation, most were intensive in nature (often with heavy expatriate participation), were not replicable, and consequently had limited impact on a national scale while demanding considerable counterpart support in scarce qualified human resources. The Bank's extension program has enabled the development of nationally owned systems into which various donors are expected to fit their support.

5. Recommendations and issues

This review does not identify an extension model that the Bank should use universally to enhance technology adoption in developing countries. Rather, it supports a position that conditions in each country should determine the scale and type of public sector extension services to be developed. This implies that the Bank should place much more emphasis on designing projects to fit the particular circumstances of the borrower (fiscal, institutional, and human resource) and of the farming systems in the rural communities to be serviced. The Bank, moreover, must assess the availability of appropriate, sustainable technology and the capacity for its continued generation.

There is no universal extension model; rather, country conditions determine the scale and type of service

Action required

Although project preparation is the formal responsibility of the borrower, the Bank, as the dominant international development institution and the leading lender in the field of agricultural extension, should give more attention to working with nationals in the upstream phase of projects. This would raise the costs of processing extension loans, but should have high development dividends in creating sustainable extension systems, and would provide a valuable training exercise for national personnel.

Annex 4 suggests a process for developing a relevant extension strategy and preparing an investment program. This involves a comprehensive analysis of:

- Production conditions in agroecological zones, the characteristics of major farming systems in each zone, and the access by farmers in each system to resources and services (public and private, including NGOs).[1]
- The stock of technology that is appropriate for more profitable and sustainable production in the farming systems and the capacity for technology generation.
- The macroeconomic, sectoral, and market factors that influence the use of farmers' resources and of technology to increase productivity.
- The commitments to improved extension, existing and anticipated fiscal resources for extension, and institutional human resources by governments.

The analysis would serve as the basis for developing an extension strategy and an initial investment program, provided that a suitable macroeconomic and sectoral environment and borrower and agency commitment to improvement exist. The strategy would be for the entire sector, so that agricultural development projects of any type would be accommodated within this strategy. This analysis would involve the following:

- Prioritizing target groups and areas for extension investment.

Box 5.1: Differences between OED and AFR staff on the interpretation of findings

A conclusion of this study is that the Bank has erred in the extent to which it has promoted the T&V extension management system in relatively uniform packages of investments and extension practices in large state and national programs. Although the Bank is now introducing increased flexibility into T&V projects, the study also concludes that nationwide application of the T&V system is unlikely to be the most appropriate approach for improving extension in many African countries. OED believes there is a high probability that such large, ambitious programs will not result in efficient and sustainable systems given the fiscal, human resource, production environment, and technology base characteristics common in these countries.

AFR staff agree that the location and rate of introduction of extension investments should be in accordance with local circumstances, however, OED and AFR staff differ on how this principle should be interpreted in practice. AFR staff maintain that some improved technology that can be extended is always available; that existing extension programs are often diverse, inefficient, or unreplicable, while the T&V system is manageable and effective; that T&V is flexible and can accommodate various extension techniques; and that T&V is not an overly expensive system. Therefore, the case for nationwide application of T&V as a comprehensive system in most African countries is strong, especially if it is introduced through a pilot phase.

The following paragraphs describe the reasons for the major differences between AFR and OED staff on the interpretation of this study's findings.

T&V as a nationwide strategy

AFR staff maintain that the T&V management system should be introduced nationwide to avoid the inefficient use of scarce resources on a large array of individual projects that introduce staff-intensive (and often expatriate-intensive) technology transfer systems that are unreplicable on a large scale, and to develop a clearly defined, single extension framework to focus available resources. In addition, the T&V management system is flexible, can incorporate such practices as complementary mass media methods and commodity-specific technical services, and is continually evolving.

OED staff concur that having a national extension strategy is desirable, and Annex 4 describes how such a strategy could be developed. The strategy would determine where and how public sector extension investment should be involved, and lead to a program of specific extension practices in accordance with assessed needs and available resources. The common T&V format of regular face-to-face services, numerous small technology demonstrations, and regular training is likely to be an important component of the extension program in specific instances. Programs would give equal consideration, however, to such approaches as (a) short-term campaigns that take advantage of all available sectoral staff to address particular problems; (b) commodity-specific extension programs aligned with delivery of an input package, preferably with cost recovery; (c) highly participatory schemes that involve fewer, but better educated extension workers and farming communities in an infrequent, but scheduled program of interaction for defining and resolving problems; or (d) reliance on well-organized mass media programs to complement existing

(Box 5.1 continued)

commercial services in appropriate circumstances, all in accordance with the situation analysis as outlined in Annex 4.

Although commodity-specific services have been allowed to persist alongside the T&V general service in some Bank projects (cotton in Côte d'Ivoire, tea in Kenya) and radio and written mass media have received some attention, in practice, T&V projects continue to focus on implementing and improving the regular visit and demonstration format characteristic of the system. Modifications have usually only been variations on the main format and have not given rise to substantial, widespread innovations. More recently, however, individual staff in AFR have been actively seeking variations to improve system efficiency, albeit within the constraints imposed by limited operational funding for the services, which can be partly linked to their large scale and staffing.

Technology availability

AFR staff maintain that some improved technology that can be promoted is always available, so delaying introduction of the T&V format in an area for want of technology is usually unnecessary.

OED staff agree that in most instances an analysis of existing farming systems will reveal some technology that can be profitably introduced using the resources available to farmers. However, this does not necessarily justify the establishment of a permanent extension force to promote its adoption unless the prospects for further improved, relevant technologies being made available are good. Temporary campaigns may be appropriate in cases of limited technology. Most of the research systems in AFR are weaker than in other regions, which exacerbates the normal development delays in producing relevant research for particular farming systems. Although borrowers are investing in improving their research systems (with Bank and donor assistance), enhancement of this capability will be a slow process.

Sustainability

AFR staff do not consider sustainability to be a serious issue, because T&V systems established in Asia have persisted for nearly 20 years and empirical studies indicate that extension is generally a sound economic investment.

OED staff agree that most national T&V extension systems have persisted, albeit in drastically modified forms in some cases. However, this persistence should be viewed as a commitment to some form of public sector extension. Governments appreciate that extension is warranted, and the national T&V system, despite its problems, is in place to give advice to all farmers.

Any public sector program that extends profitable, relevant, and improved production technology is likely to yield favorable economic returns. Reorganizing a large, unproductive public sector to make the same people more effective would invariably result in high marginal returns as the improved efficiency takes effect. Unless new relevant technology continues to be generated, however, the marginal return must decrease. Nor should it be assumed that a favorable economic rate of return will generate the required annual recurrent budget support. Fiscal constraints and political realities will often reduce the priority given to a service such as extension, regardless of its economic worth.

(continued on next page)

(Box 5.1 continued)

A system that finance managers perceive as lean and efficient and public beneficiaries appreciate as necessary and effective has the best chance of attracting the necessary funding to keep it efficient and responsive to demand.

The cost of extension investments

AFR staff maintain that extension investments are not excessively costly in relation to agricultural GDP, and do not represent a high cost per beneficiary household, so that service costs should not be considered a deterrent to nationwide programs. In any case, in many instances services use existing agricultural sector staff. Staff reductions have even occurred in Burkina Faso and are planned in Côte d'Ivoire.

OED staff agree that most extension budgets are not high in relation to agricultural GDP or, implicitly, to potential impact (although reliable data on full costs are extremely difficult to find). Annual costs have been estimated at less than $10 per beneficiary family for some services. However, what appears to be a low cost per beneficiary does not mean much if the same result could be achieved more cheaply or a better result could be achieved at the same cost, and the reality is that fiscal managers are normally under pressure to allocate recurrent costs only to the extent needed to satisfy minimum requirements. These are determined by a complex array of factors, many of them sociopolitical rather than economic, and the extension lobby is not usually strong. The size of the recurrent budget demand for staff-intensive services influences decisionmaking under these circumstances rather than particular economic ratios. Where inefficiencies in the extension system are obvious, the pressure to reduce recurrent costs is greater, hence the common occurrence of service funding being squeezed to little more than the salary budget. The objective should be to develop a service that is economic in a true sense, that is, it obtains a particular result in the most cost-effective way, and that is within an expenditure level that can be politically and fiscally supported in the future.

System hierarchy

AFR staff maintain that the T&V management system is not top-down, and that farmer feedback and the emphasis on a field orientation are integral parts of the system.

OED staff note that the objective of the T&V system is undoubtedly to take account of farmers' circumstances in providing advice, and in plenty of cases individual field and support staff have developed a responsive service. Experience has shown, however, that in large state or national programs this is the exception rather than the rule, even after 10 to 15 years of service development. A top-down system suits the public service bureaucracy, and there is normally no incentive to institute more responsive services. It is also difficult to develop the required analytical capacity and confidence in large numbers of field staff with a minimum agricultural education (and often an urban background) to analyze confidently farmers' problems and potentials with them and interact accordingly with higher levels in the technical support structure. In any public sector extension format, the top-down culture must be actively resisted. In T&V, the predetermined message concept tends to be conducive to this attitude, and extraordinary measures must be adopted to develop an effective farmer-centered culture.

(Box 5.1 continued)

The need for improved productivity

AFR staff consider that the need for increased production is so great, that introducing a nationwide program using the T&V system makes sense. They admit that the capability of the large number of existing field staff and the availability of skilled specialists to support them are limited, but rely on a gradual improvement in human resources as the system develops.

OED staff agree that the need for improved productivity is unquestionable. This study argues for an approach that does not seek perfection, but that does not overstretch the human resource and fiscal capacity so that serious inefficiencies become institutionalized (even if these are less than before the organizational changes took place). Once a hierarchical bureaucracy is established, experience indicates that it is slow to be dismantled, regardless of the level of efficiency. Salaries will be paid, but apparent inefficiency will tend to reduce the necessary operational support funding by finance managers.

Key points

One of the key elements for improving any service, regardless of the extension approach used, is the availability of skilled technical specialists who appreciate how the socioeconomic characteristics of farming systems influence the relevance of technology for each farming system. Extension programs give priority to training such a cadre, creating a conducive career structure for it, and developing the necessary linkages with the research system (which must also adopt a farming system, demand-driven perspective). This study suggests that the restricted number of such staff in the early years of an improvement strategy should be used where they will be most effective. This would include support for face-to-face services using the typical T&V format in areas where this is considered the most appropriate approach. But large numbers of skilled specialists would not be available, at least in the medium term, to service T&V field staff in a nationwide program so that the intended responsive service could be offered, as demonstrated by the long-established systems in Asia. One of the valuable areas in which skilled technicians can be used in interacting with farmers in farming system diagnostic work (preferably with researchers) to develop appropriate key improvement areas that can form the basis for focused campaigns that use all available sectoral staff, and for mass media programs and information systems designed to satisfy farmers' established needs.

The placement of the usually large number of existing sectoral service staff is a difficult issue. Depending on training and aptitude, these could be absorbed as village extension workers under T&V; be used in any commodity-specific program that may be part of the national strategy; be used temporarily in general extension campaigns, but be destined for use in other agricultural or related services; or even be retrenched if their aptitudes are low and this is politically feasible. The use of existing government sectoral human resources (and other nongovernment resources) would be part of the preparation for an extension strategy and program.

AFR staff do not disagree with the basic extension principles highlighted in this report, including the need to give priority to developing extension services that are fully responsive to the needs of farmers in the targeted farming systems, and the need for a close linkage with a research service that is itself organized to be similarly responsive.

- Developing an overall strategy[2] that takes into account the use of private and public sector services, the involvement of traditional mass media, and the applicability of modern information technologies; face-to-face communication systems; and fiscal capacity to maintain various levels of public extension services.

- Accepting that the availability of trained human resources and of relevant technology will affect the rate at which a program is developed, and that although a low education level among front-line staff may permit the delivery of general technical messages, it limits the capacity to provide comprehensive services that are responsive to farmers' needs.

Extension can result in favorable economic returns if it closes the technology gap efficiently and profitably

- Defining an initial program in the strategy that is consistent with resources and the technology base, captures any potential for cost recovery, and encourages farmer ownership of the service.

- Ensuring that a satisfactory technology generation and/or adaptation capability is in place to service the needs of all targeted farming systems, and that this process takes into account the long-run productivity of the agricultural resource base.

- Defining the scale, type, and intensity of face-to-face services for particular areas, for which many of the extension principles commonly used in the T&V model, with suitable modifications to increase responsiveness to farmers' needs, would usually be appropriate (Annex Table 4.1), but the mode of operation could vary significantly among individual programs.

- Preparing and initiating a needs-based staff training program in the technical, economic, sociological, and communication aspects of technology transfer.[3,4]

- Accepting that an extension program is not a permanent format, but must be responsive to changing circumstances, and ensuring that a properly trained extension planning unit is included and supported by a program monitoring capacity that will provide the basis for responsive management.

- Insisting that borrowers and implementing agencies are intimately involved in strategy and program design to ensure their ownership of both, and that they are fully aware of its recurrent cost implications.

The recommendations are based on the premise that an extension system must be relevant to a country's circumstances and the intended extension clientele and make efficient use of public sector resources if it is to be efficacious in meeting its objectives. Underlying this premise is an assumption that public sector extension investment can result in favorable economic returns provided (a) that the service adheres to elements of relevance and efficiency; (b) that a significant technology gap exists between current practices and available technology that is relevant to and sustainable in the targeted farming systems; and (c) that private sources cannot provide alternative, effective forms of technology transfer. Sufficient evidence in the literature supports this assumption (Birkhaeuser, Evenson, and Feder 1991; Evenson 1991; Feder, Lau, and Slade 1985). Adherence to these principles at the design stage of an extension strategy and any current program will not have the intended results, however, unless they are carried through into implementation. This assertion has implications for both borrowers and the Bank.

Implications for borrowers

For borrowers, adherence to these principles requires a recognition that the measure of an extension service's success (and justification for public resource allocation) lies not merely in having extension staff in the field with adequate infrastructure and equipment implementing an established program, but in the extent to which it is efficiently providing relevant technology to meet the needs of farmers in the targeted farming systems. Adherence during implementation to the design principles that focus on relevance will facilitate this achievement. However, borrowers must provide the resources for a capacity to monitor these factors effectively and provide the analysis required for responsive decision-making by service management (Annex 4). Client reaction should be a prominent part of the monitoring process.

Given the importance of recommending relevant technology and the contribution that close interaction with farmers can make to this goal, the findings in Chapter 4 suggest four priority elements for borrowers' extension operations:

- Continuing the process of identifying or verifying applicable technology and technology generation needs for major farming systems with farmer participation, and preferably including joint diagnostic surveys by researchers and extension staff.[5]

- Maintaining close linkages with research in joint field activities as well as in technical meetings, and also linkages with commercial and other nongovernment entities involved in technology development and transfer.

- Installing training programs for technical support staff that emphasize the practical and economic aspects of production and the decisionmaking processes of farmers facing constraints in their farming systems, that is, developing a responsive, practical, farming system perspective in the training of technical support staff.

- Training extension staff involved in face-to-face services in how to manage interaction with groups of farmers to ensure that the farmers are involved in defining problems and constraints, in analyzing the relevance of possible technological solutions, and in owning group test or demonstration plots, that is, ensuring greater participation within a programmed service that is farmer-centered rather than message-centered. This would not preclude the use of scheduled farm or group visits or the delivery of timely messages. Messages, however, would respond to the constraints and potentials periodically defined with each group, and the schedule would be in accordance with the group's needs and service resources (Annex Table 4.1). Many widely applicable technologies could be part of most of these responsive programs.

Implications for the Bank

For the Bank, project supervision would continue to require monitoring of implementation of investments, of agreed extension organization and methods, of compliance with covenants, and so on. However, the Bank would give much more emphasis to assessing the effectiveness of the extension process in meeting the same primary objective as identified for the borrower, in accelerating the rate of adoption of relevant technology in an efficient manner, and in responding to any changed circumstances. The latter could be brought about by an enhanced knowledge base or by other factors endogenous or exogenous to the extension system.[6]

While more recent projects (Bangladesh, Indonesia, Sri Lanka) have tended to increase the resources allocated to analysis at the preparation phase and to design a project accordingly, many ongoing projects did not have adequate preproject analysis and have encountered serious problems. The Bank's mid-term review process provides a convenient opportunity for making project adjustments. To be most effective, however, these reviews and any subsequent project revisions would have to consider not only problems in implementing the project as designed, but also design issues that were not adequately addressed previously. The review would necessarily include hands-on, random farmer visits and, preferably, organized rapid rural survey techniques to verify the qualitative aspects of the strategy and program.

The proper timing of extension depends on various factors—such as fiscal, human resource, and technology conditions

Issues to be faced

Even if the Bank fully accepts the foregoing recommendations as a legitimate approach to take in addressing its ongoing and future extension portfolio, it would have to confront a number of issues.

To begin with, fiscal, human resource, complementary service, and technology stock constraints often dictate that investments in statewide, staff-intensive services are inappropriate at a particular time. The Bank (and the borrowers it advises) should accept (a) that while public sector extension should be beneficial, it is often not the most limiting factor to productivity increases (Box 1.1); and (b) that staff-intensive services introduce a permanent overhead in recurrent costs that may be inconsistent with national fiscal restraint policies or capacity and force extension to compete (usually unsuccessfully) in the recurrent budget with programs that fiscal managers consider to be of higher priority. This would involve a departure from the current approach in some regions of installing (or continuing to support) relatively uniform national systems regardless of local circumstances.

The Bank must also face a limited capacity to undertake the preproject analysis and responsive design recommended. National in-house capacity will likely be extremely limited without outside support. Experienced agricultural consultancy firms and the FAO Investment Centre could do the required analysis and design, provided they are working within appropriate terms of reference and guidance.[7] The Bank, as an institution, should be able to provide satisfactory guidance (provided that it adopts appropriate regional policies), but this may not be the case in individual operating divisions. Few Bank staff have had significant experience in extension design and operations outside the Bank, and most Bank staff who work with extension projects have had little exposure to systems other than T&V because of the dominant role it has played in projects during the last 15 years. This suggests a need for education within the Bank on many of the issues highlighted in this report by external experts with wide experience in extension operations and design.

The same lack of extension expertise, as well as budgetary constraints, affect the Bank's supervision capacity. In AFR, the Bank has made considerable progress in increasing the supervision resources allocated to extension projects, which could increase the Bank's capacity to interact with borrowers in addressing problems and adjusting programs. Unless the Bank relaxes its almost exclusive focus on nationwide T&V systems in AFR, however, this potential may not be realized.

Finally, the Bank and borrowers should understand the impact of changing economic, trade, and sectoral conditions on the public extension services that can be

offered and will be demanded, even though a large proportion of farmers are still near subsistence levels in regions such as AFR. Not only must the national strategy to encourage technological improvements be responsive to changing circumstances, but any program to develop a cadre of extension staff must be aware that such staff need to be capable of meeting requirements for a more responsive and analytical service, whether in public or private sector service. This has particular implications for regions such as AFR, where agricultural education is often of a low standard, and even the ability of agricultural universities to produce well-trained graduates for technical extension support and adaptive research is seriously deficient in many countries. Conversely, the encouragement of a public sector establishment with large numbers of poorly qualified staff and limited ability to meet emerging demands for services, but which incurs substantial recurrent cost financing in a tight fiscal environment, must be questioned. The Bank's AFR staff do not completely accept some of the inferences in this and the previous paragraph, and Box 5.1 elaborates on these differences.

Notes

1. Farming system refers not only to on-farm activities, but to all household resources and the use of these resources, including off-farm and nonagricultural pursuits and factors influencing them.
2. Many countries have an overt objective of providing extension services to attain government production targets, which may be as general as increasing the use of production inputs or as specific as promoting particular commodities. Governments commonly have specific production objectives within a sectoral strategy. The findings of this review, however, support an approach in which the government promotes its production objectives by creating an appropriate economic and sectoral policy environment to elicit the desired response by farmers. Extension, by contrast, would aim to educate and assist farmers to make the best use of the resources available to them. This complementary approach of having the government create an incentive environment to promote any national production objectives and an extension service to help farmers to meet their own objectives is most appropriate if production, income, and poverty alleviation goals are to be met efficiently.
3. Expertise in sociological principles and the theory and practice of group dynamics is usually absent in extension systems and in their training programs. Technical assistance would normally be required to develop this capacity, and experienced NGOs are a possible source. Similarly, extension systems rarely appreciate the benefits of professional programming of radio and television. These activities will benefit not only from technical assistance, but also from contracting particular services to the private sector to maximize efficiency and impact. The common difficulty in retaining skilled media professionals in the public service also supports the use of contracted services to work with the public extension program.
4. In commenting on this report, staff of the Agriculture and Natural Resources Department indicated that the review has concentrated on extension in the narrow confines of technology transfer, rather than taking the broader view of extension in farmer education and organization, which would be beneficial even when relevant improved technology is scarce. The report has, indeed, concentrated on technology transfer, as this has been the character of Bank projects on which it was based. In emphasizing the need for relevant technology and responsive services, however, the report strongly supports greater client participation in problem definition and resolution (Annex Table 4.1). The report contends that with reasonably educated extension staff, intensive training, and appropriate leadership this capability can be developed, and the rate at which further investment is made in regular face-to-face services should be geared to a realistic expectation of trained staff availability.
5. Joint diagnostic surveys have commenced in some projects in a number of countries, for example, Brazil, Indonesia, Mexico, Thailand, Zimbabwe, and recently Ghana. In most cases, the leadership and initiative in these operations has been with the research system, which is possibly associated with a more analytical approach to problem solving by researchers with a higher level of education than most extension staff.

6. In most of the Bank's free-standing extension projects, a general objective of improving production and welfare in the smallholder farming subsector has been commonly translated into an immediate project objective of institution building. This, in turn, has meant that the Bank had dedicated much supervision to monitoring the implementation of the institutional investments in facilities, staffing, and agreed organizational arrangements without paying adequate attention to the program's efficiency in meeting its primary purpose of accelerating technology adoption. Particular emphasis on ensuring that the monitoring is being carried out efficiently, on using monitoring data to assist in analysis, and on interacting with a random selection of farmers in the different types of farming systems would be essential for effective supervision.

7. The FAO Investment Centre has developed a method for integrating socioeconomic considerations into the design of agricultural investment projects. The method has been applied in more than 50 projects, but only nine of these have been Bank projects. The International Fund for Agricultural Development has been the major client. (See FAO Investment Centre 1991, 1992a, b, 1993.)

PART 2: AGRICULTURAL RESEARCH: ACHIEVEMENTS AND PROBLEMS IN NATIONAL SYSTEMS

6. Introduction

Following a review of the performance of national agricultural research systems (NARSs) in developing countries in the 1970s and of the World Bank's support for them, in 1980 the Bank produced a policy paper on the agricultural research sector (World Bank 1981).[1] The policy paper stressed the importance of agricultural research in economic development, recommended that the Bank and the international community increase their support for NARSs, and provided guidelines for Bank intervention. In 1983 the Bank's Operations Evaluation Department undertook a review of both agricultural research and extension and largely supported the recommendations made in the policy paper. This report examines the performance of the Bank's agricultural research project portfolio since the earlier reviews and identifies issues that warrant attention in future interventions.

In the 1980s, the Bank expanded support for agricultural research

The Bank expanded its support for agricultural research in the 1980s. This report assesses the impact of the Bank's support on NARSs and the extent to which its 1980 policy guidelines were appropriate and were followed. As the Bank has not been the only provider of assistance, the report takes into account the participation of other donors and of external agencies when examining institutional development.

Projects receiving Bank assistance are divided into free-standing research projects and component research projects, in the same way that the extension portfolio was divided.

The review covers projects for which the bulk of implementation occurred during the 1980s and early 1990s (annex tables 5.1 and 5.2). Except for the Africa region, this includes all free-standing research projects approved from fiscal 1977 to fiscal 1992. In AFR, because of the large number of projects and countries involved, a sample of 12 countries was selected to represent a range of per capita incomes, agroclimatic zones, historical backgrounds, and degree of development of institutions and human resources. As Bank involvement in research projects in the Europe and Central Asia region was negligible during the review period except for Turkey, this Bank region has been combined with the Middle East and North Africa region for the analysis. The review also took account of contributions of projects in the education sector as appropriate.

This report uses the term agricultural research to encompass both production and processing aspects of field crop, tree crop, livestock, forestry, and fisheries research. However, this does not imply that the Bank always took this comprehensive view in determining its interventions to support research, even for free-standing research projects. As the report will show, the Bank's intent was that all or most research entities and domains would be influenced by research coordination and planning interventions. However, direct support for agricultural research institutions was much narrower and was commonly focused on field crop production research. The Bank rarely attempted to expand the research interests of the institutions assisted into additional commodity groups. Forestry and tree crop research benefited more from commodity-specific component projects, but particular assis-

tance for fisheries and for postharvest and processing research has been limited. Given the lack of data on and analysis of the justifications for allocations to different commodities and commodity groups, the report does not address this allocative aspect of the Bank's assistance to agricultural research in depth.

The Bank's databases provided information on its involvement in the agricultural sector and in agricultural research. Documentation of the Bank's experience with project interventions was reviewed by region within a uniform framework derived from the policy paper and from ex post evaluations of research projects. This gave rise to working papers on the research portfolio in each region. Although completed and evaluated projects formed the core of the review, incomplete projects in advanced stages of implementation were included to reflect the evolution of project design and more recent developments. Consultants well versed in research in each region produced the working papers using interviews with knowledgeable Bank staff to complement their reviews of written materials. Other donors were also contacted to gain a better understanding of the extent of their support for NARSs in each country.

The report does not treat research on environmental concerns as a distinct research area. The development of technology for sustainable agricultural production must encompass environmental concerns, whether the technology relates to a commodity, a discipline, a farming system, or a natural resource management framework. The appraisal documents associated with Bank-supported projects have generally stressed this aspect of sustainability.

The ultimate objective of Bank assistance has been to enhance the capacity of NARSs to provide relevant technology in a cost-effective manner and to achieve sustainable increases in agricultural productivity. Virtually all the assisted NARSs have developed or are developing technologies that should result in increased agricultural production. The benefits of Bank-supported research programs have rarely, however, been quantified. The absence of such analysis precludes a quantified economic approach to measuring the impact of past investments in the Bank's large research portfolio. This is a serious deficiency, not only on the part of client agencies, but also on the part of the Bank, which has not emphasized quantitative analyses sufficiently. The report examines this deficiency and elaborates on how it might be corrected. The lack of quantitative data obligated the use of more qualitative criteria for this review, especially to determine the extent to which projects have met institutional development objectives. This is based on the premise that if projects result in the development of sustainable institutions that use sound research management principles, then the intended technology and economic benefits will eventuate. The ex post evaluation reports on individual research projects on which much of this review is based also adopted this approach in assessing project outcomes, as did the review of the extension portfolio (see Part 1).

Prior to describing the Bank's support for research and analyzing the performance of the research project portfolio during the review period, the report provides a historical perspective of the Bank's investment in research and its justification on grounds of economic development and poverty alleviation. In doing so it introduces the issue of how to measure the impact of research.

Notes

1. In this report, NARSs encompass all public, semipublic, private, and academic agricultural research institutions in a country in conformity with the widely accepted definition of the International Service for National Agricultural Research.

7. Justification for agricultural research investment

The primary objectives of development work in the rural sector are economic growth, poverty alleviation, and improved management of the natural resource base. The agricultural research system is central to achieving these broad objectives because of its focus on boosting productivity, which is the primary engine of economic growth in the agricultural sector, and typically leads to corresponding growth in the wider rural sector. If a large number of all categories of farm operators obtain the productivity boosts that result from improved technology, then the investment in agricultural research has also achieved the poverty reduction objective in a direct manner. During the green revolution, even though the smallest-scale farmers showed little growth initially, multiplier and linkage effects rapidly reduced overall rural poverty (Hazell and Ramasamy 1991; Lipton with Longhurst 1989).

The agricultural research system is central to boosting productivity

The impact of agricultural research is not restricted to the rural sector. Consumers, especially poor urban consumers, who spend a large proportion of their earnings on buying food, benefit directly from cheaper, more reliably abundant or higher quality food. Indeed, as one of the reviewers of this paper has proposed, agricultural research, particularly research on those aspects of agriculture important to the poor, may be the most cost-effective approach to poverty alleviation. The authors of this review are comfortable with this proposition but, as evidence to support this proposition is not available, it must await an appropriate new study.

In recent decades, agricultural research initiatives, especially in the public sector, have been directed largely at the core objectives described above, and have typically been remarkably successful at achieving them.

Historical perspectives

The Bank became actively concerned about agricultural research during the 1960s as Bank staff increasingly became aware of the urgent production problems, as well as the major potential, of many food-insecure areas of the developing world. Country dialogue in Asia, especially in India, helped Bank staff to appreciate the urgent need for providing greater support to the fledgling research systems of many developing countries. Development assistance work by innovative organizations such as the Rockefeller and Ford foundations, especially in Mexico and India during the 1950s and the early 1960s, provided some of the framework for possible interventions, as did the efforts of such donors as the U.S. Agency for International Development (USAID) and its engagement of U.S. universities and Land Grant colleges that worked closely with research personnel and university staff in several developing countries, again most notably India.

The foundations' early activities also led toward the first steps in formalizing the international dimensions of agricultural research through the creation of such institutions as the International Center for Improvement of Maize and Wheat in Mexico, the International Rice Research Institute in the Philippines, the International Center for Tropical Agriculture in Colombia, and the International Institute of Tropical Agriculture in Nigeria, with the latter two set up somewhat later in response to the recognition that a broader focus on the two major cereal staples, rice and wheat, was going to be needed for many developing countries (Anderson, Herdt, and Scobie 1988).

These international initiatives continued through the 1960s, and the need for a sustained effort and expanded scope of such work led to the Bank taking a major lead in fostering the creation of the Consultative Group on International Agricultural Research (CGIAR) in 1971. Robert S. McNamara, president of the Bank, played a vital, personal role in bringing a diversity of donors, including many governments, to the table and in ensuring significant grant support from the Bank to help the initiative translate into a sustainable enterprise. The Bank has continued to play a critical role, including helping to resolve the CGIAR's funding crisis of the mid-1990s (World Bank 1996b).

The Bank realized early on that the goals of international research would be achieved only if national counterpart agencies were strong and effective

The Bank progressively developed its policy dialogue on agricultural research through the 1970s and 1980s, emphasizing that the benefit of investments in international research could only be fully realized if the national counterpart agencies with which the international system worked were strong and effective partners. This required significant investment in NARSs, which was forthcoming (partly as Bank loans and credits) and was growing at an average annual rate of 6 percent from the 1960s through to the 1980s (Anderson, Pardey, and Roseboom 1994).[1] The expansion of the number of scientific staff and of research programs was even more rapid than the growth in investment, and the number of full-time equivalent agricultural research personnel grew from some 20,000 to more than 80,000 from the early 1960s to the mid-1980s, an annual growth rate of 7.2 percent.

Some significant successes, most notably the achievements in plant breeding that led to the green revolution and the eventual coverage of more than 70 percent of the developing world's cereal area by modern varieties, led to strong growth in the research establishments of developing countries. Most of the modern varieties had strong and direct links to the CGIAR centers, but the part that strong national programs played was also both significant and critical. Many of these varietal-based new technologies spread quickly and widely because of the wide adaptation of the materials and the relative ease with which further selection could lead to ready production of varieties suited to local conditions (Anderson, Herdt, and Scobie 1988). The same research model has not, however, served as well for the crop and resource management research that will be critical to productivity growth in many parts of the world, especially in the rainfed agriculture such as dominates much of sub-Saharan Africa. Such work needs long-term strategic research to understand the processes involved, and much of this work can be done anywhere in the world, including in more developed countries. Nevertheless, site-specific research that yields information about the particular circumstances of farmers in many of the less favored parts of developing countries is vital. Herein lies much of the research challenge the world faces as researchers struggle to bring about the productivity changes that will be required to feed the global population adequately during coming decades (Crosson and Anderson 1992, 1994). In defining its policy guidelines for agricultural research, the Bank's 1980 policy paper successfully articulated many of the perceptions of interventions needed and of problems to be addressed.

Agricultural research as a contributor to economic growth and productivity

Economic growth in any sector depends on the interplay of many factors, and agriculture is no exception. The factors that contribute to the growth of an agricultural sector and its productivity include things as diverse as the provision of infrastructure, such as rural roads and irrigation schemes; of conventional inputs such as electricity, fuel, and agricultural chemicals; and of several services that contribute to the formation of human capital in the sector, such as general education of farm workers and more specialized education of farm managers and decisionmakers. However, the most crucial factor is the knowledge system that underpins agriculture.

The most important contributor to agricultural growth and productivity is the knowledge system that underpins agriculture

The knowledge system has many components, but one of the most crucial is the subsystem that generates new knowledge concerning, for example, new methods of production, new technologies that farmers can adopt, and new information that will make pertinent institutional structures more effective and improve the policy environment for agriculture. Information dissemination, which facilitates the transmission of new knowledge to producers, is another important component of the knowledge system.

With the exception of a small, but growing, number of research products subject to effective protection of the intellectual property involved, an individual or group of individuals cannot appropriate the knowledge resource. In addition, knowledge cannot be "consumed": its use by adopters does not diminish the extent of the resource available to others. These two features are central to the public good rationale for public investment in the knowledge resource.

The knowledge resource has many important interactions with other factors. Some of the resource is held in human capital elements, such as the skills of farm managers and their advisers; other elements are harnessed in institutions, such as the educational and research bodies that serve the sector; and yet others are incorporated in the policies that underlie its day-to-day functioning. Most of the resource, however, resides in a diffuse stock epitomized by libraries and gene banks, from which those involved in the knowledge industries systematically draw on, but most important, also add to in the course of their investigative work, namely, the process of research.

These realities have led most analysts of the knowledge resource to recognize that measuring the stock of the knowledge resource or the service flow from it is virtually impossible, and instead to use some appropriate surrogate. The most popular option has been to attempt to represent the stock of knowledge by an assessment of the stock of research investment, suitably depreciated. Needless to say, such a process must address many uncertainties, even assuming that research investments can be adequately measured, let alone their productivity-enhancing influences. Several studies have investigated the lag structure of research results. Sheer accomplishment of a research investigation takes time, and even if it succeeds, the investigators have many more (largely sequential) steps that they must take, such as transmitting their results to the formal knowledge base, perhaps through the pages of scholarly journals or through professional discourse, and then communicating the findings to the ultimate users, especially farmers, perhaps via a public extension service.

Measurement of research effects

The knowledge resource can be conveniently represented in terms of three subsidiary elements, namely, the research stock at any time, the flow of activities in

the public and private extension systems, and the flow to agriculture of analogous services from the agricultural education subsector. One general representation in the spirit of, say, Binswanger and others (1987), Griliches (1964), Mundlak (1996), and Pardey (1989) is to view agricultural output as a function of:

- Conventional inputs, such as land, labor, and capital.
- Research, extension, and education.
- Other factors, such as agroecological, infrastructure, and policy effects.

In this case, a general specification of output would, in principle, allow interaction between all the determinants of output, and also the incorporation of crucial time-dependent effects.

Data deficiencies may hinder the inclusion of all these variables in empirical studies. For instance, in Fan and Pardey's (forthcoming) work on the relationship between the variables for China, data on the education and extension factors were not available. However, with the statistically "explained" variation amounting to some 99.8 percent, either the direct contribution of these omitted factors was minor, or their effects were so highly correlated with those of the included variables (including time trends), that they were already effectively subsumed in the estimation. Fan and Pardey included regional differences, indicators of major policy reform, a simple lagged weighting of the past seven years' research expenditures to form a stock variable (with an output impact elasticity of 0.07), a specification that separated the effects of conventional inputs from those of all other inputs, and time dummy effects to condition the contributions across different policy epochs.

A growth accounting framework is helpful for ready overview. In the China case, agricultural output grew at an average annual rate of 4.7 percent during 1965–93, and Fan and Pardey attributed this to conventional inputs (46 percent), institutional changes (18 percent); and research (20 percent), leaving an unaccounted 16 percent, which may include the omitted extension and education effects, as well as other omitted variable and interaction effects. The components of the conventional inputs were labor 7.5 percent, land 0.1 percent, fertilizer 21.7 percent, power 12.9 percent, and irrigation 3.7 percent, though these varied considerably over the epochs. Thus in this case, research ranks with major policy reforms and dominant, modern, conventional inputs as a source of growth in recent agricultural development. The case of China is chosen as the first example because it is the world's most populous nation, and because it has the largest NARS. It is thus an appropriate case for reviewing the contribution of research to agricultural growth, to economic development generally, and to the achievement of food security specifically.

What studies such as Fan and Pardey's do not reveal is whether investments in research were as productive as they should or might have been. This issue is of special concern in the face of restrictions on fiscal support for public sector research, as is occurring in China. Fan and Pardey (forthcoming, p. 22) observe that "compared with the relatively small size of the investment, the payoff to research was extremely high," but this avoids the potential problem of bias associated with only measuring the effects of favorable programs, which sometimes occurs. At the same time, however, the aggregate research approach does not indicate the relative benefits of the components of the research program, the returns to some of which could have been poor. The finding of high aggregate returns is, of course, consistent with the contention that the high returns to agri-

cultural research are symptomatic of persistent underinvestment in this form of public undertaking.

Other matters of concern persist in connection with the effectiveness of research investment. The system that the investment created must be sustained to realize its long-run benefits of boosted productivity efficiently and to play its part in agriculture's contribution to long-term economic growth. The investment must also involve an appropriate mix of specialized research inputs (beyond merely the number of researchers and their direct staffing costs), including information and materials from abroad (see, for example, Tolley and others 1996, 133). As discussed in Chapter 9, many parts of the developing world have too seldom met these two sets of conditions, despite targeted Bank interventions. Even within a country there can be considerable differences in effectiveness in various subsectors of agriculture. Contrast, for instance, the high impacts and returns of research and development on commercial farming in Zimbabwe (Thirtle and others 1993) with the insignificant effects on smallholders (Jayne and others 1994), where weaknesses in infrastructure and institutions compromised the effectiveness of research.

Studies of knowledge or research production and productivity functions are not numerous, yet referring to them is natural for guidance on the achievable effects of research investments and for signals on the role and value of external support, such as that from the Bank. The transmissibility of such econometric findings is surely questionable, but alternative sources of quantitative information are scarce. Agricultural research contributes positively and significantly to the sector's performance, as evidenced by recent econometric studies of a range of different types of agriculture. The studies summarized in Table 7.1 focused on multiple-factor productivity measures that critically determine efficient growth of the agricultural sector. The process of research leading to enhanced productivity takes time, and the total factor productivity studies cited have modeled this process through a weighted summation of past investments into a research stock, with lags of up to 27 years. The statistically significant, positive, and strong elasticities measuring impact reported in the right-hand column provide a quantitative basis for evaluating investments in research.

Recent econometric studies find that agricultural research contributes positively and significantly to agricultural performance

Agricultural research is a crucial input that can drive agricultural growth sustainably (more effectively in open or reformed agriculture). Notwithstanding the small coefficient for sub-Saharan Africa, where productivity change is still largely driven by population density and weather, agricultural research is thus a strong candidate for development assistance, providing that the returns to such investment are sufficiently rewarding. While econometric estimation of the effect of research on productivity provides a statistical basis for evaluation, calculating returns is a further consideration. This involves manipulating the return effects partially represented by, say, the gross productivity impact elasticities, along with another potentially demanding set of variables that must be estimated, namely, the costs, plus output values over the life of the research and the research lags involved. Not all the studies cited in Table 7.1 took this further step. Accordingly, let us now consider those econometrically based and other studies that have led to estimates of rates of return.

Returns to research

The literature on measuring economic and social returns to investment in agricultural research is large, features diverse methods of analysis, is probably affected by systematic upward biases, but generally reports high rates of return.

TABLE 7.1: OVERVIEW OF RECENTLY ESTIMATED IMPACT COEFFICIENTS: ELASTICITIES OF AGRICULTURAL RESEARCH AND PRODUCTIVITY

Setting	*Reference*	*Performance measure*	*Research variable*	*Estimated elasticity*[a]
Global (67 countries) 1961–90	Craig, Pardey, and Roseboom (1996)	Labor productivity	Total expenditure (cross-sectional)	0.10
United States 1950–82	Evenson (1996)	TFP[b]	Public Private	0.06 0.26
United Kingdom 1967–87	Thirtle and Bottomley (1989)	TFP	Public	0.52
European Community (10 countries) 1973–89	Thirtle and others (1995)	TFP country average	Total agricultural R&D	0.26
India 1956–87	Evenson and Rosegrant (1995)	TFP (crop sector)	Public	0.05 to 0.07
Sub-Saharan Africa (22 countries) 1971–86	Thirtle, Hadley, and Townsend (1995)	TFP	Public (cross-sectional)	0.02

a. An elasticity of, say, 0.1 is to be interpreted as follows: a 10 percent increase in the research stock variable would yield a sustained 1 percent increase in the corresponding productivity measure.
b. Total factor productivity, usually in practice a multifactor productivity index expressing total measured output relative to an index of all the measured inputs.
Source: Author's research.

Many of the studies follow the tradition Griliches (1958) established in his pioneering studies of the returns to hybrid maize research in the United States and involve a variety of assumptions about shifts in the supply schedule for particular commodities or aggregates of different kinds, including sectoral output. Alston, Norton, and Pardey (1995, chapters 3 and 4) review these methods, and conclude that despite several problems of method and bias, the finding of consistently high returns is probably robust.

The country most studied is the United States. Recently, Alston and Pardey (1996) and Evenson (1996) summarized most of the couple of dozen studies, many of them studies of aggregate research investment. Evenson includes his own latest estimates of marginal internal rates of return (IRRs) for public research (43 percent), private research (83 percent), extension (82 percent), and schooling (37 percent). The bulk of the studies of IRR for research in the United States feature returns of about 30 to 40 percent. In a similar compilation for studies of other Organization for Economic Cooperation and Development (OECD) countries (Alston and Pardey 1996), the returns are somewhat higher, on average about 50 percent, but are slightly more variable across studies, with a coefficient of variation of 0.45.

The Alston and Pardey (1996, 219) generalization for the United States may also hold well for the developing world: "The undiscounted sum of estimated research benefits is typically on the order of twenty times the research costs [but

even with] the long lag time before realizing benefits . . . unbiased estimates of rates of return would still indicate a high rate of return to public-sector agricultural R&D." A careful analysis of the findings for the developing countries has yet to be made. In his wide-ranging compilation of studies up to 1990, Echeverría (1990) assembled findings for more than 100 studies, some 42 of which pertained to developing countries. Brazil is the most studied country in this regard, with typically an IRR of about 40 percent on aggregate investment. The average IRR for the 10 aggregate investments in the sample of 42 is about 43 percent, with a coefficient of variation of 0.6 across studies. A tentative generalization is thus that investment in agricultural research in developing countries is somewhat less profitable, on average, than in OECD countries, and is somewhat more variable in profitability, but generates rates of return amply high and sufficiently above the opportunity cost of capital in most countries to justify strong and more intensified investment.

The expectation that returns to research are high has clearly been behind much of the Bank's enthusiasm for supporting public investment activity (World Bank 1981). Indeed, it is why the Bank's management has not required ex ante assessment of rates of return in Bank-assisted agricultural research projects: returns to incremental investment would likely be high, and estimates of benefits would be highly subjective, especially as most projects have been of a diverse institution-building nature. The probability of high returns has likely also been the main reason that building up a capability for economic impact assessment in NARSs has not received the priority it deserves, which has, in turn, made ex post economic analysis of projects by the Bank difficult because of the lack of necessary data. Subsequent sections of this report argue strongly that the Bank should adopt a more aggressive approach both in promoting and in using the techniques that are now available for practical ex ante and ex post evaluation of agricultural research.

The Bank has not required ex ante evaluation of rates of return in agricultural research projects because it expects high returns

Private investment in agricultural research

The role of private sector research, which this report presumes is part of NARSs' activities, has been mentioned. For the private sector to be interested and engaged in the development of research products, it is necessary for a firm to be able to appropriate their benefits and to exclude other suppliers from doing so. When exclusion mechanisms are in place and profitable opportunities are available, private sector research is assuming growing and significant proportions of NARSs' efforts in many parts of the developing world (Pray and Echeverría 1991). Examples range from cases where exclusion is based on secrecy or physical protection, such as with inbred lines in the case of hybrid crops and with agricultural chemicals, to those where intellectual property protection can be enforced, such as making licensing arrangements for the manufacture of agricultural machines and patenting biotechnology innovations. Most products of agricultural research continue, however, not to be strong candidates for pursuit by private firms. For this reason, the public sector continues to predominate in agricultural research, especially in the developing world.

The predominance of the public sector, in turn, provides an important part of the rationale for World Bank support of the public elements of NARSs, although the Bank must, through its policy dialogue, continue to foster an enabling environment for the development of the private elements of NARSs as and where appropriate. Such is the stance most Bank agricultural research projects take, with more recent ones giving greater prominence to the private sector through discussion of such topics as the disengagement of public support for research on

export commodities, for which producers can be organized to finance their own research needs (for example, in the proposed Second Agricultural Research Project in Kenya appraised in late 1995). The examination of research funding in each region provided in Annex 6 generally describes the scope of private sector research in each country included in the review. As the projects reviewed took little direct initiative to promote investment in private sector research, the issue is not treated in depth. The report does, however, emphasize the need for greater recognition of the private sector's role in future interventions, and it will no doubt assume greater significance in any subsequent study of contemporary and future Bank-assisted agricultural research projects. A recent Bank study (Umali 1992) reviews the analytical issues involved in private versus public research, supported by illustrative case material from several borrowing countries. The Umali study considers the balance of public versus private research and provides details that go well beyond the scope of the present study.

The private sector will no doubt assume greater significance in future Bank-assisted agricultural research projects

Indeed, the economic, social, and institutional issues involved in analyzing the appropriate roles of various players in agricultural research go far beyond any mere consideration of public-private balance and producer-consumer partition of potential benefits and costs. In addition, in the context of agricultural research policy and funding, farmers are an important category of the "private sector" in all their diverse situations of resource custody and tenure, including those where common property (grazing land, water resources, forests, and fisheries) is managed and community action is important. Nongovernmental organizations are often active in such situations and in related research activities. Thus insights and methods from the new institutional economics (see Klitgaard 1995 and Picciotto 1995 for discussion relevant to Bank projects) will increasingly be required to develop frameworks adequate for institutional analysis of agricultural research. This will be particularly important for research on natural resource management (de Janvry and others 1996; Tinker and Anderson 1996), as is increasingly being emphasized by contemporary Bank-assisted projects.

Note

1. Despite this improved awareness of the importance of national agricultural research and the increased support provided by the Bank, which Chapter 8 discusses further, this does not imply that the Bank has given sufficient attention to the role of research in its dialogue with borrowers in the context of economic development.

8. Bank lending to the research subsector

Bank funding

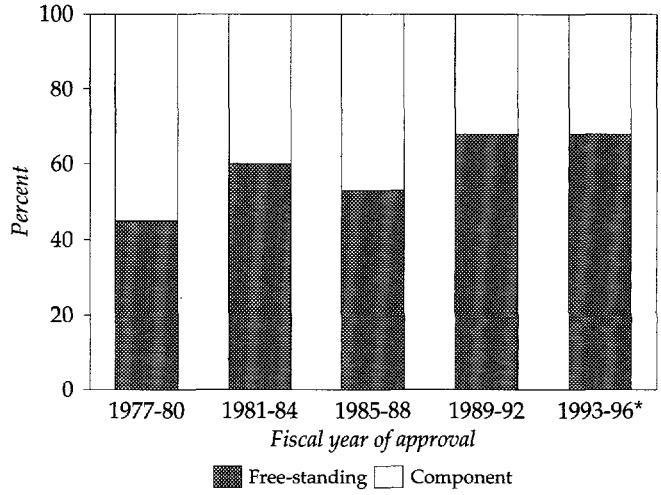
Bank lending for the agricultural sector as a whole increased in the 1980s, but then lost some of these gains in the early 1990s (see Figure 1.1). However, as a proportion of Bank lending commitments, the agricultural sector has progressively declined from 31 percent to 14 percent (Figure 1.2). Commitments to agricultural research and extension have been increasing since the mid-1960s, and as a proportion of sectoral lending, rose from 7.5 percent to 12.0 percent in the quadrenniums commencing in fiscal 1977 and ending in fiscal 1992. Estimates indicate that commitments to these subsectors will have increased further in the quadrennium ending in fiscal 1996 (Figure 1.3).

This support has been in the form of free-standing projects and research and extension components in agricultural and rural development projects. The Bank has also provided some assistance through structural adjustment lending for research policy and reforms of research institutions. As a proportion of commitments to research and extension, the amount allocated to research increased substantially in the early 1980s from 26 percent to nearly 50 percent, but then declined somewhat before again increasing to about one-half of this combined portfolio (Figure 1.3). An analysis of the incidence and sequence of research and extension investments supported by the Bank in individual countries did not reveal that these subsectors were competing for Bank funds. Lending was simply responding to the 1980 policy paper's recommendation to expand the funding of research. The assistance provided through free-standing and component projects in the review period appeared to reflect a willingness to support both subsectors, with intervention opportunities being realized as they arose.

Total nominal loan commitments to research during the review period were about $2.2 billion (Annex Table 5.3). In the final quadrennium of the review period (fiscal 1989–1992), the annual commitment to research was equivalent to $200 million. Within the total commitment to research, 61 percent was in the form of free-standing projects, and this proportion has shown an upward trend (Figure 8.1). This reflects the Bank's increasing emphasis on helping countries develop the overall institutional capacity of their NARSs, as opposed to helping them develop technology for specific areas or commodities, which is more common in component projects. Among the regions, AFR is now the dominant region in place of the South Asia region and the Latin America and the Caribbean region, which received more commitments in the initial years of the period under review (Figure 8.2).

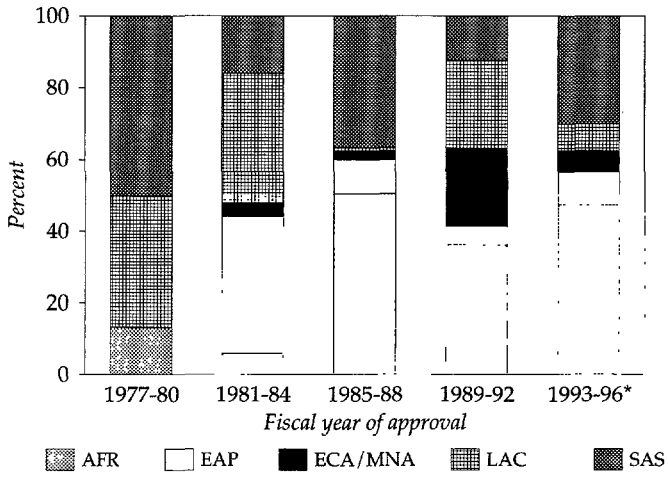
Although an increasing proportion of the Bank's agricultural sector lending has been going toward research, agricultural sector lending has declined as a proportion of total Bank lending. This has occurred even though in most borrowing countries, development of the rural economy should be a key element of attempts to alleviate poverty. The role of broadly based productivity growth in

FIGURE 8.1: FREE-STANDING RESEARCH LENDING RELATIVE TO TOTAL RESEARCH LENDING, FISCAL 1977–96



*Estimates.
Source: Annex Table 5.3.

FIGURE 8.2: DISTRIBUTION OF COMMITMENTS TO FREE-STANDING RESEARCH BY REGION, FISCAL 1977–96



*Estimates.
Source: Annex Table 5.3.

alleviating rural poverty and helping to lower food prices and enhance food security for the urban poor is critical.

Another measure of the Bank's contribution to improving NARSs is the extent to which borrowers rely on the Bank for external support. Much of the external

support from donors is in technical assistance and in-kind contributions, which are difficult to document, to account for, and to value relative to Bank commitments. The accounting methods donors and recipients adopt quite understandably often differ. Putting aside the intrinsic difficulties involved in analyzing such data, the Bank's share of total external assistance for public expenditure on agricultural research in developing countries, as reported by recipients, amounts to about one-half. If the figures used are more generous in terms of other donors' contributions, then the Bank's share comes to a significant one-quarter of total assistance (Pardey, Roseboom, and Anderson 1991c, 303).

During the review period, the Bank continued and substantially expanded its support for international research

The Bank provided some support for agricultural research through its education sector portfolio during the review period, but this was limited to 17 projects.[1] A few projects have included the objective of improving agricultural research programs in assisted faculties or in related institutes (for example, in China, Peru, and the Philippines). However, most support for agricultural research provided through the education portfolio has been more indirect, and has focused on strengthening the teaching function in agricultural higher education by upgrading faculties, improving curricula, and reinforcing basic and applied science facilities. This support has usually been linked to meeting projected human resource needs, especially at the undergraduate level. With one exception (China Agricultural Education II), the agricultural higher education component of these projects represented only a small slice of project resources, with an allocation of one-third of project costs being the highest slice. The East Asia and Pacific region led in the number of projects supported in this category, followed by AFR.

The Bank continued and substantially expanded its support for international research through the CGIAR during the review period. Contributions (in current values) to the CGIAR agreed research agenda from all sources were $248 million in 1992, compared with $84 million in 1978. The Bank contributed 13.6 percent of total CGIAR resources from 1978 to 1992, and its annual contribution increased from 10 to 15 percent of annual totals during this period (Annex Table 5.4). Even though donors had expanded the consultative group (CG) system to some 16 institutions, their contributions declined in 1993, and the research program had to be curtailed to remain within its funding limits. The donors agreed to a stabilization program for 1994 and 1995. The Bank's offer to provide up to $20 million in additional funds to match (at a 50 percent rate) incremental donations was a cornerstone of this program and the response was positive. The Bank also continued to provide secretariat facilities for the CGIAR.

Policy framework

The Bank has carried out its lending for research within the framework of the 1980 policy paper on agricultural research. Although not all the components of this policy statement have been validated, it does provide a benchmark for performance in the years following its issue.

The essential elements of the policy paper can be summarized as follows:[2]

1. Scale of investment

    a. Agricultural research has the potential to contribute significantly to economic development. There was a need to continue to improve both unit yields and production efficiency in agriculture. Investment in agricultural research was low and prejudiced the prospects for rapid technological improvement. National governments and the donor community should

substantially increase their support so that average public research expenditure as a proportion of agricultural gross domestic product should rise from less than 0.5 to 2.0 percent in developing countries as a group.

b. The Bank should play a leadership role in mobilizing potential donors to support an agreed research strategy in a country. It should increase its own lending for research and extension so that donors' share of agricultural sector lending rises from 9 to 12 percent by the mid-1980s, and the share of research within this should increase from less than 30 to about 50 percent. The Bank should stress collaboration with potential donors, the Food and Agriculture Organization of the United Nations (FAO), and the CGIAR centers.

c. The Bank should not adopt a uniform package approach to institutional support of the research system. The scope of activities must be related to the existing and prospective institutional, human resource, and fiscal capacity of each country. In poorer developing countries, the Bank should consider funding research operating costs in the early years of NARS development.

d. The Bank should commit to continue support for long-term development as long as the borrower and its institutions are substantially complying with an agreed strategy. Support should be phased. A first phase could emphasize technical assistance to help countries plan for national research, prepare programs and investments, and recruit and train staff. A second phase could introduce major physical investments defined in the earlier phase. A third phase could consolidate gains or expand or refine the NARS.

e. In agricultural development projects in which research is a lesser component, the research must be clearly elaborated, must be appropriately linked with the national research and extension systems, and must be realistic in its expectations and in resource allocations in relation to sectoral standards.

Bank policy advises each country to have a realistic, long-term agricultural research strategy to guide investment and institutional change...

f. Each country should have a realistic, long-term agricultural research strategy to guide investment and institutional change that is consistent with national development objectives and with anticipated access to resources. The Bank should promote preparation of such a strategy. It should also enhance the prospects for strategy effectiveness by addressing economic and sectoral policy issues in its dialogue with borrowers, to the extent that the issues affect agricultural production and the use of improved technologies.

2. Management and planning in NARSs

a. The Bank should work closely with the International Service for National Agricultural Research (ISNAR) in enhancing NARSs' capacity for planning, organizing, and managing research programs. The Bank should support internal and external reviews of research programs that should cover both the scientific and administrative aspects of the programs.

b. The fundamental concern of research investment should be to increase the productivity of land and labor. It should not be considered a major means of income distribution. However, Bank staff should consider the distribution of productivity gains in defining the Bank's focus on specific areas of research program assistance. This should include commodities important to low-income farmers and consumers and not only cash and export crops, which would usually receive attention from national planners. This also often implies attention to relatively resource-poor areas, which will require emphasizing farming system research to understand their biological and socioeconomic constraints and technological potential.

c. In general, Bank support should be directed at improving institutional capacity for applied and adaptive research that responds to farmers' pro-

duction problems. The Bank should selectively support more basic research with the potential to improve food supplies in the longer term in stronger NARSs and through international centers.

d. Effective linkages with extension services and with farmers are necessary to ensure the relevance of research. The Bank should organize linkages with international research centers to promote the efficient use of research resources and to accelerate the adaptation and dissemination of new technologies.
e. More researchers will be needed to staff the expanding systems, including a substantial number of researchers with postgraduate degrees. The Bank should support training, but it would be linked to skill needs identified in research plans. Systems should avoid hiring an excessive proportion of postgraduate staff, as staff who are extremely specialized may be less interested in addressing applied and adaptive research problems. Training should cover research management as well as the social and biological sciences. In the near term, many NARSs are likely to require some support from expatriate researchers, but the use of nationals should be emphasized.
f. Adequate incentives are essential if researchers are to achieve favorable returns to research investment, including appropriate facilities, operational funding support, recognition of performance, promotion according to performance, and competitive remuneration in comparison with alternative employment opportunities. NARSs should also incorporate incentives for posting in less favorable working and living environments.
g. The Bank should encourage the establishment of monitoring and evaluation systems that focus on the impact of research on production and factors that influence the adoption of technologies.

...and notes that adequate incentives for researchers are essential to achieve good returns on research investment

3. Other Bank support

a. The Bank's Economic Development Institute should expand its course material pertaining to the organization and development potential of agricultural research for use in its agriculture-related training of mid-level and senior officials from developing countries.
b. The need for Bank financial support of the CGIAR will likely increase in the 1980s as the system expands its coverage, and the Bank should be prepared to provide up to 10 percent of its total requirements. The importance of the international research function and the advantages of linking CG research with national research systems justify this support. The Bank should also concern itself with improved scientific and financial management of the CGIAR system.
c. NARSs will require more support from the Bank and other donors and agencies in preparing and implementing programs. An expansion of Bank staff with the required skills may be necessary.

Assistance strategies

Annex 6 elaborates on the strategy the Bank adopted to help NARSs in each region and on the Bank's relationship with other financiers and donors that were also supporting the subsector. The following paragraphs summarize the history of interventions during the review period.

NARSs in South Asia have benefited from a longer period of Bank support than those in most other regions. This is reflected in the fact that during the review period all the recipient countries in SAS other than Nepal participated in a series of research projects. Elsewhere, Brazil, China, Colombia, Indonesia, and the

Yemens also had repeater projects. In AFR, only four of the 18 countries with free-standing projects undertook a second Bank research project. However, this is more a function of serious Bank intervention in NARS support in AFR starting later than elsewhere (Figure 8.2) than of the absence of a policy of long-term commitment to NARS improvement. In all regions, the Bank has adopted the latter policy to the extent that continued assistance is warranted and the borrowing country is interested in Bank support. Indeed, of the countries that the Bank has assisted with NARS development, nearly all currently have an ongoing research project or a project in preparation except Malaysia, Papua New Guinea, and Thailand in EAP; Peru in LAC; and Sudan in AFR. Malaysia has not requested more support for its general agricultural research institutes, but the Bank has continued to provide significant support for tree crop and forestry research. The Asian Development Bank is taking the lead in a follow-on research project in Papua New Guinea. Thailand has a well-established crop research system and has not sought further support for its NARS. Peru has not expressed interest in another Bank research project following the relatively unsatisfactory outcome of the previous Bank project. Finally, the deterioration in the Bank's relationship with Sudan has precluded further support for research in that country. Overall the Bank has honored its policy to provide long-term support for NARS development.

Most free-standing research projects focused on the institutional development of key agencies in the research systems

The primary focus of the Bank's support for research in most free-standing projects has been institutional development of key agencies in the NARSs. However, half of the free-standing research projects have also supported extension.[3] Bank research interventions in Brazil, Indonesia, Thailand, and AFR countries focused on research only, and in the latter half of the review period, many countries that had previously had dual purpose projects also undertook projects solely devoted to research. In those countries that initiated exclusive research projects, the Bank provided separate support for extension through similarly dedicated projects, often in area development projects.

Research component projects were often forerunners to free-standing research projects, and have mainly been referred to as area development or commodity improvement projects. Area development projects often were not designed to improve NARS management or organization, but to develop technology for farming systems in the specific area. Many of the commodity projects, however, had a definite institution-building character. This type of intervention has benefited forestry and tree crop research in particular. The Bank has provided separate support for tree crops because of the frequency of their production in estate systems, and because of their status as export commodities that tend to receive preferential treatment in autonomous research institutes, often with substantial funding from producers and processors. Consequently, the institutional development requirements for tree crops can differ from those for field crops and livestock. Similarly, forestry research often pertains to a ministry other than that responsible for the crop and livestock subsectors and has distinctive characteristics.

Although many of the research and extension and component projects emphasized adaptive research, the projects with a broader institutional development focus have supported not only adaptive, but also applied, and often strategic, research.[4] Considering the scarce resources available to most developing country NARSs and the potential to access basic and strategic technology developed by more advanced NARSs and by the CG centers, this strategy appears to have been appropriate and is in accord with the policy paper's recommendation. However, the Bank has also legitimately supported more upstream basic research in institutions with demonstrated scientific maturity and capability, such as those in Brazil.

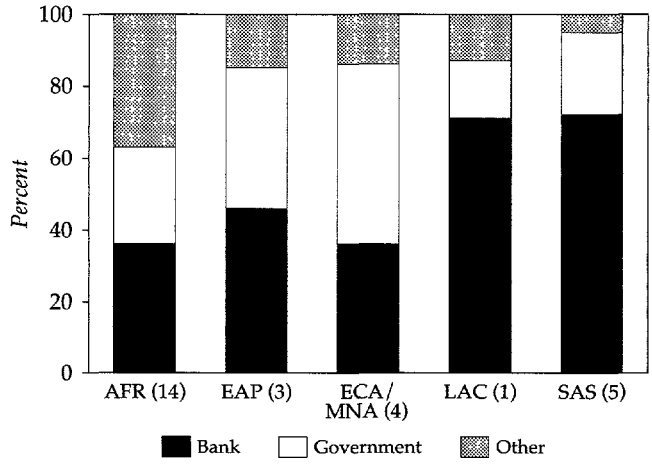
The Bank's promotion of agricultural higher education was not properly coordinated with the development of research capacity

The Bank has not properly coordinated its interventions in agricultural higher education projects with projects to develop the research capacity of NARSs. Although a few projects have attempted to address research capability within assisted agricultural faculties, most have focused on strengthening the teaching faculty and improving the scientific course curricula. However, even in the latter circumstances, the projects have largely overlooked linkages with other components of the NARSs and with the national research strategy. In addition, the agricultural research policy paper paid relatively little attention to the role of universities. The usual arrangement whereby ministries of agriculture are responsible for public agricultural research institutes and ministries of education are responsible for universities may have hindered cooperation between these two arms of NARSs. A similar separation of the Bank's operational divisions appears to have contributed to a comparable deficiency on its part.

Other collaborators

In addition to the Bank, other multilateral and many bilateral donors have contributed substantially to NARS development. In general, bilateral donor assistance has complemented the Bank's interventions, but in some cases donors have supported enclave projects that are inconsistent with the research agency's strategies and that often operate under unsustainable conditions (for example, in Ghana and Malawi). USAID has been the most active single donor, but Australia and Japan have participated more in EAP. The Asian Development Bank has been especially active in EAP (except for Thailand), and the Inter-American Development Bank has supported research in more countries in LAC than the Bank. The United Nations Development Programme and the FAO have been active in many countries, especially in training (see Annex 6), and essentially carried the research development load in the two Yemens prior to Bank intervention in 1984.

FIGURE 8.3: PERCENTAGE OF PROJECT COSTS FUNDED BY COFINANCIERS BY REGION, 1977–92



Note: Figures in parentheses represent the number of projects cofinanced.
Source: Annex Table 8.1.

TABLE 8.1: RESEARCH PROJECTS WITH COFINANCIERS

Loan/ credit no.	*Country*	*Description*	*Donors and amounts ($ millions nominal)*								
			IDA	*IBRD*	*Government*	*USAID*	*IFAD*	*UNDP*	*AfDB*	*Other bilateral*	*Other*
AFR											
L2766	Cameroon	Agricultural research	na	17.8	23.0	na	na	na	na	1.6 (ODA)	0.8
C2247	Ghana	Agricultural research	22.0	na	5.7	na	na	na	na	1.8 (ODA)	na
C1955	Guinea	Research and extension	18.4	na	2.9	na	1.9	na	na	6.1 (EDF)	1.6
C1849	Kenya	Agricultural research	19.6	na	13.7	21.0	na	2.2	na	7.5 (NL); 7.5 (ODA); 14.0 (EDF)	5.6
C2042	Madagascar	Agricultural research	24.0	na	36.2	na	2.6	na	na	na	7.8
C1549	Malawi	Agricultural research	23.8	na	16.9	9.2	na	na	na	na	na
C2122	Niger	Agricultural research	19.9	na	3.5	2.0	na	na	na	na	2.6
C1176	Senegal	Agricultural research	19.5	na	32.9	16.3	na	na	na	35.3 (France)	2.1
C0834	Sudan	Agricultural research	15.0	na	3.6	20.0	na	na	na	na	4.5
C1639	Sudan	Extension and research	22.0	na	15.2	na	na	na	na	na	0.8
C1970	Tanzania	National agricultural and livestock research	8.3	na	1.6	na	na	na	8.2	2.7 (France)	4.5
C2292	Zaire	Agricultural research	16.7	na	19.5	19.2	na	9.8	na	na	na
C1746	Zambia	Agricultural research and extension	13.0	na	6.0	na	na	na	12.6	7.2 (NORAD)	na
L2335	Zimbabwe	Extension and research	na	13.1	10.0	na	18.0	na	na	na	na
EAP											
L3031	Indonesia	Agricultural research management	na	35.3	11.7	na	na	na	na	na	3.4
L1922	Thailand	Agricultural research	na	30.0	44.5	na	15.0	na	na	na	2.0
C1407	Vanuatu	Agricultural extension and training	2.0	na	0.8	na	na	na	na	na	1.1
ECA/MNA											
L3036	Morocco	Agricultural extension and research	na	28.0	17.2	na	na	na	na	15.2 (France, Germany)	na
L2405	Turkey	Agricultural extension and applied research	na	72.2	123.7	na	10.0	na	na	na	na
C1259	Yemen Arab Republic	Agricultural research and development	6.0	na	11.7	na	5.8	na	na	8.9 (Italy)	na
C2299	Yemen, Republic of	National agriculture sector management support	14.4	na	4.6	na	na	na	na	3.0 (NL)	na
LAC											
C2216	Bolivia	Technology development	21.0	na	5.3	na	na	na	na	na	3.5

SAS											
C1215	Bangladesh	Agricultural extension and research II	27.0	na	10.9	na	na	3.0	na	na	na
C1455	Bangladesh	Agricultural research II	24.5	na	5.6	na	na	2.1	na	na	na
C1100	Nepal	Extension and research	17.5	na	2.7	na	na	0.7	na	na	na
C0922	Pakistan	Extension and adaptive research (Sind Province)	9.0	na	4.6	na	na	0.7	na	na	na
C1776	Sri Lanka	Agricultural research	18.6	na	7.1	na	na	na	na	na	0.8
Total			362.2	196.4	441.1	89.7	53.3	18.5	20.8	110.8	41.1

na = not applicable.
AfDB = African Development Bank.
EDF = European Development Fund.
IBRD = International Bank for Reconstruction and Development.
IDA=International Development Association.
IFAD = International Fund for Agricultural Development.
NL = Netherlands Development Agency.
NORAD = Norwegian Agency for Development.
ODA = Overseas Development Administration (U.K.).
UNDP = United Nations Development Program.
Note: In the case of Kenya and Zimbabwe, the Bank participated in a time slice of the national research program. The project costs and contributions have been reduced to approximate the estimated incremental values associated with the projects.
Source: Staff appraisal reports; cofinancing database.

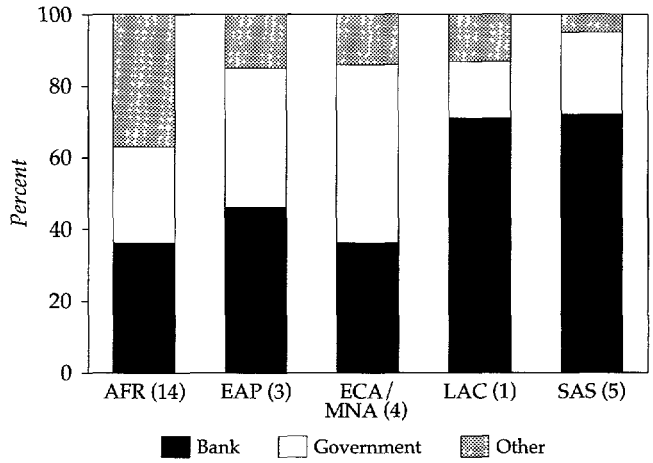
Cofinancing has taken place in 27 research projects, but has not contributed a substantial portion of funding except in AFR (Figure 8.3 and Table 8.1), where six bilateral organizations (especially the African Development Bank, the International Fund for Agricultural Development, and USAID) have been involved. Cooperation is heavily skewed toward International Development Association (IDA) credits rather than Bank loans, but this is no doubt associated with the dominance of cofinancing for AFR projects, which are mostly financed by IDA (figures 8.4 and 8.5). USAID is the dominant external cofinancier in Bank projects, followed by the International Fund for Agricultural Development and the European Development Fund. The African Development Bank is also a major cofinancier in AFR. Former colonial powers—especially the United Kingdom and France—tend to participate with the Bank in projects in their former colonies.

The Bank was a prime mover in the creation of the Special Program for African Agricultural Research

Although cofinancing has been limited and multilateral and bilateral organizations have generally preferred to finance their own projects, this does not mean that the Bank has not had any influence on participation by other donors. In many cases, cooperation between the Bank and bilaterals, especially USAID, has been used to enhance benefits through complementary activities. In addition, the emphasis the Bank (and others) have given to the development of research strategies by NARSs has provided a framework for intervention by other donors. In AFR, the Bank was a prime mover in the creation of the Special Program for African Agricultural Research (SPAAR), which had the dual objective of strengthening NARSs and increasing the effectiveness of donor support.

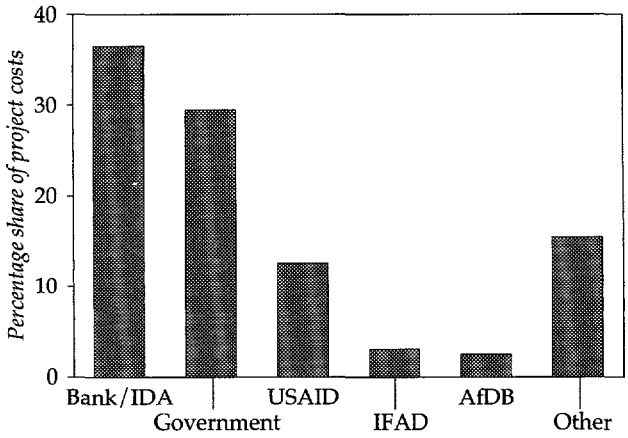
The many references to the activities of CG centers in Annex 6 and Chapter 9 illustrate the centers' significant contributions to the development of most of the NARSs supported by the Bank. Some national agencies contend that the centers are sometimes more interested in using the national agencies to benefit CG programs than to address local priorities. However, the centers' activities have generally complemented Bank project activities and, indeed, often provided essential services that would have been difficult to supply from other sources. A

FIGURE 8.4: COFINANCING OF RESEARCH PROJECTS SUPPORTED BY BANK GROUP LOANS, FISCAL 1977–92



Note: Figures in parentheses represent the number of projects confinanced.
Source: Annex Table 8.1.

FIGURE 8.5: COFINANCING OF RESEARCH PROJECTS IN AFRICA, FISCAL 1977–92



AfDB=African Development Bank; IFAD=International Fund for Agricultural Development.
Source: Staff appraisal reports; cofinancing database.

major independent review in the mid-1980s (Anderson, Herdt, and Scobie 1988; Evenson 1987) showed that in many countries, spending by the centers on particular commodities, especially cereals and potatoes, stimulated national research spending on the same commodities. Cereals and potatoes are food crops important for smallholders, a group that was generally perceived to be receiving too little attention in developing countries in the early 1980s.

The CG interdisciplinary team's approach to addressing the practical problems farmers face had been widely adopted during the period under review. Center training programs and technical assistance had successfully transferred improved research methods to NARSs, and perhaps the most important impact was the centers' encouragement of national researchers to solve farmers' problems by promoting a farming system perspective. Professional interaction between center staff and national scientists in the regional programs sponsored by the centers has stimulated better performance in the NARSs, which has been reinforced by the development of networks for particular research interests or problem areas. ISNAR has played a key role in attempts to improve research planning and management systems (Annex Table 5.5), and the International Food Policy Research Institute's policy research has contributed to knowledge on sectoral linkages, environmental and production technology policies, food trade and security, and food consumption and nutrition.

The CGIAR centers encouraged national researchers to solve farmers' problems by using a farming system perspective

Despite the impact of the CG centers, staff appraisal reports for Bank projects have rarely specifically included their involvement, while other donors have even used CG centers as implementing contractors.[4] However, in the Peruvian project the recruitment of research program leaders through the centers was agreed on at appraisal and was processed by the project agency, the National Institute for Research in Agriculture and Livestock, during implementation. The sectoral adjustment loans in the Magreb countries also enabled the use of ISNAR to develop research strategies, and the 1992 Ugandan project specified collaborative research with CG centers. Also, the staff appraisal reports for the research project in Morocco and the ongoing project in Yemen specified the use

TABLE 8.2: FUNDING FOR CGIAR RESEARCH AND RESEARCH-RELATED ACTIVITIES, 1992–94

	1992		1993		1994	
Activity	*($ millions)*	*(%)*	*($ millions)*	*(%)*	*($ millions)*	*(%)*
Germplasm enhancement and breeding	69.9	21.9	67.4	21.7	70.5	21.7
Production systems development and management						
Crops and cropping systems	49.8	15.6	47.1	15.1	49.7	15.3
Livestock and livestock systems	20.4	6.4	18.9	6.1	16.4	5.0
Trees and tree systems	4.4	1.4	5.2	1.7	5.0	1.5
Fish and aquatic systems	1.9	0.6	1.9	0.6	1.6	0.5
Protecting the environment	36.9	11.6	42.2	13.6	51.3	15.8
Saving biodiversity	21.7	6.8	16.4	5.3	25.6	7.9
Improving policies	32.4	10.2	31.5	10.1	34.5	10.6
Fortifying NARS						
Training	30.6	9.6	27.9	9.0	22.6	7.0
Information dissemination	21.8	6.8	23.6	7.7	20.6	6.3
Organizational and management counseling	16.3	5.1	18.4	5.9	14.5	4.5
Networks	12.6	4.0	11.0	3.5	12.9	4.0
Total	318.7	100.0	311.3	100.0	325.2	100.0

Source: CGIAR 1994 *Financial Report.*

of CG centers for external review of the research program. Nevertheless, these instances were exceptions, and scope exists for much more planned collaboration between CG centers and NARSs through Bank projects. In 1993/94, the Bank tried to interest Burkina Faso and Nigeria in using loan funds to contract particular rice research programs with the West Africa Rice Development Association, a CG center, but these countries were not interested in using borrowed funds for this purpose. More recently, in 1995 four CG centers (the International Center for Agricultural Research in the Dry Areas, the International Potato Center, ISNAR, and the International Plant Genetic Resources Institute) participated with the Bank in identifying and preparing an agricultural research project in Russia, but the project is not forthcoming. Finally, the Bank has been more forthright in stipulating CG services for program review during project preparation in Bangladesh and Kenya.

The policy paper recommended that the Bank provide up to 10 percent of the funding requirements for an expanding CG system. In the 1980s the Bank substantially exceeded this target, and in 1994 provided 19 percent of the funds (Annex Table 5.4).

In 1992, 1993, and 1994 the percentage of CG expenditure applied directly to fortifying NARSs was 26, 27, and 21 percent, respectively. This expenditure was for training programs, information dissemination, organizational and management assistance, and networking. The remaining CG expenditures also had direct or indirect benefits for the developing country NARSs in that they went toward such items as genetic improvement, production system development, environmental protection, biodiversity preservation, and agricultural policy (Table 8.2). AFR continued to absorb the highest proportion of CG expenditures, which may be appropriate in view of the importance of agriculture to AFR countries and

their low level of productivity, but has been questioned in some quarters (Gryseels and Anderson 1991, 323). This emphasis on AFR is also evident in the Bank's research assistance program (Figure 8.2).

Notes

1. This review has classified the China Agricultural Education and Research Project as a free-standing research project.
2. The recommendation for the level of research expenditures in point 1a was excessively ambitious and not well founded; the recommendation for project phasing in point 1d was idealistic rather than practical; and the intended role of the Economic Development Institute in point 3a was somewhat superseded by the creation of the International Service for National Agricultural Research; and some important aspects of research were not included or not adequately emphasized, for example, sustainability of investments, farmer involvement in the research process, and gender implications.
3. In the case of India and Pakistan, the research component in many of the combined research and extension projects was dedicated more to the production of technology to meet the needs of a localized extension system than to overall NARS improvement. Elsewhere, most dual purpose projects had a greater degree of direct support for NARS institution building.
4. These types of research activities can be defined by their purposes. The purpose of basic research is to achieve new understanding, of strategic research is to solve specific problems in a manner that is widely applicable, of applied research is to create new technology, and of adaptive research is to adjust technology to suit local conditions.
5. Possibly the Bank's guidelines for the use of consultants using loan funds were a disincentive for staff to specify this type of external support by CG centers in staff appraisal reports and project legal documents. However, appropriate specifications in terms of reference and full participation of the borrower's implementing agency in any decision on the comparative advantage of a center in providing a service has overcome this constraint.

9. Portfolio performance

Nearly all free-standing research projects included components in support of research infrastructure and human resource development

The sample

With the exception of AFR, the study included nearly all countries that had received Bank support through free-standing research projects during the review period. This provided substantial coverage of the major agricultural sector borrowers in all regions. Table 9.1 shows the countries and shows the number of projects in each region included in the review. Annex Table 5.1 lists the project costs; the loan or credit amounts; and the approval, anticipated closing, and actual closing dates for the 56 research projects examined. Virtually all the free-standing research projects have components that support research infrastructure and provide equipment and technical assistance, and most include human resource development and some form of organizational improvement. Relative emphasis varies considerably. Financing by the Bank, which in this report refers to both International Bank for Reconstruction and Development loans and IDA credits unless otherwise stated, covers direct foreign expenditures, the estimated foreign portion of local expenditures, and often, especially in countries eligible for IDA credits, a portion of local costs, even incremental operating costs and salaries in some instances.

The review also examined component research projects with significant research expenditures in each of the sample countries. Relevant structural and sectoral adjustment loans are included in this category. In the case of EAP, component projects in five additional countries (Laos People's Democratic Republic, Myanmar, Solomon Islands, Vanuatu, and Western Samoa) were included to allow coverage of smaller island states and less advanced countries. In AFR, two additional countries were included (Côte d'Ivoire and Nigeria) because of the major contribution of component research in these countries. Argentina was added to the LAC sample because of its recent major agricultural services project. Annex Table 5.2 lists the project costs, research costs, loan or credit amounts, and pertinent dates for the 123 component projects. Annex Table 5.6 lists the 17 education projects with implications for agricultural research.

TABLE 9.1: COUNTRIES INCLUDED IN THE REVIEW BY REGION

SAS (19)	*EAP (8)*	*AFR (15)*		*LAC (6)*	*ECA/MNA (8)*
Bangladesh	China	Burkina Faso	Niger	Brazil	Morocco
India	Indonesia	Cameroon	Senegal	Colombia	Turkey
Nepal	Malaysia	Ghana	Sudan	Mexico	Yemen, Arab Republic
Pakistan	Papua New Guinea	Guinea	Tanzania	Peru	Yemen, People's Democratic Republic
Sri Lanka	Philippines	Kenya	Uganda		Yemen, Republic of
	Thailand	Malawi	Zimbabwe		

Note: The figures in parentheses indicate the number of projects in that region included in the review.

Performance measurement

As explained in the first part of this report, once loan disbursements are complete, Bank staff undertake an ex post evaluation of a project and rate its performance as either satisfactory or unsatisfactory in meeting its objectives. This is done through a PCR by the regional office responsible for implementation, and through a subsequent PAR by OED on a proportion of projects. Twenty (51 percent) of the 39 completed free-standing projects in the sample underwent such a performance audit. While there are isolated instances of empirical ex post evaluation studies of programs in some NARSs that received Bank support during the review period, unfortunately, the ratings were not generally based on economic impact analysis.[1]

Chapter 7 intimated that one could tentatively make the general statement that investment in developing country NARSs is somewhat less profitable, on average, than investment in NARSs in OECD countries and is somewhat more variable in profitability, but that it generates sufficient rates of return that exceed the opportunity cost of capital in most countries. The same chapter pointed out the complexities inherent in evaluating research. Two factors—a recognition that most research investment has paid off handsomely and that quantifying its economic impact on a routine basis involves a number of difficulties—have led the Bank (and borrowers) largely to neglect quantification of the impact of research projects and programs. This review argues that this attitude must change. Apart from the obvious benefits to the Bank of being able to assess the impact of its interventions more reliably, fiscal constraints in most of the Bank's client countries dictate that economic evaluation should be developed to enable prioritization in resource allocation. Annex 7 elaborates on the practicality of overcoming the difficulties involved in the economic evaluation of research and of introducing these techniques into the research process. Meanwhile, however, the absence of quantitative evaluation ratings and the dearth of data that might permit attempts at economic impact measurement oblige this review to use alternative performance measures.

The Bank and borrowers neglected the need to quantify the impact of research efforts; this attitude must change

Even in the absence of comprehensive, quantitative impact data and of economic analysis, analysis would have been facilitated if projects had regularly produced a series of research output indicators, for example, number of varieties produced. Unfortunately, this is not the case, as most project performance indicators are associated with project implementation, such as equipment purchased or number of staff trained, rather than with outputs.

The review adopts the same criteria that the OED database uses to rate individual projects. In essence, these are institutional development factors. Although research investment may potentially yield favorable economic returns, nearly all developing countries face resource constraints in research funding, and often lack experienced human resources trained in the sciences. Hence, a NARS must be particularly concerned about whether available resources are being used in the most cost-effective manner—the efficiency factor—and whether the structure and its output are likely to be sustainable.

To facilitate analysis within this framework, this study examines a number of areas that are commonly accepted as key elements of a viable research system, namely:

- The development of human resources.
- The provision of research facilities and equipment.

- The organization, management, and planning of a NARS and the linkages between research entities.
- The linkages with clients and the relevance of the technology produced.
- The funding of a NARS.
- The provision of incentives to stimulate researchers' performance.

This less than ideal analytical framework relies on the assumption that if institutional arrangements and research processes are efficient in meeting the agricultural sector's technological needs, then the investment will yield favorable economic returns. This is a reasonable assumption.

Project outcome ratings

Of the completed free-standing research projects, 72 percent were rated satisfactory...

Of the completed free-standing research projects, 72 percent had a satisfactory rating (Table 9.2).[2] This compares favorably with the average satisfactory rating of 63 percent for agricultural sector projects as a whole during the period under review. However, as emphasized later, this performance should in no way generate complacency.

Of the unsatisfactory projects, in three cases internal security problems or economic crises that were beyond the projects' control accounted for the poor rating. The remaining eight projects encountered a number of problems: seven were severely influenced by funding problems that affected implementation and the sustainability of investments; six suffered from poor institutional management; five had difficulties in staffing research stations, particularly in remote locations; one was especially weak in meeting its major objectives of promoting on-farm research and linkages with agricultural extension; and one was too ambitious for the competency levels of the officials responsible for the project.

Since 1989, the Bank has also rated projects specifically on their performance in institution building and on the sustainability of the project outcome.[3] A subsample of 32 of the completed free-standing research projects has received such ratings, of which 63 percent had a satisfactory rating. Sixteen percent of the subsample had substantial institutional development and 81 percent had moderate institutional development, with only one project (in Peru) found to have negligible institutional impact. This implies that although most projects were institution-building projects and had some impact in this area, it was not always sufficient to warrant a satisfactory outcome rating. This is linked to lower sustainability ratings for the projects, of which 69 percent had an uncertain or unlikely rating (Table 9.3), and was usually associated with concerns about con-

TABLE 9.2: PROJECT OUTCOME RATINGS FOR COMPLETED FREE-STANDING RESEARCH PROJECTS BY REGION

	SAS		*EAP*		*AFR*		*LAC*		*ECA/ MENA*		*Total*	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Satisfactory	11	73	6	75	6	67	3	75	2	67	28	72
Unsatisfactory	4	27	2	25	3	33	1	25	1	33	11	28
Total	15	10 0	8	100	9	100	4	100	3	10 0	39	10 0

Source: OED Annual Review Database.

TABLE 9.3: OUTCOME, SUSTAINABILITY, AND INSTITUTIONAL DEVELOPMENT RATINGS OF FREE-STANDING RESEARCH PROJECTS BY REGION

Category and rating	SAS (no.)	EAP (no.)	AFR (no.)	LAC (no.)	ECA/MNA (no.)	Total No.	Total %
Outcome							
Satisfactory	6	5	6	2	1	20	63
Unsatisfactory	4	2	3	1	2	12	38
Total	10	7	9	3	3	32	100
Sustainability							
Likely	1	5	2	2	0	10	31
Uncertain	8	1	6	0	1	16	50
Unlikely	1	1	1	1	2	6	19
Total	10	7	9	3	3	32	100
Institutional development							
Substantial	1	3	0	1	0	5	16
Modest	9	4	9	1	3	26	81
Negligible	0	0	0	1	0	1	3
Total	10	7	9	3	3	32	100

Note: OED has only rated projects on their sustainability and institutional development since 1989.
Source: OED Annual Review Database.

tinued funding of the research systems. Sustainability is one of the serious issues that receives particular attention in this review.

...but sustainability remains an issue

The OED database does not rate research components of agricultural projects separately. However, their performance was assessed as part of this review, and is included in the following discussion on performance. Similarly, for the education projects with implications for agricultural research, the Bank did not carry out formal performance ratings because of the relatively minor proportion of resources allocated to this component. However, in a 1992 review of these education projects by OED, EAP and SAS had much better results than AFR. The single project in LAC (in Peru) was a failure. Overall, development of agricultural faculties was satisfactory, especially at the undergraduate level, but for most projects, performance in improving research capability and postgraduate training was inadequate. In addition, the education projects generally overlooked linkages between assisted faculties and other components of NARSs.

Institutional development

Annex 6 provides a more detailed record and analysis for each region of the institutional performance factors noted previously. The remainder of this chapter describes the overall performance of the portfolio according to this framework.

Human resources

The Bank's interventions have supported an increase in the number of researchers and, often, in the number of technical support staff, to work within the expanding NARSs. The planned *recruitment* in projects has usually been directed at identified staffing gaps in particular skill areas or in specific zones or production systems. In many cases, however, projects did not fully meet their recruitment targets (Annex 6). This was usually associated with the fiscal con-

straints of the 1980s, which often resulted in a freeze on additional staffing for some years.[4] While the reduced recruitment may have had some negative repercussions for the research programs and the utilization of facilities, there is no evidence that this was a serious limitation to institutional output. Indeed, in AFR more extensive staff rationalization should probably have occurred (Annex 6) in view of existing and prospective funding constraints, and recent projects in Kenya, Mali, and Uganda are attempting to reduce their staff establishments.

The Bank projects strongly supported human resource development through *postgraduate training*. This was an important component in virtually all projects except in India, and will likely have a substantial impact on research output. Much credit for human resource development, however, must also be given to bilateral donors. Unfortunately, insufficient emphasis has been given in these programs to the development and use of needs-based human resource planning to guide training and recruitment (Annex 6), although many of the more recent projects are introducing this concept (usually in association with research program planning). The lack of appropriate planning has resulted in some mismatches in research skills and requirements and staff shortages in some disciplines (Annex 6). Needs-based planning of training would have focused more extensively on research management skills, although Bank projects did emphasize the latter more during the second half of the review period.

Some borrowers tended not to use loan (or even credit) funds for training because they had access to bilateral grant funding (Annex 6). This was legitimate, but suggests that the borrower and its agencies may not have participated sufficiently in project design, and that liaison by the Bank with other donors during project preparation and appraisal may have been inadequate. The China and Thailand projects demonstrate the benefits of long-term training linkages between major national institutes and reputable universities in donor countries.

While not all participants in the training programs have remained in national agricultural research (Annex 6), wastage of trained personnel has not been a significant problem in most countries. The persistent problem of Chinese trainees remaining overseas, however, has reduced China's potential returns to its training program.

Bank-supported research projects helped improve the number and qualifications of researchers, thereby reducing the need for expatriates...

Bank projects have generally funded a suitable mix of doctoral and master of science programs. The policy paper had been concerned that an excessive emphasis on doctoral training might detract from the required emphasis on applied and adaptive research. The Brazilian NARS, several South Asian NARSs (Annex 6), and even some African NARSs now have a high proportion of postgraduate researchers. However, making a judgment on the "correct" proportion of qualification levels would be inappropriate, as so much depends on the nature of the degrees concerned (Annex 6) and the relative emphasis on different levels of research sophistication. Even among more developed countries, the content of and expectations from different degrees vary.[5]

The improved human resource numbers and qualifications have reduced the need for *expatriate researchers*, although francophone Africa still has a significant number of them. Brazil made particularly good use of long-term research consultants to allow programs to continue while large numbers of staff were in training, while Peru made use of long-term contracts with researchers provided by CG centers to lead its programs (Annex 6). Some countries, however, were loathe to use loan funds to recruit expatriate researchers on a long-term basis (Annex 6).

National capacity to train researchers at both the undergraduate and postgraduate levels varies greatly. Most SAS, LAC, and larger EAP countries have acceptable *postgraduate training capacity*, particularly at the master of science level, but many also have respectable doctoral programs. While the AFR university systems have substantially increased their production of basic degrees in agriculture, the quality of these degrees varies, and their capacity to train at the postgraduate level continues to be poor, even though most of the larger AFR countries now have master of science programs. Bank agricultural research and higher education projects have paid scant attention to this deficiency.[6] The recent (1992) research project in Uganda, however, is attempting to link researchers and educators at universities with researchers in institutes for the mutual benefit of research and education. Mekerere University in Uganda is one of the most mature in AFR, which has facilitated this innovation. Bilateral donors have been more active than the Bank in supporting AFR agricultural universities. Trying to bring all national universities with agricultural faculties up to a satisfactory postgraduate training level is impractical, and a regional plan to support key faculties appears essential. The regional groupings that have been instituted in AFR and have sponsored the frameworks for research action could take some initiative in this area.

The 1980 policy paper did not mention the need for a *gender-related focus* in agricultural research, nor did this issue receive specific attention in Bank projects during the review period, although the focus on institutionalizing a farming system perspective could imply some consideration of gender in analyzing and responding to household economies. The importance of women in the farming business is now widely appreciated, as is the fact that agricultural researchers have traditionally given little consideration to how the role of women might affect the type of technology required to address constraints in a farming system. While a greater emphasis on gender issues is unlikely to alter the general thrust of research aimed at maximizing net economic benefits, it could affect the direction of adaptive research work designed to maximize the relevance of technology and its rapid uptake. Bank projects did not focus on the need to increase the proportion of women scientists as a way to enhance research effectiveness through staffing diversity and the introduction of a woman's perspective. Nevertheless, a steady increase in the percentage of female scientists has occurred in many countries; the Philippines is outstanding with 53 percent of researchers being female (Brush and others 1995), closely followed by Thailand with 44 percent. The number of women undertaking postgraduate degrees in areas pertaining to agricultural research has also increased significantly. This is demonstrated by the percentage of women among foreign students studying in the United States, of whom 25 percent were studying for postgraduate degrees in agriculture in 1990, compared with 15 percent in 1981 and with the percentage of women obtaining postgraduate agricultural degrees in many developing countries, which ranges from 22 percent in Colombia in 1989 to 45 percent in Syria in 1986 (Merrill-Sands and Sachdeva 1992).

...but did not focus on the need to increase the proportion of women scientists

In the early 1980s the CG system did not focus on gender, but in the late 1980s this issue received increasing attention. By 1991 women occupied 12 percent of posts at CG centers, and this figure had risen to 15 percent by 1995, with a resultant effect on CG programs and on their influence on NARSs. From 1990 to 1995, 140 CG projects incorporated gender analysis or had a gender perspective (Sims, Feldstein, and Slack 1995), and female staff undertook 44 percent of these projects. Apart from gender-focused training programs for NARS scientists carried out by the centers (the International Center for Research on Agroforestry, the International Center for Tropical Agriculture, the International Crops Research Institute for the Semi-Arid Tropics, the International Institute of Trop-

ical Agriculture, and the International Potato Center), the implementation of gender-related projects normally involves national counterparts who benefit from hands-on experience. Projects that had a particular impact include those that focused on the gender aspects of farming system and household diagnostics, on participatory planning and evaluation of research, and on studies of the adoption of technology.

Research facilities

The fiscal capacity of some countries was sometimes at odds with the goal of expanding research capacity

In all regions, the civil works and equipment categories of projects concerned with research facilities absorbed a substantial part of loan funds—from 35 percent in SAS to 56 percent in EAP, with an average of 45 percent (Table 9.4). Overall, 55 percent of the funds allocated to these two categories were spent on equipment; however, SAS projects spent more on civil works than on equipment. Although the high allocation to civil works might appear unusual for SAS research systems, which had been established for some time, contributing factors were the emphasis on infrastructure for research on agroecological zones, expansion of the Pakistan Agricultural Research Council facilities, and coverage of additional commodities in Bangladesh.

Overall, the investment in *research infrastructure* in Bank projects and in projects supported by bilateral organizations has expanded NARSs' potential capacity to undertake agricultural research. While investments were generally justified from the point of view of expanding research capacity, the appropriateness of the expansion was questionable in some countries given their fiscal capacity (Annex 6). Some unwarranted expansion occurred in one project apparently in response to political concerns, and in another because of inadequate attention to the facilities already available in the NARS.

Research facilities appear to have focused on a reasonable balance of cash and subsistence crops and annual and perennial crops. However, in most Bank research projects, investment in livestock production has been low relative to its importance in the economy, even in the latter part of the review period. Such investment amounted to 2 percent of research lending for 1990–92 (de Haan 1993), which compares with a 1990 FAO estimate of 25 percent contribution by livestock to agricultural output in developing countries.[7] However, the private sector tends to be more active in research on animal diseases and breeding, and forage research often falls under crop research categories. Similarly, Bank projects have given little support to research on postharvest technologies, agroprocessing, and fisheries, partly because agencies other than the dominant crop research

TABLE 9.4: CIVIL WORKS AND EQUIPMENT AS A PERCENTAGE OF RESEARCH LOAN FUNDS, 1977–92

Region	*Civil works*	*Equipment/vehicles*	*Total*
Africa	22	21	43
East Asia and Pacific	28	29	56
Latin America and Caribbean	12	33	45
Europe and Central Asia	16	27	42
Middle East and North Africa	28	32	60
Europe and Central Asia / Middle East and North Africa	21	29	50
South Asia	22	13	35
Total	20	25	45

Source: Loan and credit agreements.

organizations often handle research on these topics. This suggests that the Bank should take a more encompassing view of the national system in supporting NARS development, especially in those countries where limited resources demand prioritization of new investment or rationalization of existing investment.

Bank projects amply supported the provision of scientific and experiment station *equipment* and of vehicles to improve researcher mobility. However, some projects gave insufficient attention to planning the type of equipment to be procured and to its maintenance (Annex 6). Project documents also refer to inefficiencies in training programs and equipment procurement, whereby these were not in accord with eventual research requirements, because of premature decisionmaking in the absence of defined research programs (Annex 6). Bank staff should have paid greater attention to ensuring the procurement of appropriate equipment. The Bank generally did not follow the policy paper's recommendations to progress systematically through the phases of a project to avoid this *sequencing* problem. Based on the policy paper, a first project would have concentrated on improving the human resource situation and developing research strategies and programs, with a second project to handle major investment in facilities. Even in countries where the initial Bank intervention stressed research organization and management (for example, most NARSs in Africa), there was still substantial investment in infrastructure.

The sequence described in the policy paper represents an ideal situation. In most cases, however, because of the Bank's conviction that research capacity must be improved to support sectoral production objectives, and because of demands by many borrowers that they have something physical to show for their investment (as opposed to having important, relevant technology in the future, which is the real justification for the investment), substantial adaptation is necessary. As long as project designers are aware of possible sequencing problems, they should be able to avoid them, even in the absence of clearly defined research programs, by restricting early investment in infrastructure and equipment to those basic items that will be essential regardless of the eventual definition of the research program's details. Similarly, prior to the definition of researcher expertise requirements, a review of existing qualifications and specializations should enable the commencement of training in skills that would be needed in any case.

Cases in which the wrong equipment was procured indicate that the Bank made avoidable sequencing errors

The Bank has not always taken such a rational approach, however. The noted cases of inappropriate equipment procurement, poor utilization of scientific equipment, and mismatches between researchers' skills and actual needs indicate that the Bank has made avoidable sequencing errors that have reduced the cost-effectiveness of the research investment. The poor results of the piecemeal research interventions in Nepal further support the arguments for a more comprehensive and sequential approach. In addition, the heavy assistance given to the Agency for Agricultural Research and Development in Indonesia would have benefited from a greater emphasis on research management issues in the early phase of intervention.

Library facilities and equipment received attention in most projects. However, fiscal constraints and a scarcity of research funding pose a threat to the upkeep and usefulness of these scientific literature facilities. More recent projects are paying greater attention to electronic communication and networking, but a recent review of 29 African NARSs by the Center for Agriculture and Biosciences International (Getaneh and others 1995) indicated that NARSs will not reap the benefits of CD-ROM bibliographical databases without considerably more invest-

ment in training of both users and library staff and sensitization of managers to the value of information. With respect to the latter, improved scientific communication depends not only on investment and training, but also on the installation of appropriate review and publication policies in NARSs.

Peer review is a critical element in the scientific publication process, and many recent projects have sought to develop this. However, traditional attitudes often interfere with this process. Publication not only preserves research findings and disseminates results to the scientific community, but is a strong vehicle for quality control in the research enterprise. It naturally has its own costs, and unfortunately Bank projects have seldom catered for these adequately. Of course, good judgment is required as to where to position scientific publication efforts for maximum effectiveness on the spectra from glossy to mimeographed, from local to international, from in-house publications to those put out by independent professional associations. More attention to such management issues was warranted, in addition to physical investment and training.

Delays in implementing civil works and procuring equipment have been the main causes of postponement of loan closing dates, which occurred in 72 percent of loans, with the highest number of postponements in ECA/MNA (100 percent) and the lowest in LAC (50 percent). More realistic assessment of agencies' implementation capacity would probably have prevented many of these delays by reducing the targets for specific project periods. Factors that contributed to the delays included insufficient attention to the design of facilities during the project preparation phase, unfamiliarity of agency staff with Bank procurement requirements (which could often have been corrected with improved supervision assistance, especially at project start-up), lack of counterpart funding (Annex 6), and cumbersome administrative procedures on the part of the borrowers.

Management of NARSs

The management of any entity has a number of different components. The following paragraphs discuss these components with reference to the management of NARSs.

The Bank was more involved in strengthening apex institutions than in modifying the basic structure of the national research systems

Structural models. The Bank-supported NARSs employ a number of structural models. These include a dichotomy in central and provincial or state agricultural research in some of the larger systems, such as those in Brazil, China, India, and Pakistan, but most consist of institutes within sectoral ministries or are linked to sectoral ministries in an autonomous or semiautonomous relationship.

The Bank has generally not attempted to modify the basic structure of NARSs, but has been heavily involved in promoting the strengthening of apex institutions to coordinate the different entities involved and to permit prioritization of resource use. Not all projects have included this support, but those with a strong institution-building objective (the majority) have usually attempted to establish apex organizations or strengthen existing ones.

Where an overall coordination system for all NARS entities has not been a project objective, the Bank has usually attempted to install or strengthen a coordinating entity within the dominant group of research institutes (for example, in Mexico, Morocco, and the Philippines). The Bank has not always completely achieved its objectives in this area (for example, in Bangladesh and the Philippines), especially where those people responsible for formulating programs are separated from those responsible for allocating funds to programs, and in some instances the Bank's efforts in this regard have been rejected (for example, in

Thailand). However, in line with its increasing emphasis on reform of institutional management, the Bank has made significant progress in creating enabling arrangements to develop national research strategies, to plan research, and to promote linkages that can result in more efficient use of available resources.

The contribution of local universities. The contribution of agricultural faculties of local universities to NARSs' research output varies. The greatest involvement is in India, where the state agricultural universities (which the Bank has strongly supported) are responsible for research in the states, and in the Northwest Frontier Province of Pakistan. Other NARSs in which universities have substantial research capability are Brazil, Chile, China, Mexico, and Pakistan, and to a lesser extent Morocco, Tunisia, and Uganda. However, most agricultural universities concentrate on education and do not have the funds or the facilities to make a significant contribution to research, especially in AFR.

Bank support for agricultural research through education sector projects has been extremely limited. Nevertheless, the Bank has promoted the involvement of agricultural faculties by funding contract research components in its projects (Annex 6). The contract research facility ensures that the research a recipient university or private sector entity carries out is within the scope of the contracting institution's overall program. Where a national apex organization exists, it can, to some extent, coordinate research activities carried out by the publicly funded universities under a national plan. Few data are available to assess the extent to which this coordination is effective, but the overall impression is that faculty research tends to be governed by national guidelines only to the extent that the institution is participating in some form of centrally funded national commodity or production program (for example, as in India and Pakistan) or in contracted research.

Research planning. During the review period, especially since the mid-1980s, the Bank attempted to introduce or reinforce improved research planning and review procedures in the NARSs through its project interventions. Its intent was to make research more responsive to national priorities and to the needs of the different agroecological regions and the farming communities in those regions. Technical assistance to improve planning capacity has been provided under Bank loans or with bilateral or CG support in virtually all projects. ISNAR has participated extensively (Collion 1991), but the FAO and private consultants have also assisted.

Projects aimed to introduce or reinforce better research planning and review procedures

ISNAR has produced a number of technical papers on *research planning* (for example, Bottomley and Contant 1988; Collion 1989; Dagg 1991) and has identified three distinct steps in research planning:

- A strategic plan that sets out the desired evolution of the system during the following 10 years or more that includes such items as guiding principles, organizational structure, overall investment levels, human resource requirements, priorities among broad research areas and resource allocation among them, and linkages between different parts of the system and with outside agencies and users of technology.

- A medium-term master or implementation plan for a period of perhaps five years, which is a plan for implementing the research policy and strategy. This can be channeled through commodity, theme, production factor, or system programs.

- Annual programming at the institute or research station level.

In practice, however, any planning that NARSs have undertaken has varied significantly in the depth of analysis. In addition, the line between strategic and master plans has often been fuzzy, and they have sometimes combined these two steps into a single product. Distinctions are further complicated by the existence in many cases of some kind of plan at the time of external intervention in the planning process and the need to have rolling plans that adjust to any substantial changes in circumstances.

Bank assistance to national agricultural research systems to date can at best be described as a significant start

At best, the overall outcome of the assistance provided to date can be described as a significant start to a more rational planning process in most NARSs or major agencies within NARSs. At the broad strategy level, NARSs have made considerable progress, but even here the model they have used to examine commodity and other programs in formulating the strategy has not always been appropriate.[8] Furthermore, NARSs have often not realized the implications of the overall strategy in terms of reallocating national or state research investment. Performance has been weakest in two areas: first, in prioritizing programs and subprograms within the strategy, which has been affected by poor selection and use of arbitrary prioritizing tools, along with inadequate use of economic principles; and second, in adopting measures to avoid duplication of efforts by different research entities and programs, an outcome of unsatisfactory research information systems. In addition, some NARSs, especially in AFR, have tended to accept their governments' sectoral policies without attempting to influence the priority setting process when the policies seemed to be inappropriate, for example, major allocations to wheat production and research in the absence of comparative advantage in its production. This, and the "softness" (or lack of rigor) that often occurs in the overall prioritization process, can be partly linked to weak capacity in policy and economic analysis in most NARSs. This is an important deficiency, especially given the resource constraints they are facing and the substantial economic policy adjustments that have been taking place in many developing countries. Given circumstances in which countries are adjusting their economic policy, NARSs should be able both to make useful contributions to policy formulation and to respond efficiently to economic realities (Manning 1995).[9]

Some improvement has occurred in many second-generation strategies and plans. The net impact of changes in planning procedures is, however, difficult to identify. At this stage, research planners seem to be more aware of and responsive to the constraints and potential of less favorable environments and resource-poor farming systems. However, rarely do they follow through on these perceptions and priorities as effectively as they should. Many established researchers are still hesitant to accept that research should be demand driven and to respond, for example, to the potential for realizing substantial social benefits by conducting research in poorer environments where the prospects for technological advances are normally fewer. Also, in many research systems, specializing in a subject such as plant breeding still carries with it a traditional prestige, while specializing in key research areas in applied and adaptive production technology, including soil and water management techniques, is not considered as prestigious, with consequent biases in planning methods that rely heavily on subjective rankings.

The issue of resource allocation to research is particularly important in AFR. Much of the research effort in the region has been devoted to crop breeding, following the successes of the green revolution in Asia. The green revolution, however, relied largely on younger, more fertile soils in favorable production environments. Africa, with its ancient soils, erratic rainfall over many of the cropping zones, and less irrigation than Asia (Annex Table 5.7), has a different set of problems. Although germplasm is important, the more intractable prob-

lems of crop husbandry and management, for which research is likely to generate fewer economic returns than germplasm research did for Asia, have not yet received the required research attention (Lynam and Blackie 1994). Unless NARSs use sound quantitative methods to establish priorities, vested interests can distort the planning process to their own advantage.

External entities have been the source of virtually all the improved planning initiatives, and consultants have carried out much of the analytical work or it has been developed under their intensive guidance. This is of special concern, as ownership by nationals is essential if the results of prioritization exercises are to be taken into account and if the process is to be institutionalized for its continuing use. Clearly the Bank and other donors and international agencies will have to persevere in promoting this aspect of research management and take care to foster the development of the required skills among national staff and the institutionalization of the process as routine. There is also a need for well-founded advice on strategic planning and prioritizing so that the process leads to sound conclusions.

Economic analysis, essential for reliable prioritization of research resources, received little attention in the past

Economic analysis. Economic analysis is essential for reliable prioritization of the uses of research resources. Annex 7 makes a strong argument for this, and points out that techniques are available that permit economic analysis in most situations (see Alston, Norton, and Pardey 1995 for a discussion of the use of economic principles in research planning). Although Bank-supported projects have provided for training of social scientists and have attempted to install a farming system perspective (which usually implies an economic orientation) in most NARSs, economic evaluation of research has received less attention, and NARSs staff are usually only exposed to it through consultants employed to develop master plans.

Program and project review procedures. Most NARSs that have received Bank support now have some procedures for program and project review. Peer review has been an important element in these procedures. One should not, however, take the effectiveness of peer review for granted. Full expression of this critical process has been especially difficult in most NARSs in the developing world, where public service and seniority traditions seldom encourage the free exchange of constructive scientific criticism, particularly of the most established scientists. More recent projects have sought to address such problems by encouraging hard-hitting peer review, not only at the earlier stages of project selection and progress review, but also through anonymous peer scrutiny of completed work prepared for publication. External support agencies will need to persevere to obtain full adoption of this principle.

Apart from the issue of peer review, in some NARSs the scarcity of operational funds has limited their ability to bring researchers together to benefit from interaction at such reviews. The concept of independent program review using experts from other local institutions has been adopted in some cases, but could be used much more extensively. All regions have used program reviews involving expatriate scientists who specialize in particular fields, often with participation by CG center personnel (for ISNAR see Annex Table 5.5), but these are unlikely to occur unless external funds are available.

Many Bank projects have stipulated that research agencies submit their annual research programs and budgets to the Bank for review. This has not been a satisfactory method of ensuring appropriate research programming (Purcell 1994). First, the Bank does not have enough task managers of research projects capable of undertaking a sound review, and second, even those who could do so do not

have enough time to do the job properly.[10] Periodic independent review by an experienced team is the most appropriate way to ensure that research programming is addressing the sector's real technological needs.

The Bank should address some borrowers' reticence to use borrowed funds to recruit (relatively expensive) international experts. One avenue is for the Bank and its recently created Agricultural Research and Extension Group (ESDAR)—created in 1994 and financed by a number of donors—to encourage bilateral donors to fund the use of such experts as part of their support of research and the agricultural sector. ESDAR may be able to enhance the role of leading research institutions (especially the CG centers) in providing expertise for program review and other key areas of technical assistance.

The introduction of comprehensive management information systems is a slow process

Management information systems. A practical management information system (MIS) should not be an end in itself, but can generally facilitate research programming, review, budgeting, monitoring, and evaluation (Annex 7). Many Bank projects have provided for technical assistance to develop an MIS for major agencies in the NARS. Other donors, especially USAID, have promoted MISs, and ISNAR has been particularly active in supporting the development of this management tool (Annex Table 5.5 and Annex 6). Evidence to date indicates that introducing comprehensive MISs will be a slow process. Pilot or more comprehensive schemes have often faced difficulties in training sufficient numbers of staff and retaining them in relevant positions and with less than full commitment by the management of some institutes to the use of an MIS (for example, Bangladesh, Senegal, and Sri Lanka). However, progress in Brazil, Indonesia, and Mexico shows that effective MISs can be established.

ISNAR developed an MIS called INFORM, which has now been introduced in nearly 40 NARSs, about one-half of which have incorporated INFORM's principles into at least some of their research system. In 1993/94 an external review of INFORM experience in AFR, LAC, and SAS concluded that to increase acceptance, INFORM would have to be introduced sequentially, starting with briefings for top management, followed by seminars for researchers, training for selected staff, and follow-up visits. Particular attention should be paid to the selection of two INFORM "practitioners" at each institute. However, an MIS is only a tool for improving management, and unless planning and evaluation are developed at the same time, there will be little incentive to adopt an MIS (Vernon 1995).

Regardless of the introduction of a suitable MIS, the financial management and accounting capabilities of many research agencies need substantial improvement. Poor accounting exacerbates funding problems by impeding disbursements and reimbursements from loans and grants, and even releases from national funding ministries (Bruneau 1994).

Ex post evaluation. The virtual absence of ex post evaluation capacity in developing country NARSs is not surprising in view of the difficulties experienced in taking economic considerations into account in research planning. However, ex post evaluation should be an integral part of the quality enhancement process, and can be a powerful tool in gaining public sector budgetary support. While economic ex post evaluation of all research programs would not be feasible (or even desirable, considering the scarcity of economic skills in NARSs), evaluation of selected programs is a realistic objective.

Performance indicators. The Bank could hardly have expected NARSs to develop economic ex post evaluation capacity when its own staff have largely neglected this aspect of the research process in both ex ante appraisal and in completion

reviews. Perhaps even more worrisome has been the weak use of performance indicators in Bank-funded projects, which might have provided some quantitative basis for gauging impact. The Bank has generally not adhered to the policy paper's recommendations on monitoring and evaluation.

The weak use of performance indicators shows that the Bank has not followed up on earlier recommendations on monitoring and evaluation

Project indicators may relate to (a) implementation targets (for example, equipment procured, training undertaken, contracts with research product end-users); (b) project outputs (for example, new varieties produced, revised fertilizer recommendations, cropping pattern changes); (c) efficiency of producing output (for example, use of equipment, road worthiness of the vehicle fleet used for on-farm research, ratio of on-farm to on-station trials, technical support to scientist ratios, measures of client involvement in design and evaluation, and collaborative studies with other institutions); (d) institutional sustainability (for example, proportion of total budget supported by sales of products and cost recovery, operating cost to salary cost ratios, agricultural research intensity ratios, and donor dependence measures); and (e) project impact on production and welfare. The first category is straightforward, has immediate and obvious benefits for agency management, and Bank-supported projects have generally adopted it. The second, third, and fourth categories should not present any difficulties, and represent explicit measures of outcomes in meeting technology development and institutional development objectives. They have not, however, been widely used in Bank-supported projects. Greater attention to formulation of measurable indicators in these categories during project preparation with intensive participation by project agencies should overcome this problem.[11] The fifth category—indicators that measure the impact of the research system and its programs on production and welfare—is more complicated, is the most important, and has received negligible attention in Bank projects.

By measuring indicators of agricultural growth, changes in rural poverty, exports of agricultural commodities, non-negative trends in environmental indicators, and so on borrowers can gain an understanding of the impact of research investment on broad development objectives. These indicators of impact are measurable and borrowers should routinely monitor them. However, a specific research project is unlikely to result in any significant change in these broad measures during its implementation period, and measuring these indicators is not usually the prerogative of the research agency.

Indicators that measure more direct and immediate impacts, such as the adoption of specific technologies among different social groups, are of greater practical relevance to research agencies. This is not a costless undertaking, as some form of survey is involved; however, such measures do indicate the extent to which people are using the products of research and increase the validity of assessments of economic impact. Bank-supported projects can stipulate adoption indicators for critical research programs, but research agencies should ensure that the adoption of technologies derived from their programs is monitored. (Note that monitoring of adoption should not be the responsibility of research agencies alone. Other agencies in the technology generation and transfer system, such as those involved in extension, can play a major role.) The generic indicators the Bank proposed in 1995 are already being used in the recently approved Bangladesh research project. However, these proposals were not based on field-tested material, and the continuing development of appropriate indicators for specific situations should be a pressing, but iterative, process. Fine-tuning will be required to accommodate individual projects.

The Economic Development Institute. The policy paper recommended that that the Economic Development Institute expand its training in research management.

Nearly all projects included components to improve links between research, extension, and farmers

The paper was written before the creation of ISNAR, which reduced this priority for the institute; the institute, in turn, has offered little training in research management. However, in 1993 the institute did cooperate with ISNAR in holding an international workshop in Nairobi, Kenya, that emphasized the relationship between research programs and economic and sectoral policies. Participants were drawn from research administration, planning, economic and funding ministries, sectoral ministries, and universities of about a dozen AFR countries. No direct follow-up to this exercise has taken place, however.

Research relevance

Most staff appraisal reports for Bank projects involving technology development or transfer have highlighted the need to produce technology relevant to smallholders, especially those farming in more difficult production environments. Nearly all projects have included components to improve the linkages between research, extension, and farming communities, which are designed to inform researchers about the constraints and possibilities of the main farming systems and to facilitate the adaptation of technology to specific circumstances. The interventions cover a range of analytical techniques and interaction arrangements to enhance this process. They also include adjustments in resource allocations to particular production environments in response to the realization that the technology development and adaptation system was not paying enough attention to particular agroecological regions (often the less favorable environments), and thus the supply of technology relevant to these environments was inadequate (for example, projects in Brazil, India, Indonesia, Mexico, and Sri Lanka). Projects have also often directed research attention toward food crops as opposed to the traditional emphasis on export crops to provide technology relevant to most smallholders (for example in many AFR projects, in the Magreb NARSs, and in Malaysia). The attempts in Bank-supported projects to redirect resources have largely succeeded, although difficult working and living conditions have made it hard to retain sufficient staff in applied and adaptive research establishments in some agroecological zones.

The process interventions can be grouped into three areas: a greater emphasis on on-farm adaptive research; the adoption of a farming system perspective in research planning and technology adaptation, which incorporates extensive on-farm adaptive research combined with an increased stress on socioeconomics; and the installation of formal communication arrangements to improve the exchange of information needed to produce relevant technology.

The development of on-farm adaptive research. All projects whose objective was to develop technology for particular areas or zones (many component projects and most research and extension projects) and most projects whose aim was to emphasize institutional development among major agencies in NARSs have succeeded in developing on-farm adaptive research capacity. While accomplishments have been substantial, and in China a pilot scheme to establish centers to organize research-extension-farmer interactions and sponsor on-farm adaptive research (the agrotechnical extension centers) appears to be functioning well, the full potential of on-farm research has often not been realized. The reasons for this are as follows: (a) field trials replicate work done in experiment stations rather than being adapted to farmers' circumstances (Annex 6); (b) design and management of trials is insufficiently rigorous, and often supervision is poor and responsibility is delegated to low-level technicians, so that trial results are unreliable (Annex 6); and (c) such programs require funds for travel and subsistence, and thus are usually the first to suffer when resources become scarce.

The introduction of a farming system perspective. Many projects in all regions have created farming system research units and have introduced a farming system perspective by encouraging research and extension staff to work together to carry out farming system diagnostic surveys. The underlying objective is for all applied and adaptive research programs to be demand driven. Associated with this emphasis on understanding farmers' circumstances and adapting technology accordingly, projects have also promoted greater use of social scientists, who are a necessary adjunct to biological scientists in this endeavor. Bilateral donors, especially USAID, and often the CG centers as its implementation contractors, have also been strong supporters of this initiative.

The farming system perspective is a major step forward in addressing the issue of technological relevance

To the extent that national systems have adopted it, the farming system perspective is a major step forward in addressing the issue of technology relevance. In most cases, however, the impact has been limited and the approach will need much more nurturing before it can pervade the research system. This has been caused by the reluctance of many traditional researchers to accept that most technology development should be demand driven (Annex 6), by the higher prestige accorded to researchers in traditional scientific disciplines such as plant breeding, and by the scarcity of researchers trained in the farming system perspective. This has meant that economics and farming system units in the research agencies, and even initiatives in farming system diagnostic work by commodity researchers, have usually not been sufficiently incorporated into the mainstream of research. This limits their impact. In many cases, Bank staff have not been as insistent as they might have been on mainstreaming the farming system perspective.

Enabling the farming system perspective to reach its full potential will require continued donor support, more researchers trained in the social sciences, and institutional arrangements that promote its full integration into the research planning and review process. Increased attention to the social sciences and the concept of farming systems in agricultural undergraduate and postgraduate courses would also have major benefits.[12]

The full development of farming system research in diagnostic work, in component experiments to address problems and underutilized potential, and in testing improvements in production models, all with intensive monitoring of inputs and outputs in the selected household production systems, should normally not be allowed to absorb an inordinate share of resources. The need is for all researchers to be aware of the types of and variations within farming systems so that commodity, discipline, or system research is responsive to the needs of these systems—a farming system perspective. The two key elements are farming system diagnostic investigation and continual monitoring of the adoption of improved technology to verify that research is meeting farmers' real needs. A notable deficiency in the Bank's agricultural higher education portfolio (Annex Table 5.6) has been the lack of attention to the farming system perspective in curriculum development components. This illustrates an absence of links between the Bank's support for agricultural research and its support for the education sector during the review period.

The installation of communication systems. Communication initiatives include programmed meetings between research and extension staff at the regional and provincial levels to discuss production problems and formulate recommendations; in-service training of subject matter specialists in the extension service by research staff; and the appointment of specialized outreach officers at research institutes to interact with extension staff and farmers and, sometimes, to be responsible for the on-farm adaptive research program (Annex 6). The results of

these meetings have been mixed, but overall have been beneficial and should be encouraged. The main deficiencies have been (a) a deterioration in the quality of interaction when researchers promote standard recommendations without attempting to adapt them to circumstances as defined in direct dialogue with farmers or by the extension staff, and (b) an inability on the part of extension staff to identify and articulate the circumstances of the farming systems with which they are dealing. Similarly, the use of researchers as trainers has been beneficial, but has suffered from an inability of many researchers to adapt theoretical and general technological material to trainees' needs and a virtual absence of attention to economic considerations. When the limited effectiveness of this training has become apparent, support for the process has declined on the part of both researchers and extension staff, thereby exacerbating the problem. An earlier OED review of the Bank's agricultural extension portfolio highlighted these deficiencies. The adoption of a farming system perspective throughout research and extension) systems would improve the effectiveness of these communication initiatives.

Some countries in all regions have tried the outreach officer concept (for example, Brazil, Kenya, Nepal, Senegal, Sudan, Thailand, Turkey, and the Magreb countries). Results have been mixed. In Brazil, where the research/extension liaison unit is well integrated into the overall research institute system, it appears to work reasonably well. It has been less effective in Nepal and Turkey, and assessments have not yet been made in the remaining countries. The problem with the concept is that it allows most researchers to leave the responsibility for interaction with the users of generated technology in the hands of a few specialists, and unless these specialists are closely integrated into the research planning and review process, their contribution toward improving research relevance is reduced.[13] Where the Bank does promote this concept, the integration aspect must be carefully planned and monitored.

The increase in on-farm trials, farming system diagnostics, and general interaction between scientists and farmers has contributed to better research by providing opportunities to use farmers' views in designing adaptive research and assessing its results. More, however, could have been done in formally involving farming communities or their representatives as partners in the design and evaluation of adaptive research, which would have contributed both to the relevance of research and rapid adoption of its findings (see, for example, Ashby and others 1995; Sperling, Loevinsohn, and Ntabomvura 1993). In the recent project in Mali, however, community associations are involved in planning research with the Institute of Rural Economy (Collion 1995), and some Indian state agricultural universities are trying to involve communities in planning for zonal research station programs (Annex 6). Involvement by targeted clients in program planning will be even more essential as they become more involved in direct payment for research.

Government commitment is critical to the institutional development of national agricultural research systems

Research funding

With few exceptions, NARSs in countries the Bank supports are encountering serious funding problems. This raises questions about governments' commitment to sectoral development and about the importance they ascribe to the creation and acquisition of technology that can increase the productivity of their agricultural sectors. Without government commitment, external support for institutional development of NARSs will inevitably fall short of its objectives.

National statistics show that agriculture is important in all regions, although its importance relative to other sectors in the economy varies across regions. Agriculture's share of total GDP is highest in AFR and SAS and lowest in LAC

(Annex Table 5.8). As economies diversify, their reliance on agriculture declines, with this decline being slowest in AFR, followed by the SAS countries.

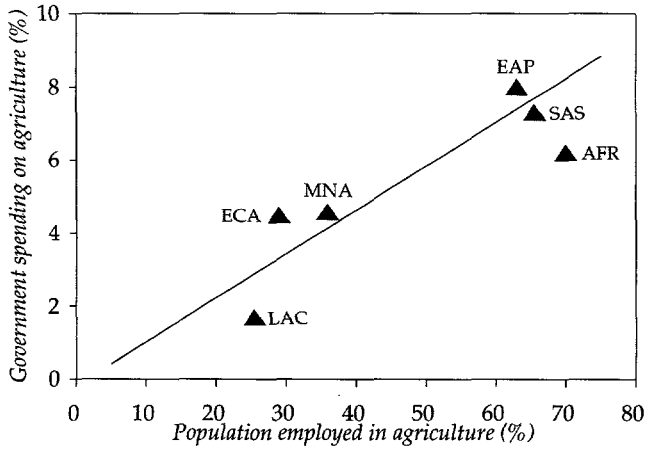
Countries differ widely in the level of agriculture's contribution to exports, but AFR as a region still leads in terms of reliance on the agricultural sector. Despite the low ratio of agricultural GDP to total GDP in LAC, agricultural exports are important in many countries of this region. AFR and MNA were the only regions in which agriculture's contribution to exports increased in the 1980s (Annex Table 5.8).

In three regions—AFR, EAP, and SAS—agriculture provides employment for a high percentage of the population (64 to 71 percent). In other regions it is lower (25 to 36 percent), but is still important. Although this percentage is declining in all regions, the decline is slowest in AFR and SAS (Annex Table 5.8).

Government expenditure on agriculture as a percentage of total government expenditure is highest in EAP, followed by SAS and AFR. The regional averages for this ratio were maintained or increased slightly in the 1980s, except for LAC, which declined due to the influence of Brazil and Mexico as two large economies (Annex Table 5.8). However, there was considerable variation within each region. For example, in AFR the ratio declined substantially in nine of 19 countries, and in SAS, a positive trend in India (a large economy) more than compensated for a decline in the other countries. Expenditure on agriculture appears to have been related to the proportion of the labor force employed in agriculture, though less so in AFR and LAC than in the other regions (Figure 9.1).

The proportion of the agricultural sector budget that countries and regions allocate to research indicates the relative importance governments give to research within the limitations of sectoral funding.[14] Unfortunately, insufficient data were available to comprehensively review the country and regional trends for this measure. In addition, variations in the nature of agricultural sector budgets across countries complicate the use of this measure as an indicator of govern-

FIGURE 9.1: GOVERNMENT EXPENDITURES ON AGRICULTURE IN RELATION TO EMPLOYMENT IN AGRICULTURE, 1990



Note: The number of countries in each region is represented in the data set as follows: AFR 18, EAP 5, ECA 1, MNA 3, LAC 5, and SAS 5.
Source: FAO, various years; IMF, various years; and World Bank, various years.

ment commitment. Nevertheless, it can contribute to deliberations on the extent of external support that might be warranted.

Agricultural research intensity. The discussion on the funding of research in Annex 6 provides considerable information about public expenditure on research as a proportion of agricultural GDP, the so-called agricultural research intensity ratio (ARI), for countries in each region. The policy paper had targeted an ARI of 2 percent by 1990, but most countries did not achieve this level of support. Apart from Malaysia, Tunisia, and some of the NARSs in AFR, ARIs have not exceeded 1 percent. The ratio for NARSs in EAP and SAS generally fluctuated from 0.2 to 0.5 percent. In LAC, after some high ARIs in the early 1980s in Brazil and Mexico, they dropped to 0.5 percent or less. ARIs in ECA/MNA were also less than 0.5 percent. Overall, AFR has performed better in allocations in terms of ARIs, with most being in the 0.5 to 2.0 percent range. However, this must be viewed against the relatively small agricultural GDP in most AFR countries and the heavy donor support for their NARSs. Nevertheless, the policy paper did not provide any reasoned basis for the target ARI of 2 percent, other than stating that most areas needed to increase their allocations to research.

Decreased spending per researcher was a problem in all regions; more staff were hired, but funds did not keep pace

Perhaps of greater significance would be any appreciable increase in the ARI from the generally low levels at the start of the review period. This only occurred in AFR, where eight of 12 borrowers on which data are available experienced a stable or increasing ARI during the review period. (Note that the agricultural GDP in these countries was not declining during this period.) However, because of the substantial increase in the number of researchers, the funding per researcher in AFR declined in all cases, so that funding for operational support was a serious problem (Annex 6). Declining expenditure per researcher has been a problem in all regions, as the rate of staff increases has substantially exceeded increases in budgetary support. This is a continuation of the disturbing trend noted by Pardey, Roseboom, and Anderson (1991b) observed from the 1970s into the 1980s, and one that has no doubt been exacerbated since. In the 1980s EAP countries were the exception, but a negative trend has now developed for major countries in this region also (China, Indonesia, and the Philippines).

Most national agricultural research systems and donors who wish to support an improved research capacity face a dilemma. On the one hand, there is an identified need for improved technology in many aspects of agricultural production, the prospects for favorable economic returns on incremental research investment are high, and research institutions wish to expand and improve their research capability. But on the other hand, ministries of finance are unable or unwilling to fund the operations of expanding research institutions adequately. Possible ways to address this dilemma include increasing the efficiency of all investments in a system, demonstrating the system's cost-effectiveness and favorable returns to funding authorities, and reducing the need for public sector funding of a system.

System efficiency. In general, the Bank and the donor and international research communities have tried to improve system efficiency through coordination and research planning and review mechanisms. They have made considerable progress, but in most cases, the introduced systems are still not fully functional. They have also made some attempts to introduce needs-based planning techniques for recruiting and training researchers, which would match skills to the requirements of defined strategies and programs and boost returns to human resource investments, but these efforts have been insufficient.

Projects have made a start in introducing MISs and improving financial management and monitoring. Nearly all projects have promoted the notion of research relevance to avoid wasting resources with varying success, and this will need continued support if appropriate techniques are to institutionalized. The Bank could have given much more attention to rationalizing existing research systems, as opposed to expanding facilities and programs even though a need for them had been established. Rationalization occurred in Thailand and is included in the Mali and Uganda projects, but should have been invoked in Bangladesh, for instance, and in many Africa region NARSs.

Except in Brazil and Indonesia, as already noted, NARSs have done virtually no impact evaluation studies to support funding proposals. Unfortunately, presentation of ex post program benefits does not guarantee a favorable attitude on the part of funding authorities. The studies in Brazil and Indonesia, for instance, failed to prevent a decline in national budgetary allocations for operational support.

Funding responsibility. Bank research projects have not paid a great deal of attention to the partial transfer of funding responsibility from the public sector to users, and could have done more. According to its mandate, the Bank deals with public sector research institutions, but this does not preclude the Bank from having substantial input into reviews of the existing capacity of and potential for private sector research and of the possibilities of user financing of public sector research. Private sector research and user financing of public sector research are already in place in many countries, especially in LAC and in those NARSs that have traditionally had substantial tree crop export industries.

When governments introduce cesses or charges on processed or exported products, they must not view these in isolation from pricing systems and other regulatory interventions that may already impose substantial taxes on the producers of a commodity. Under such circumstances the Bank could try to encourage governments to link at least part of their explicit or implicit taxes on a commodity to the provision of funds for developing technology. In addition, to ensure continued support from NARS clients by providing relevant research outputs, NARSs need to install mechanisms so that clients can become involved in program planning and evaluation.

Regardless of the success of attempts to transfer funding responsibility, substantial public sector research funding will continue to be needed to provide what are largely public goods, and in many countries the transfer to private funding is likely to be small because of the predominance of smallholders and of production systems that are not much above subsistence (with the exception of funding that producers and processors of export crops might generate).

The Bank has generally discouraged the use of research facilities for production purposes such as commercial seed sales or cattle fattening. This has been legitimate in view of the potential for diverting the management's attention from research to commercial activities at the expense of relevant research output. However, some systems have gone in this direction to meet operational fund requirements, and in the case of the former Soviet Union, to sustain the households of NARS staff. China is another case where such a diversion of focus could have detrimental effects on the NARS's output (Annex 6).

Dependence on donor support. Through their loans and grants the Bank and donors have substantially reduced the need for governments to fund research investment. However, this same support expands the eventual requirements for

government funding of the research investment. The willingness to support some governments in research investment has led to an unhealthy dependence on donor support on the part of even some relatively large NARSs, such as those in Bangladesh, Indonesia, and Kenya, and the expansion of most NARSs in the 1980s has undoubtedly contributed to the serious recurrent cost funding problems so many systems are experiencing in the 1990s.

In AFR, the low fiscal capacity of most governments has led to particularly extensive support by the Bank and donors. Not only has this meant funding incremental operating costs, but the recent Mali project and the proposed Cameroon project included all recurrent costs as "capital" items, and in other countries the full costs of priority research programs were funded (Annex 6). While this may have merit on the grounds of importance and need, it is questionable with respect to the objective of building sustainable research institutions. Certainly, the Bank and other donors should not consider such measures without first analyzing the appropriateness of a government's strategy and practice concerning:

- The support for the agricultural sector and the adequacy of this support in relation to its economic and social importance.
- The allocations to research within the sectoral budget.
- The existence of policies and regulations conducive to the private sector participating in technology development and adaptation and to users being able to pay for these services (through a policy environment that allows them to realize an appropriate percentage of the real economic value of commodities produced).
- The extent to which a NARS is willing to rationalize its investments and to cooperate in regional initiatives to make the best use of available research resources.[15]

The Bank and donors should resist the temptation to be excessive in supporting NARS development because of the apparent immediate need for improved technologies for AFR farming systems. Fiscal sustainability must be a primary consideration. Otherwise, substantial investments will not be efficiently maintained or utilized, to the detriment of aid effectiveness. The Bank and donor community need to work with national governments and their NARSs in determining how best to develop sustainable systems, rather than uncritically drifting toward models that might be preferable under higher, but unsustainable, levels of funding.

Regional rationalization of research investment. The Bank's support for initiatives to rationalize research investment in AFR on a regional basis, so that each NARS does not attempt to be self-sufficient in all aspects of technology development, is to be highly commended. However, although the frameworks for action developed under these initiatives have merit (Box 9.1 and Annex 6), the collaborative aspects of the programs are of concern. Donors are still somewhat reticent about adjusting their support from research areas in which they have enjoyed a long-standing relationship with a NARS agency to contribute to general agricultural research funds. This reticence may be overcome by strengthening national research master plans, developing regional research priorities, and adopting mechanisms that allow the identification of particular donor-financed components within research programs supported under consolidated funding mechanisms. Similarly, individual NARSs are reluctant to contribute counter-

part funds to support regional programs implemented in other countries. The only instance in which this occurred as of the end of 1995 is the contributions by the Southern African group of NARSs to the Southern Africa Development Community's crop and forest seed gene bank program in Zambia, which had previously been wholly funded by the Nordic donor group. Since 1992 the coverage of participation costs by African country members in the secretariat activities for this group have also increased gradually, so that in 1995/96 these member states were meeting nearly 60 percent of the total secretariat costs of $1.6 million, with donors funding the remainder. In addition to these initiatives in sub-Saharan Africa, agroecological similarities in, say, the Magreb countries suggest possibilities for substantial regional collaboration in research, but the Bank appears to have done little to promote this efficiency concept beyond its indirect influence through the regional networking activities of the International Center for Agricultural Research in the Dry Areas (which it supports through the CGIAR).

Researcher performance incentives

The Bank's support for NARS development has been directed at increasing both the quantity of relevant technology and the quality of the research process. Neither objective can be fully realized in a NARS, however, unless an appropriate performance incentive framework for researchers is in place.

An attractive remuneration package and promotion and merit awards based on performance are the best incentives for researchers

The virtually universal components in research projects of infrastructure, equipment, and postgraduate training opportunities have helped provide basic facilities and the scientific skills needed for effective research. The opportunities for researchers to have access to advanced training and overseas study tours and to participate in conferences in projects funded by the Bank and donors have acted as incentives for researchers to remain in public sector research, even if the awarding of such benefits has not always been commensurate with candidates' real performance or potential. In practice, many large NARSs have commonly favored federal or central research staff for receipt of scholarships over state or regional researchers (for example, India, Indonesia, and Pakistan), and an "allegiance" factor has also been a major prejudicial influence, as in the case of Peru.

If a capacity for sound research strategies and carefully prioritized research programs can be developed, this should eventually have an indirect, positive effect on researchers' incentives to perform, as they would tend to view themselves as part of a legitimate, important strategy to develop technology. However, these management concepts still have a long way to go before they are accepted procedures in most NARSs. Collaborative research work with leading research institutions (including CG centers) has usually had positive effects on researchers' morale.

Despite these factors conducive to enhanced performance by researchers, the common occurrence of funds being too scarce to support research operations has had, and is having, a negative effect on research quality. Unfortunately, reduced budgetary support has especially affected the quantity and quality (through reduced supervision and beneficiary interaction) of critical on-farm research. Such research is necessary to generate relevant technology, but usually involves greater expenditures for consumables such as fuel and travel allowances than does research at existing facilities on-station.[16] Not only has the budget been a constraint, but in many counties, delayed release of approved funds has thwarted efforts to make the best use of scarce funds. Limited national funding and an excessive dependency on external loans and grants has also meant that many researchers are on temporary contracts under development budgets

BOX 9.1: REGIONAL RESEARCH INITIATIVES IN AFRICA

The Special Program for African Agricultural Research (SPAAR) was established in 1985 as an informal group to improve donor consultation and collaboration in support of agricultural research in sub-Saharan Africa. Its secretariat is now located in the World Bank within the Technical Department of the Bank's Africa region. Although the NARSs in sub-Saharan Africa were always party to the collaboration process, in 1994 SPAAR membership was formally opened to representatives of all NARSs in sub-Saharan Africa.

SPAAR had little impact in the late 1980s. In May 1990 it adopted a more proactive approach and launched a special initiative to revitalize agricultural research systems in the main ecopolitical regions of sub-Saharan Africa. The main objective of this initiative was to increase agricultural productivity by invigorating NARSs within a regional context, including establishing new modes of regional cooperation based on principles of comparative advantage and the relative strengths of national systems. In conjunction with relevant African national and regional organizations, SPAAR developed four regional frameworks for action to promote a coalition for financial support among national governments, donors, and nongovernmental organizations (Spurling and others 1992; Weijenberg and others 1993, 1995).

The four regional frameworks for action have been designed for (a) the Sahel and the nine countries collaborating in the Permanent Inter-State Committee for Drought Control in the Sahel, (b) the 11 countries collaborating in the Southern African Development Community; (c) the 15 countries of the humid and subhumid zones of Central and Western Africa; and (d) the eight countries of Eastern Africa, including members of the Inter-Governmental Authority on Drought and Development, Burundi, and Rwanda. Implementation of the frameworks for action began in two pilot countries, Mali and Tanzania, in 1991. Early experience led to identification of the following six principles as important for a strong NARS: (a) a plan of action or a master plan for research; (b) a financing mechanism that will assure a stable, sufficient, and timely supply of funds to implement the plan; (c) a management and institutional capacity to implement the plan and be accountable for the budget; (d) the establishment of a management advisory group consisting of representatives from all stakeholders to advise management on its program of work; (e) the presence of effective linkages between the research and extension services and farmers; and (f) the presence of strong linkages with regional and international research institutions. The findings of this review are consistent with these principles.

(for example, Bangladesh), which means they are less likely to be completely dedicated to research programs.

Probably the most direct incentives for encouraging researchers' performance and research quality are an attractive remuneration package and promotion and merit awards in accordance with performance. These characteristics are rare in developing country NARSs, where personnel policies tend to be the same as those in the national public service rather than being geared to stimulating performance. In SAS, promotion in accordance with length of service rather than performance appears to be especially entrenched. In Bangladesh and Sri Lanka many researchers are resisting the adoption of any system that might detract from employment security, even if the alternative pays more to those exhibiting higher levels of performance.

(Box 9.1 continued)

SPAAR engaged independent consultants in 1994 to examine progress made in Mali and Tanzania in implementing their respective frameworks for action and in four other countries in East and West Africa (Spencer, Kleene, and Davies 1995). Some of their findings relevant to this review include the following:

- The master planning process had a significant effect in aligning research with national development objectives. Priority setting, usually based on a weighted checklist system, was successfully undertaken. The process allowed the NARSs to be more competent in identifying priority areas for collaborative research, particularly with the CG centers.
- The use of carefully selected consultants with experience in research planning and in existing agency systems was justified to improve the research planning process. ISNAR's contribution was particularly beneficial.
- In line with weaknesses in economic analysis capability, policy research received little attention.
- Moves to decentralize decisionmaking complemented more client-oriented initiatives.
- The involvement of nongovernmental organizations and farmers' organizations in research committees and planning was efficient in promoting client responsiveness, and the involvement of farmers worked well at the local level.
- The preparation of a master plan generally resulted in increased commitment to budgetary support by national funding agencies, and NARSs were also pursuing private sector funding.
- Consolidated funding mechanisms were not being activated as quickly as intended financiers intimated. The necessary legal frameworks were often not in place.
- Research investment necessarily had to support research facilities and equipment hardware as well as attempting to improve management systems in the research software emphasis of the frameworks for actions.
- The conservative attitudes of both NARS agencies and donors in giving priority to their perceived institutional interests rather than to investment in regional research cooperation were evident.
- Significant downsizing had commenced in some NARS agencies, but uncertainties created in the process needed to be complemented by improved conditions of professional service if anticipated benefits were to be realized. Semiautonomous institutional status appeared to be essential for improved schemes of service.
- The persistent problem of poor financial management was being partly addressed by the use of appropriate financial hardware and software, but agencies needed training and assistance to use these effectively.

For improved personnel policies that can provide incentives to staff, an autonomous or semiautonomous institutional arrangement usually seems to be necessary. However, even though use of the autonomous institute model has increased, attempts to make pay scales reasonably attractive have been rare. In AFR, Mali and Uganda are attempting to introduce improved schemes of service. However, most NARSs have made little progress in this direction, and pay scales for researchers generally remain low relative to those available in the private sector, and even at universities in some countries (for example, Turkey). Morocco and Tunisia achieved improved salary scales for their autonomous research institutes with the assistance of sectoral program lending. However, general public sector pay increases subsequently nullified this advantage in Morocco, and in Tunisia the initial advantage has been gradually reduced. A similar decline has occurred in Brazil.

Even when the adoption of an autonomous status has led to better remuneration for researchers, this has not always had the desired effects on performance. In The Gambia the increased cost of salaries starved operational support within the limited budget to the detriment of research output. In China researchers' salaries are relatively low, but are being supplemented by general bonuses derived from development or commercial income (which also supplements the operational costs of research). Salaries are still not high enough, however, to attract many externally trained scientists to return to China. Fortunately, the work ethic is generally high in China, which has favorable implications for this massive research system, and awards for outstanding achievements in research (which carry considerable prestige and provide a modest amount of cash) have also capitalized on this ethic.

Across the NARSs, salary scales in public research institutions are unlikely to be able to compete with alternative private sector employment. This applies equally to major NARSs in higher-income developing countries in LAC and to smaller systems in AFR. Institute autonomy offers the possibility of at least reaching benefit levels comparable to those in other public entities, such as universities and production parastatals, but as previously indicated, this has not always resulted in the intended advantage in salary levels. This implies that performance incentives will have to rely heavily on the adoption of measures that recognize good performance and create working environments conducive to productive output (for example, adequate facilities and operational funds, a demand-driven and clearly defined research strategy, and sound management).

Research components in commodity development projects largely succeeded when they supported existing public or semipublic research institutions

Contribution of component projects

A 1991 review of ongoing and completed research component projects funded by the Bank (Purcell 1994) reached the following tentative conclusions about the component project part of the portfolio:

- When research was a minor component in a project, it usually did not receive adequate attention from the borrower or from Bank supervision missions, and thus the results were poor.
- If a research capacity had to be established, expecting significant research output within a project time frame was unrealistic.
- Linking projects with established research institutions can be beneficial in deriving technology relevant to the project, as well as in supporting national capacity.

This more comprehensive review generally supports these findings and expands some of them (Annex 6). Research components in commodity development projects have largely succeeded when they were able to support existing public or semipublic research institutions (the latter are common for many export commodities). Attempts to establish special research units for the project outside the national system research system have usually been inadvisable. However, reliance on existing institutional capacity that is deficient in terms of management, direction, and implementation has also tended to yield less than satisfactory results. Providing project support for particular aspects of research strategies and programs that are being generally supported under a more comprehensive project has yielded good results, not only in institutional development, but also in the development of technology relevant to the component project's beneficiaries.

Overall, component research projects are likely to contribute to technology development in the short term if they are significant enough to command attention and are linked with an established, reasonably efficient, institutionalized research system for the sector or for the commodities concerned. They are likely to contribute to institutional development for research only when their input complements a more comprehensive attempt to enhance NARS efficiency.

The Bank's education portfolio did not contribute significantly to the development of universities' agricultural research capacity

A positive contribution of policy-based lending in structural and sectoral loans in ECA/MNA has been mentioned (Annex 6). However, these instances represent interventions that were not isolated attempts at institutional improvement, but were part of a progressive dialogue and action program for reforming research institutions. In other countries that lack an established commitment to improvement, the relatively minor role of any research reform in the total adjustment package usually leads to poor or partial implementation (Pritchard 1990, 1994; Purcell 1994). The Bank's education project portfolio did not contribute significantly to the development of agricultural research capacity at universities. Curriculum development in agricultural faculties was, however, appreciable through these projects, even though linkage with other components of NARSs was usually insufficient to ensure that curricula were responsive to emerging research strategies and orientation, such as the increased use of a farming system perspective and greater emphasis on socioeconomics.

Notes

1. In Indonesia, a 1992 study by ISNAR and Indonesia's Agency for Agricultural Research and Development on the two major research programs, rice and soybeans, from 1974 indicated marginal rates of return of around 100 percent and 48 percent, respectively (Pardey and others 1992), based on production function estimates of the growth-promoting effects of the agency's past research investments in these commodities. The Brazilian Agricultural Research Corporation, using a simplified version of an economic surplus model, estimated economic rates of return of 40 percent on its research investments in three regions that were assisted by Bank projects. Other economic surplus evaluation studies in Senegal with a 63 percent rate of return (Schwartz and others 1989) and Peru with a 17 to 38 percent rate of return (Norton, Ganoza, and Pomareda 1987) are not relevant as the former was limited to a particular aid program for cowpeas and the programs in the latter had been little influenced by Bank projects.
2. Of the 17 projects that were audited independently by OED after fiscal 1983, 59 percent were rated as satisfactory. Five research projects (29 percent) were downgraded at the time of audit, which is a higher proportion of downgrading than for all projects (10 percent), but the sample size is small.
3. In the Bank's rating system for agricultural research projects, as most have a strong institution-building component, the major consideration in rating sustainability is whether the system supported by the investments in infrastructure, equipment, staff training, and management is likely to be sustained. The likelihood of adequate funding, particularly as fiscal support for public sector research institutions, receives special attention. The sustainability assessment does not normally pertain to the output or funding of individual research programs, except where the Bank's support pertains to the development of technologies through specific programs.
4. Loans rarely funded incremental salaries in AFR, ECA/MNA, and EAP; however, they did do so in one-third of LAC projects and three-quarters of SAS research projects (Annex Figure 6.1).
5. In the U.S. NARS, which is generally considered to be a productive system, about 80 percent of the researchers have doctorates and a further 10 percent have master of science qualifications. By contrast, the Australian NARS is also rated highly and has demonstrated substantial returns to research investment, but in the early 1980s the federal-level institutions (basic, strategic, and applied research) operated with a staff of which 51 percent held doctorates and 17 percent had master of science degrees, while the state-level institutions (primarily applied and adaptive research) had only 17 percent of staff with

doctorates and 17 percent with master of science qualifications, with a large part of the research load carried by staff with bachelor of agricultural science degrees (Pardey, Roseboom, and Anderson 1991c). University staff in the U.S. and Australia, however, had a similar distribution of qualifications.

6. According to an internal Bank report, where agricultural higher education projects have attempted to address postgraduate training, they paid little attention to the different levels of requirements for doctorates and master of science degrees, which implies inadequate analysis of resource capacity and insufficient attention to strategic planning in these facilities.

7. While this particular lack of congruence is by no means the only factor to be considered in rationalizing allocations by NARSs and in determining Bank support, it does illustrate the generally low level of support most NARSs give to livestock research. Prioritization using an economic surplus model approach would likely indicate a greater need for resource allocation to livestock research; however, such analyses would have to take into account the possibility of acquisition of technology from elsewhere, including private sources.

8. Unless the weights given to different aspects of a ranking system are appropriate, the analysis can give misleading results. As Annex 7 points out, the primary ranking should be based on estimated productivity and economic growth prospects, with other considerations such as distributional and equity factors perhaps being applied subsequently as modifying weights. CSIRO (1993) provides an example of a ranking exercise within a national animal health program in an industrial country.

9. In smaller countries, scarce human resources in the social sciences may dictate that a sectoral ministry is the primary location of sectoral policy analysis. This does not, however, remove the need for NARSs to have a capacity in the social sciences to enable appropriate research planning and interpretation of results and to facilitate interaction with policymakers on sectoral technology issues.

10. During the period under review, the Bank recruited a number of agricultural research specialists, but this has been largely offset by attrition.

11. In recent years ISNAR has produced guidelines on concepts and methods of monitoring and evaluation and the use of performance indicators in research programs (for example, Horton and others 1993; Murphy 1995). In 1995 the Bank also made a concerted effort to formulate performance indicators for agricultural sector projects, including research projects (World Bank 1995).

12. Currently, researchers in Kenya are progressively taking a six-month course in the farming system approach to research under the auspices of a Swedish International Development Authority / International Center for Improvement of Maize and Wheat program at Kenya's Egerton University.

13. The designers of the next phase of the Kenyan agricultural research system are emphasizing the involvement of research-extension agronomists in farming systems research and adaptive research design and implementation at regional centers.

14. In their review of this proportion across different country income groups based on data for 1981–85, Roe and Pardey (1991) observed no obvious trend related to income group.

15. In some of the few instances in which the Bank has, in principle, agreed on rationalization in its dialogue with borrowers, the Bank unfortunately has not paid sufficient attention to lack of action on the borrowers' part (Annex 6).

16. Despite this, a greater reliance on on-farm research need not necessarily mean higher costs for a total research system if the on-station research investment and infrastructure are correspondingly rationalized (reduced).

10. Conclusions and recommendations

The ex post ratings of research projects indicate a satisfactory performance for 72 percent of the research portfolio during the review period, which was better than the performance of agricultural sector projects overall. However, considering the key role that technology development plays in improving agricultural productivity and alleviating both rural and urban poverty, and the currently unavoidable softness of the performance criteria used in assessment, the Bank should consider this level of performance to be unacceptable. Concern about this performance is exacerbated by ex post evaluations that indicate that the sustainability of research investments was uncertain in almost half of the projects assessed as satisfactory.

Most national research systems have a long way to go before they can be seen as efficient and able to meet the sector's technology needs

The Bank largely met the lending targets enunciated in its 1980 research policy paper and made significant efforts to address most of the paper's recommendations. However, most of the NARSs it assisted still have a long way to go before they can be viewed as efficient research systems adequately geared to meet the sector's technology needs. In addition, the policy paper did not give adequate attention to some important issues, including the need to ensure that research investments are in line with the borrowers' institutional and fiscal capacities and the need to examine whether borrowers should rationalize their existing research investments before the Bank supports new development. Both these issues are associated with one of the most serious problems facing NARSs: inadequate funding of the public sector elements of these systems. In addition, the Bank did not take sufficient account of economic considerations in program planning and evaluation, which could yield rewards in terms of more efficient use of scarce resources.

The policy paper was uncritically enthusiastic about setting ARI targets at an average of 2 percent for developing countries in which agriculture was the key economic sector, and did not adequately appreciate the need to balance the desirability of expanding capacity with concern for the efficiency and sustainability of a research system. It also neglected to give sufficient attention to farmer involvement in the research process and to gender issues.

Challenges of NARS assistance

As Chapter 9 noted, the current status of assisted NARSs (as well as others that have not yet received Bank support) poses significant challenges for the Bank if it is to meet its objective of stimulating technological development and productivity growth in the developing world. These challenges are:

- Commitment by borrowers to develop and sustain appropriate research capacity and by the Bank to assist in this process.

- Design of research interventions that have a high probability of being sustained with adequate funding in both the near and the long term.
- Project design that ensures that investments are suitable for local conditions.
- Programming and management of NARS institutions to maximize efficiency and cost-effectiveness in the research process.
- Incentive structures for staff of NARS institutions.
- Bank staff capacity.

Commitment

Borrowers have indicated their support for expanded agricultural research capacity by undertaking research projects using loan, credit, and grant financing. Government ministries responsible for public sector research institutions have generally been eager to expand their research agencies. This apparent support, however, has not been sufficient to result in adequate funding of these institutions once infrastructure and human resource investments have been made, nor has it resulted in the necessary attention paid to measures to increase research quality.

Agricultural services, and especially the role of national research systems, should be an integral part of the country assistance strategy

The Bank has demonstrated its commitment through expanded research lending. However, with few exceptions, it has usually undertaken research projects in response to a simple appreciation that new technology must be generated, or at best, in response to an analysis of constraints to development of the sector. Rarely has the Bank considered project identification as an integral part of a borrower's strategy for economic development and poverty alleviation.

Agricultural research should assume its proper place in the dialogue between the Bank and its clients concerning national economic development. Borrowers depend heavily on the agricultural sector for production value and employment, although countries vary considerably in the degree of this dependence. Thus in discussions with borrowers the Bank should present the acquisition and generation of technology to boost productivity in the sector as a key element of development. This implies that within the Bank, not only the agricultural sector, but agricultural services generally and the role of NARSs in particular, should be an integral part of the *country assistance strategy* developed with client government officials. Without this overt attention, most funding ministries are likely to consider research as a useful, but not critical, service that warrants investment, but is not essential enough to have high priority for operational funding in times of fiscal scarcity. In the same vein, ministries such as finance and public service are unlikely to treat attempts to introduce personnel and incentive policies conducive to high performance by research workers in the public sector sympathetically.

In its dialogue with borrowers the Bank should also pay specific attention to the relationship between *the research and the education sectors.* This is important not only because of the need to establish facilities and curricula consistent with the objectives of both public and private research agencies, but also because of the contributions that academic institutions can make to research programs. The Bank must make its country operations managers aware of the value of this linkage.

The installation of monitoring and evaluation procedures and the development of economic analysis expertise within countries' research systems are other

aspects of research that would benefit from inclusion in general economic dialogue with borrowers. Agreements with central ministries that research institutions will use ex ante and ex post evaluation as part of their programming would be a strong incentive for agencies quickly to incorporate such measures and make them effective. Similarly, an increased ability by NARS units to contribute to economic policy formation is likely to increase the prestige and importance of research.

The Bank has amply demonstrated its commitment to *international agricultural research*. However, Bank projects should further develop and strengthen the linkage between CG centers and NARSs. This issue is raised again later in the discussion of Bank staff capability.

Project design in accord with borrowers' capacity

According to the findings of this review, the most serious problem facing the Bank in its assistance to NARSs is ensuring that its investment in institutions will be *sustainable*. The record is not encouraging. This is largely related to borrowers' inability or unwillingness to support the investments when external support declines. Thus the Bank has two obligations: (a) to seek to influence public expenditure patterns to include appropriate future levels of support for research, both in total budgetary allocations and in the timely release of these allocations; and (b) to be realistic in designing its interventions so that they are consistent with probable future levels of support for a research system.

The obvious need for greater research capacity must not be allowed to dominate the practical issue of sustainability

The Bank has devoted little effort to *rationalization* of systems, giving priority instead to expansion and to the improvement of processes. The obvious need for greater research capacity must not be allowed to dominate the practical consideration of sustainability. Given the long-run nature of agricultural research and its dependence on stable resource commitments, investments made and not sustained are a waste of national and Bank resources. In most cases, at least some expansion of critical parts of the system will be warranted, but the Bank should recognize that undertaking such expansion without prior analysis of the entire system and its agencies is a risky and potentially wasteful approach.

A national agricultural research system includes state and parastatal research institutions, academic institutions, and private sector research entities. The latter are much more significant in some developing regions than in others, and are the most developed in LAC. In all countries, however, the Bank should *promote conditions conducive to private investment* in research and conditions that favor the importation of technology. Public sector research into cost-effective production of public good products should be socially quite profitable in its own right, and public funding is likely to dominate in developing countries for the foreseeable future. However, fiscal resource constraints dictate that the private sector should be encouraged to develop its own capacity in those fields that lend themselves to the development of appropriate research products. In addition, the public and private sectors do not need to be completely separated: important components of public programs might be done under tender arrangements with private interests under competitive research funding arrangements.

Particularly pertinent for most NARSs is *cost recovery* of public sector research expenditures. Sources of funds include commercial firms, producer organizations, parastatal enterprises, and nongovernmental organizations interested in particular areas of technology development. The Bank has paid little attention to cost recovery in its sectoral analysis and project design, except in promoting the establishment of funds or foundations that could be used to finance research

under competitive grant schemes. Bank-supported projects made wide use of this concept, especially in the latter part of the review period, and particularly in AFR, LAC, and SAS. However, it was usually introduced to encourage participation by sister research agencies and to foster greater accountability, rather than to attract private resources into the research fund.

The results of the competitive grant schemes varied, but such initiatives have largely represented an attempt to involve those parts of the research system not being directly assisted. Even though this may sometimes be seen as an easy way around the requirement to take all potential research institutions into account in project formulation, if properly organized and managed, competitive grant schemes can be a useful tool to mobilize resources and create a facility to expand funding sources. In practice, however, borrowers' limited capacity to manage project components adequately has often resulted in such schemes achieving little. Nevertheless, Bank staff are obligated to explore such opportunities and, where useful, help to arrange external assistance and bring experience in other settings to bear on local implementation efforts.

Before agreeing to high levels of support, the Bank should be convinced of the borrower's full commitment to the intended scale and quality of research

The Bank should continue to support the *SPAAR initiative* in AFR as one way to grapple with the funding crisis in that region, and should encourage similar collaboration in other areas for example, the Magreb countries. Support by borrowers (and even by some donors) for this concept in terms of contributing funds to regional research units for particular aspects of research with ecoregional implications has been less than satisfactory. This represents an area where borrowers can demonstrate their commitment to research. It also represents appreciation of the fact that resources are scarce and of the need to establish sustainable institutions, and acceptance of the ultimate objective as being to meet the technological needs of the farming sector rather than to expand local bureaucracies.

Aware of the dire need to improve research capacity, the Bank has, in some instances, funded high proportions of the *operating costs* of research agencies. While this has obvious short-term advantages to agencies in easing their financial constraints, it can have negative implications for the sustainability of the institutions and of research programs. Before agreeing to high levels of support for operating costs on a temporary basis, the Bank should be convinced that the borrower has demonstrated (rather than merely promised) its full commitment to support the intended scale and quality of research. Factors that would demonstrate commitment might include a willingness to rationalize existing facilities and programs, to cooperate in regional and international initiatives, to adopt a favorable framework for importing relevant technology, to introduce personnel policies that create a favorable environment for research, and to release budgetary allocations for research in a timely manner. The intensive financing of key programs within comprehensive projects to assist national research should be subject to similar criteria that demonstrate commitment.

All potential borrowers are unlikely to have the commitment and the policy and institutional environment needed to establish effective, efficient, and sustainable national research systems. If that is the case, the Bank could not normally justify embarking on a comprehensive investment program to overhaul the national system. This does not imply, however, that support for targeted programs within a NARS would not be warranted while the Bank attempts to create a more favorable investment environment through dialogue with the borrower. Such targeted programs are likely to be of such obvious importance that borrower and agency commitment would be highly probable. They may pertain to key programs such as plant breeding for staple crops, where interruptions would be extremely costly, or to research programs aimed at solving specific

technological constraints in commodities or systems that have substantial potential benefits, for example, an important export crop or a problem that affects large numbers of smallholders. The problems that have often occurred in isolated interventions in research component projects should be avoided in such programs because of their importance.

The Bank is the major external financier of NARS development, but there are other substantial contributors to this international effort. It behooves the Bank to be willing, when necessary, to take a leading role in *donor coordination* to encourage a unified approach in assisting development of a NARS, especially concerning sustainability of investments, and to enable fruitful dialogue with the borrower and its agencies in designing interventions that make the best use of both national and external resources.

Design of appropriate investments

Some projects have made costly mistakes in procuring unnecessary or *unsuitable equipment*. In many cases this has been associated with improper scheduling of investments. Projects have procured equipment before they have defined research programs and their specific requirements or before scientists were trained to use them. In some cases, projects did not take requirements for maintaining equipment into account, which would have called for special maintenance training programs or perhaps the procurement of less sophisticated equipment. Awareness of these issues on the part of project designers could prevent them. Some ministries have failed to pay enough attention to the detailed design of laboratories and their equipment, and Bank staff have accepted the list supplied by the borrower's agency without serious question. The capability of most Bank staff to review equipment lists in what can be a rapidly changing field is questionable, and specialized technical assistance will usually be required to give sufficient scrutiny to this aspect of design.

The Bank should continue to support the traditional emphasis of most national research systems on applied and adaptive research

The Bank should continue to support most NARSs' traditional emphasis on *applied and adaptive research*. However, the Bank should also help NARSs to develop or extend their strategic, and even basic, research capabilities where need has been established and the probability of successful execution is high.

To date, most Bank research projects have not devoted special attention to *natural resource management*, apart from the general stipulation that technology provided must enable sustainable development. In view of the growing awareness of the importance of natural resource management, encouraging the introduction of specific programs directed at this issue may also be necessary. Without doubt, however, the research process should consider fully the environmental implications of any technologies being developed or adapted.

This report has stressed the benefits of *on-farm research* and the problems countries face in maintaining such programs in times of fiscal constraint. The case for supporting investment in on-farm research is strong, even at the expense of expanding station facilities, but in practice this cannot be taken to its logical conclusion unless firm arrangements are made to guarantee the continuation of on-farm activities when funds are scarce.

Bank projects have paid a good deal of attention to the provision of *library facilities*, but a serious subsequent problem is agencies' inability to pay for journal subscriptions and maintain the facilities' usefulness. With the advancement in international communication networks, concentrating on this aspect of technological and scientific awareness may be preferable to supporting libraries that

are not maintained. This will naturally pose new challenges of adequate maintenance of the necessary telecommunications and computing equipment, of staff training, and of sensitization of managers to the value of timely information. A complementary requirement is the installation of appropriate review and publication policies.

Research as a component of other agricultural projects can be a viable investment if it is large enough to warrant attention, and especially if it is linked with an effective, existing research institution and complements its program. Many Bank projects in this category did not, however, have enough of these characteristics to warrant support. Sectoral adjustment loans in ECA/MNA had some positive impact on institutional reform, but these were part of ongoing dialogues on the role of research in agricultural development, rather than isolated interventions. Elsewhere, research components in this type of loan had little impact.

Institutional efficiency

The Bank and donors need to pay more attention to the analysis of resource availability and to priority setting

A NARS can be considered efficient if it makes cost-effective use of available resources to produce, acquire, and transfer appropriate technology to farmers and others involved in the agricultural production, processing, and marketing system. Chapter 9 showed the many ways in which Bank projects have attempted to enhance NARSs' efficiency, some of them more successful than others. A key intervention, especially in the latter part of the review period, was to try to develop sound research strategies for each NARS and rational programs to implement the defined strategies. This usually necessitated some form of *system coordination*.

The Bank seldom tried to alter the traditional structure of public research institutions, which was most often based on commodities with supporting scientific units divided along disciplinary lines. It often promoted the creation or strengthening of an apex coordinating institution for the NARS. Where this was not feasible, it promoted improved coordination by a similar body within the dominant group of research entities. These coordination efforts did not always succeed, usually because of a lack of commitment by some research entities that preferred a narrow focus on and control over their own research areas. As noted previously, success in involving academic institutions as full partners in defining and implementing research strategies has been limited. Nevertheless, future projects should re-double their efforts to promote the various coordinating mechanisms as a way to improve the use of institutional resources.

At the broad *research strategy* level, there has been progress in such matters as considering potential research outcomes in governments' long-term development programs, sorting out the implications of policy for different commodity groups, and forging links within research systems and between research systems and outside agencies. However, performance in analysis of resource availability and *priority setting* has been much weaker, and the Bank, the donor community, and borrowers need to pay considerably more attention to this area. Undoubtedly, the overall strategy and plan formulation exercises have achieved some benefits, as evidenced, for example, by a general tendency of NARs to be more aware of and responsive to the constraints and potential of less favorable environments and resource-poor farming systems, and second-generation strategies and plans have usually been better than earlier efforts. However, most exercises in programming that are intended to guide strategy implementation have indicated what should be done in terms of the demand for technological improvements. They have seldom faced the issue of deciding on priorities when confronted with binding resource constraints. Even when some form of scoring

model has been used, the model's use, and often the model itself, frequently leave much to be desired. There are also instances in which the results of seemingly useful priority setting exercises have not been translated into action. Furthermore, the extent to which research planning initiatives and the development of master plans has depended on influence and expertise foreign to the NARSs is of serious concern.

The limited institutionalization of improved planning procedures is associated with two important deficiencies in many NARSs: inadequate appreciation of the *importance of economic analysis* in the research process and a scarcity of economic expertise. In turn, the lack of full support for consideration of the economic aspects of NARSs' work can be linked to many researchers' unwillingness to accept that programs should be demand driven and responsive to their clients' needs. Installation of an economic orientation, which will usually involve a change of attitudes by a significant proportion of scientists, needs to be a priority objective for the Bank (and the donor community) in further improving the efficiency of research agencies. Economic considerations are no more important than sound general scientific discipline, which is essential regardless of the degree to which resources are appropriately directed, but the former is much less well developed among the research cadre and the management in most NARSs. As mentioned, a NARS should also be able to contribute to the national and sectoral development debate, and it cannot do this well without a solid capacity for economic analysis.

There is no effective substitute for the use of economic analysis in setting priorities

As Annex 7 demonstrates, there is no effective substitute for the use of economic analysis in priority setting, and an economic surplus model is usually the most appropriate. A simplified, albeit more restrictive, version of this model is the cost-saving/increased profitability approach, which limits itself to market benefits and ignores (at some cost) the welfare and external effects of a more complete economic surplus model (Antony and Anderson 1991; Johnston and others 1992). These approaches can be implemented without econometric analysis, and the simplified version can be implemented without the articulation of explicit supply and income elasticities. Subjective judgments will inevitably be involved, but organizing information in a manner consistent with such models increases the probability of providing relevant assessments. A by-product is a set of internal rate of return, benefit-cost ratio, and net present value estimates that can be used to help argue for budgetary allocations.

Simplified scoring methods, which often attempt to approximate economic surplus measures, can be used where the resources for a more complete analysis are not available (Annex 7). However, at least rough economic efficiency indices must be calculated for these methods to be worthwhile. The tradeoff is in their qualitative nature, whereby no concrete opportunity costs for alternatives are calculated.

Informal methods that make structured judgments based on a consideration of the principal determinants of the net present value of research (Box 10.1) are likely to be more reliable than poor execution of simplified scoring methods and than other nonscoring methods, such as congruence tests. The latter technique would, at best, give a reliable ranking only if all the factors omitted (for example, probability of research success, likely adoption rates, and likely productivity gains) were equal among programs. Congruence tests should only be used to complement a more comprehensive consideration of economic benefits (Anderson and Parton 1983).

BOX 10.1: GUIDELINES FOR PRIORITY SETTING IN AGRICULTURAL RESEARCH

Market failure

Priorities for public research funding should be in areas with high social returns and low private returns. Where market failure exists but returns accrue mainly to the private sector, forms of government intervention other than direct funding become appropriate (Lloyd, Harris, and Tribe 1990).

Efficiency

Domestic net present benefits from research are higher:

- The larger the total preresearch value of production of the commodity
- The faster the expected growth of the industry
- The greater the proportional reduction in unit costs induced by research
- The higher the probability of research success
- The higher the ceiling rate of domestic adoption
- The faster the domestic adoption of the research results
- The lower the adoption of research results in other countries
- The sooner the reduction in unit costs is realized
- The lower the rate of research depreciation
- The lower the research costs
- The lower the interest rate
- The lower the opportunity cost of government funds
- The smaller the domestic production as a share of global production of the commodity
- The greater the effects of research on reducing the distorting effects of price policies
- The greater the effects of research on reducing the distorting effects of externalities.

Many price-distorting policies do not affect net domestic research benefits, although the distribution of benefits tends to be shifted toward those being assisted by the price policy.

Distribution

Research is a relatively blunt tool for meeting distributional objectives, such as income distribution, compared with other policy instruments such as taxes and subsidies. Research tends to be both an ineffective and a costly method for pursuing social policy objectives.

Domestic producer benefits increase as a share of total benefits:

- The higher the domestic price elasticity of demand for the commodity
- The lower the price elasticity of supply of the commodity
- The smaller the domestic production as a share of global production of the commodity
- The further down the marketing chain toward farm-level production the technology is applicable
- The lower the adoption of research results in other countries
- The faster the adoption of research results domestically relative to adoption in other countries.

Source: Alston, Norton, and Pardey 1995, 491.

Equally as important as having sound priority setting procedures in place is the manner in which these procedures are carried out and the means used to communicate results to staff and external stakeholders. The process must be seen as systematic, logical, transparent, and participatory, and decisions about strategy, programs, and resource allocation must be responsive to the process if it is to be respected and supported. It must also be appreciated that priorities can change and the inclusion of a program or subprogram based on a rational priority setting exercise at one time does not preclude its modification or rejection in a subsequent planning review. Sound planning should, however, minimize the need for such changes.

At the level of annual planning and *making choices between projects*, which often has to be done within programs, institutes, or research stations, the calculation of a quantitative economic measure of likely impact would normally not be warranted. Technical review in committees using peer reviews can go a long way toward attaining efficiency in the use of resources available to individual research managers, but decisions at this level must also take the agency's objectives and the economic arguments related to how they are to be achieved into account, so that the economic implications of project options are considered. Awareness and use of the main determinants of the value of research (Box 10.1) should be of help in this. Even on the noneconomic side, the Bank will, however, have to pay more attention to the quality of the peer review process. Public service and seniority-ridden traditions frequently act against an effective peer review process.

Although less important in determining the appropriate allocation of research resources, a capacity to undertake *ex post evaluation* is necessary to inform research decisionmakers and to help justify funding by public officials and other contributing parties (including user groups). Economists favor an econometric approach that enables derivation of supply relationships in evaluating aggregate and commodity research programs, but data limitations usually constrain its application. (The evaluation study by Pardey and others 1992 cited in Chapter 9 essentially uses this approach.) When adequate time series data are not available, an economic surplus approach can still be used (as for ex ante estimations) that relies on experimental data and scientists' and extension workers' estimates of unit cost changes (or yield improvements) and adoption rates for the key technologies that developed during the relevant period (Annex 7). (The evaluation studies in Brazil cited in Chapter 9, note 1, used a simplified version of this approach.) The degree of detail to include in the economic surplus model depends on the purpose of the analysis, the information on influencing factors (for example, policies and agroecological zones) that is available, and resources. The distributional effects of research are particularly sensitive to the degree of detail in the model. Computerized research evaluation programs (for instance, Wood and Wood-Sichra 1995) have recently facilitated this type of analysis. The major constraints are the lack of information and of the resources needed to collect the information and construct the necessary data sets. Although NARSs should not attempt to evaluate all programs in this way, most could aspire to undertake such analysis on selected programs for the benefit of research decisionmakers and public funding officials, and ultimately of the farming community beneficiaries (Alston, Norton, and Pardey 1995). As in the case of ex ante analysis, a simplified evaluation model that restricts itself to direct market benefits is widely applicable (Johnston and others 1992).

The Bank cannot expect national research systems to pay attention to economic issues if the Bank itself does not give these issues priority

The Bank cannot expect NARSs to give attention to these economic issues if it does not also give them priority in project design, supervision, and ex post evaluation. The *Bank* has not done so in the past. It cannot justify this neglect and its

BOX 10.2: EX ANTE ANALYSIS FOR AGRICULTURAL RESEARCH IN BANGLADESH

Bangladesh has a large and complex NARS. The NARS has a central institution, the Bangladesh Agricultural Research Council (BARC), and 11 agricultural research institutes. The institutes are organized by commodity, with separate entities for rice, fisheries, livestock, forestry; cotton, tea, sugarcane, jute, and other crops (wheat, legumes, fruits, and vegetables), and report to four ministries. Farmers produce the commodities in disparate seasons, production systems, and scales and with varying sources of water and intensity of resource use.

Although BARC has endeavored to manage priorities for research resource allocation across the 11 institutes (there is no private research, but there is significant imported research, mainly from the CG centers), it has often lacked an organizing principle, which is vital in view of the technical (and bureaucratic) complexity of Bangladeshi agriculture. In the past seven years, BARC and the institutes have begun to introduce such a principle through ex ante economic analysis of research programs.

With ISNAR assistance, BARC began ex ante economic analysis by questioning national scientists about the constraints to agricultural production in more than 50 commodities, which constitute practically all value added in the rural sector. Scientists' estimates of probable yield gains were quantified, as were the time needed to achieve gains and the probabilities that farmers would apply new technologies generated by research. The resulting expected productivity gains in farmers' fields were defined as the benefits of research. BARC used a similar method to derive expected research costs. The resulting benefits and costs were put into a standard net present value model of net benefits. ISNAR staff developed the approach in close collaboration with national scientists, who provided the benefit and cost data. The appraisal of the new Agricultural Research Management Project, which receives IDA support, used the results of this work with some modification.

The master plans for each institute now use the method of ex ante economic analysis. It will also be applied at the level of new research programs and, where data are available, for large, discrete projects in which a separate analysis is both appropriate and feasible. BARC and the institutes will extend the method in two directions. One will be to combine data on research costs from an MIS in each institute with data on benefits from field surveys to allow research managers to modify allocations according to relative costs and benefits. A second new direction will be to take an aggregate view of returns to research across institutions and production systems to allow senior decision-makers to monitor developments. While a foreign consultant will be involved in the further development and institutionalization of this method, the great majority of the technical input and all the funding will be Bangladeshi.

Source: Personal communication with J. McIntire, World Bank.

reliance on the notion that research usually yields favorable rates of return when one considers the scale of the Bank's research investment and the pressure it puts on borrowers to allocate more resources to research. This means that Bank staff should undertake ex ante estimation of economic benefits during the project preparation and appraisal process. The staff appraisal report for the

agricultural research management project in Bangladesh approved in 1996 demonstrates one practical approach for ex ante estimation of the economic benefits of research programs to be supported under a project. It did not attempt to assess the rate of return to the overall project, but used the preparation and appraisal process as a training exercise in using economic analysis to assess program priorities (see Box 10.2). It established an economic rationale for the research programs and provided a basis for ex post evaluation within the agencies (which the Bank can also use in its ex post evaluation of the project). Examples such as this could serve as case studies in Bank staff training programs and as operational examples for research managers from other countries.

The Bank and donors should pay more attention to the adoption of practical research information systems

The Bank and donors should pay more attention to the adoption of practical research *information systems* and sets of *performance indicators*. Not only will this enable NARS management to plan better and to improve decisionmaking, but it will also provide a better basis for evaluating program outcomes (and costs) and for introducing the concept of accountability for managers, research teams, and individuals. The attempts to develop MISs have usually not generated wide support in the institutions into which they have been introduced. This, and the poor record of straightforward financial management in many NARS, are indicative of the general lack of attention to measuring progress and performance.

Most NARSs have moved, albeit often slowly, toward introducing economic analysis by employing a number of *economists and other social scientists*. However, not only will further recruitment be necessary in most NARSs, but the senior management of research institutions will also often have to give more support and recognition to the role of economists and economic analysis than they currently receive. With the emphasis on maintaining the scale of work and staffing levels within the limits of scarce resources, managers will have to be convinced of the benefits to be derived from this often new and unfamiliar thrust. The design of project interventions will have to take the need to educate managers about the opportunities and benefits into account. Nevertheless, the current scarcity of economists in research agencies will necessitate some hard choices about where to allocate this resource in the near term. Perhaps NARs should give the highest priority to improving the understanding of the characteristics of farming systems and farmer behavior, which implies a capacity for carrying out diagnostic surveys and monitoring the adoption of technologies. These considerations are basic for producing relevant technology, which is ostensibly the primary objective of many research institutions. A second priority would be the use of economic expertise in the research prioritization process, which is essential if public sector research is to make the best use of scarce fiscal resources. In most cases sufficient capacity in the social sciences to address both these key areas of research improvement should be available.

Both the Bank and donors have strongly fostered the *quality of scientific research* through postgraduate training programs and the provision of technical assistance. However, more attention should be given to the institutionalization of needs-based training processes. The CG centers have also been active in hands-on research education, aside from their important assistance in supplying germplasm and providing research management advice, and the Bank could provide further support to this training role by including its provision in Bank loan components. Another measure that the Bank should encourage is the development of long-term training and research relationships between developing country NARSs and leading education and research institutions in more developed countries.

The Bank has promoted an internal peer review system not only for project selection and progress review, but also for facilitating scientific rigor. As mentioned, however, the internal review process is not always satisfactory, and the international community supporting the NARSs will have to continue to insist on improved effectiveness. Independent review of programs by national or international experts has generally had substantial, albeit seldom quantified, benefits. The problem of financing external reviews after project closure is serious, but the Bank, in particular its Agricultural Research and Extension Group (ESDAR), through its dialogue with borrowers and donors, should represent this activity as a use of donor funds that may be highly beneficial. Scientific networking is increasing under the auspices of the CG centers and regional organizations. However, access to and use of scientific networking is weakly developed in most NARSs, especially in AFR. It should receive much greater attention in Bank preparation and supervision activities and in any regional research initiatives. The demise of many library facilities further accentuates the need for researchers to take advantage of communication technology and scientific information flows to foster research quality.

Research projects must be designed to produce technology that is relevant to farmers' circumstances

The use of economic analysis to help make decisions about research programs and allocations, and good scientific rigor generally, will not achieve the ultimate objective of meeting the farming community's needs unless research projects are designed to produce *technology relevant to the circumstances of farmers*. Bank projects have addressed this issue by placing heavy emphasis (with varying success) on the introduction of a farming system perspective in the research process, including expansion of on-farm research capacities. The constraints to full development of this concept have included a reticence by many established researchers to accept it fully; its introduction, in many cases, as a separate line of inquiry rather than as an integral part of the applied research design and evaluation process; and problems in providing adequate levels of operational funding, which is required to a greater degree for farmer interaction and on-farm activities than for on-station work.

The lack of attention paid to research output (and hence to potential impact) in staff appraisal, supervision mission, and ex post evaluation reports suggests that the focus on improving institutional processes for relevant research may not be sufficient to ensure the required technical output. This implies a need to give more emphasis up front in the preparation process, and subsequently in project supervision, to advancing the farming system analysis to a stage where some major technological requirements are defined for important farming systems. This would also be consistent with undertaking more full-blown economic analysis at appraisal. Some recent projects have done this as a basis for justifying heavy support (even 100 percent funding) for specific programs, for example, the ongoing Ghana project. Wider use of this more intensive preproject analysis, however, would in many cases probably require external assistance to help local research (and extension) teams undertake the required studies and financial support through a preparation facility with or without Bank financing. The Bank's and ESDAR's roles in coordinating donor support could be used to advantage in this regard. As in other technical assistance activities, however, the primary objective should be to develop local capacity rather than to produce a sound analytical report.

Two areas to which the Bank has given insufficient emphasis in project design and supervision are the *involvement of users* (intended clients) in the research planning and evaluation process and recognition of the important *role of women* in smallholder farming systems. Reliance on the use of an effective farming system perspective to deal with these two issues, which are linked to research rele-

vance, is insufficient. The Bank needs to take more initiative in promoting the formal involvement of beneficiaries in adaptive research processes. Practical and beneficial techniques for doing this have been demonstrated: a project in Mali has involved clients in the research planning process, and some projects in LAC and SAS are now experimenting with this, but the concept needs much more support. Gender issues must be more prominent in appraisal and supervision given the growing awareness of the need to cater specifically for the role of women in developing relevant, improved technological packages.

As reported in Part 1 of this report, the Bank has given appropriate, but seldom fully successful, emphasis to *linkages between the research and extension systems* (Annex 6) to encourage relevant research (and to enhance the quality of technical recommendations for farmers). The lack of consistent success in this regard means that the Bank should continue to support these linkages, along with both private and public agencies that purport to represent the views of producers and industry. Research institutions should not, however, rely only on these sources to appreciate the situation of beneficiaries. Joint interaction with clients is more appropriate.

Performance incentives

The Bank has often promoted the adoption of autonomous or semiautonomous status for public sector research agencies to facilitate the introduction of a working environment conducive to high researcher performance. Even where research agencies have obtained such status, however, introducing attractive pay scales has generally proved difficult.

Public institutions are unlikely to be able to compete with salaries in the private sector. The incentive to perform in these agencies will thus have to depend largely on the provision of an environment in which researchers have appropriate facilities; consider that they are part of an important development strategy; operate within well-designed programs; are not isolated, but are part of a wider network of national and international researchers; are adequately funded to conduct research efficiently; and understand that meritorious contributions will be recognized. The Bank can help create most of these conditions, and it has had an impact by improving facilities and introducing more national research programming. However, it has been less successful in installing performance reward systems within the limits imposed by salary constraints, and the persistent scarcity and untimely availability of operating funds in most institutions undermine the potential benefits of other positive developments. Both the reliability of operational funds and the adoption of appropriate criteria for advancement in research institutions warrant high priority in dialogue between the Bank, borrowers, and agencies. The Bank should also persist in its attempts to have acceptable levels of basic salaries for researchers in autonomous or semiautonomous institutes, as in many cases, especially in AFR, these are extremely low.

Dialogue should give special attention to the reliability of project funds and the criteria used to decide which researchers get promoted

Bank staff

Considering NARSs' needs for technical assistance to undertake the system improvements outlined above and the Bank's role as a broadly based development agency, expecting all Bank staff who deal with the research portfolio to be capable of or have the time for the type of *specialized assistance* needed is unrealistic. Thus NARs will have to place considerable reliance on experts from the CG centers and other reputable institutions, both for project preparation support and for long-term assistance during implementation. Nevertheless, as the leading external funder of research in developing countries, it behooves the Bank to

ensure that its staff are adept in assisting and guiding NARS agencies in their overall development.

This requires establishing a core of *staff with specialized skills relevant to research systems*. In addition to regular operational duties, this core would work closely with a larger group of staff with significant responsibility for research projects and would maintain close ties with international research entities. The core staff would be responsible for ensuring that the less specialized staff were fully informed of the latest developments and techniques pertinent to improving research systems. Particular emphasis would be given to linkages with the CGIAR, through which the less specialized staff would be made aware of how the CG centers could assist, and with ESDAR in its capacity of coordinating international support for NARSs.

Informal liaison among staff responsible for research projects would be insufficient. *Programmed courses* are likely to be necessary for staff to share experiences in such subjects as organizing participatory research, implementing practical incentive systems for boosting researchers' performance, and designing research programs that respond to identified needs and available resources. New requirements to estimate ex ante economic benefits and rates of return of research investments and to undertake more quantitative ex post evaluation will demand specialized training.

Bank-supported projects must aim not only to produce more technology but to do so in a cost-effective way

Key recommendations

The Bank's interventions in NARS development are generally intended to stimulate the production of improved technology relevant to increasing sectoral productivity, to enhance economic development, and to help alleviate poverty. To meet these objectives through assistance to the public sector components of NARSs, however, the Bank must be aware of the frequent scarcity of fiscal resources to support research. This means that its interventions must be aimed not only at producing more technology, but at doing so cost effectively. The long-term nature of research also necessitates taking into account the sustainability of investments. Thus the Bank's overall aim is to help countries develop the capability to produce relevant technology efficiently within sustainable research systems. The findings of this review indicate that the Bank will have to make a number of modifications to its strategy, policies, and design of research projects if it is to meet this objective in a cost-effective way.

Strategy

The Bank can do little to enhance the productivity of a NARS unless the borrower is committed to this improvement, and central planning and funding authorities often do not appreciate the fact that agricultural research can contribute significantly to economic and social development objectives. Elaboration of this potential has not received adequate attention in the Bank's economic dialogue with borrowers. Agriculture in general, and agricultural research in particular, demand greater attention in the formulation of country assistance strategies.

The high returns to publicly financed agricultural research warrant the Bank's continued substantial support for international and regional research initiatives and for the development of NARSs. Agricultural research, however, represents a long-term undertaking that requires sustained and adequate recurrent funding. Unless a borrower is firmly committed to support the research system, Bank investment in improving the productivity and efficiency of a national research

system is not a good use of Bank resources. The Bank should lend only when a borrower provides commitments to adopt policies and procedures that enable cost-effective and relevant research. This commitment to justify comprehensive support by the Bank for a NARS should be substantiated by a documented willingness to (a) adopt key efficiency measures; (b) institute all feasible measures to reduce the budgetary cost of research without sacrificing its quality (rationalization before expansion, introduction of cost recovery from end-users of research wherever feasible, cooperation at the regional level to avoid duplication and the concomitant waste of resources, and encouragement of private sector research); and (c) allocate a sufficient recurrent budget to enable the research system to operate effectively.

Where conditions are unsuitable for the Bank to provide comprehensive support for a NARS, there may be cases where support for selected programs is justified as an interim measure while the Bank pursues more favorable overall sectoral and research policies.

Operational policies

The Bank should not view individual NARSs as isolated entities. They are part of a global agricultural research system that has many disparate, partially linked elements. ESDAR's mission represents a step by the Bank toward creating more effective linkages. The Bank should advance this objective on two fronts: (a) by using its projects to facilitate strategic partnerships between NARSs, the international research centers, and other leading research institutions and entities that can support the NARSs' programs and institutional development; and (b) by forming strategic alliances and partnerships with components of the international research and research support community to deliver coordinated and efficient external support to NARSs.

Well-conceived investment in agricultural research in the aggregate can yield substantial economic benefits. However, NARSs must make every effort to make efficient use of scarce fiscal resources. In the absence of demonstrable efficiency in research operations, continued funding at a level needed for effective research is unlikely to be forthcoming. This implies that NARSs must prioritize their programs, subprograms, and projects, and economic analysis is the only way to inform this process. Ex ante economic assessment of programs within a borrower's research agenda should be completed during the project preparation and appraisal process. Ex ante analysis will also provide a basis for ex post economic evaluation of research programs, which has been lacking to date, and has impeded the Bank's efforts to assess the impact of its support for agricultural research.

The Bank should create a core of staff specialized in agricultural research systems to help design and implement projects

Bank staff who deal with agricultural research projects do not always have expertise in research organization or implementation. The Bank should create a core of staff specialized in agricultural research systems. In addition to regular operational duties, these staff would (a) maintain linkages with the international agricultural research community and facilitate the alliances referred to previously; (b) inform and train less specialized staff designated as task managers for research projects; and (c) assist task managers directly, especially in designing and implementing projects in selected NARSs that can serve as functional models of sound research organization principles in diverse institutional and economic environments. Bank staff will need substantial training in the use of economic surplus models for research prioritization and ex ante program assessment.

Research that is not applied is not effective. Thus, an effective technology transfer system (public, private, or a combination of both) is needed to increase the

rate of adoption of new or modified technology, and so reduce the adoption lag normally associated with research investment. Bank-supported research projects should ensure that efficient dissemination of research findings is an integral part of the technology development process. Part 1 of this report already stressed these links.

Monitoring and evaluation procedures should be mandatory in all Bank-supported research projects

Project design

Among the numerous recommendations for improving project design, three key elements demand special attention: research relevance, monitoring and evaluation, and scientific rigor.

The relevance of technology must be a primary consideration of the research process. The use of ex ante economic assessment is relevant in this context, but farming system diagnosis, technology adoption surveys, and active stakeholder involvement in research design and evaluation are essential.

Monitoring and evaluation procedures that provide information not only for financial and program planning, but also for assessing the adoption of developed technology by the intended clientele (and for understanding the reasons for nonadoption), should become a mandatory element of Bank-supported research projects.

More emphasis is needed on improving the scientific rigor and quality of research through needs-based training programs, well-directed technical assistance, external reviews of research programs, enhancement of the internal peer review process, competitive grant funding of research subprojects, effective internal and external scientific networking, and linkages and alliances with established research entities that can contribute to NARS development by providing long-term guidance and training.

Issues paper

Given the recommended changes in strategy, policy, and project design to improve the performance of the Bank's agricultural research portfolio, a restatement of its agricultural research policy in the form of a strategic issues paper is warranted.

Prospects

International research can assist in the development of relevant technology, but the main task must rest with the NARSs themselves. If borrowers are willing to make the required commitment and establish appropriate linkages in the global research system, the opportunity to improve substantially the research effectiveness, efficiency, and relevance of NARSs is considerable. The challenges for the Bank are also considerable. The task is not insurmountable, however, and if the Bank addresses effectively the issues raised in this review, significantly improved performance in the agricultural research portfolio is a distinct possibility.

PART 3: ANNEXES AND REFERENCES

Annexes

Annex 1: Extension projects: particulars and ratings

ANNEX TABLE 1.1: FREE-STANDING EXTENSION PROJECTS APPROVED FROM FISCAL 1977 AND COMPLETED BY END 1992

PCR[a] Report number	PAR[a]	Loan/ credit number	Country	Description	Loan/credit amount ($ millions)	Project cost	Extension cost	Approval date	Original closing date	Actual closing date	Project rating	Extension methodology
Africa												
		L2765	Côte d'Ivoire	Agriculture Extension	34.0	58.5	40.8	Dec-86	Jun-92	Jun-92	Unsatisfactory	Some form of T&V[c]
11467		C1387	Kenya	National Extension	15.0	28.6	26.9	Jun-83	Dec-87	Jun-91	Satisfactory	Some form of T&V
11515		C1669	Rwanda	Gitarama Agriculture Services	12.7	22.6	7.6	Mar-86	Sep-91	Sep-91	Unsatisfactory	Some form of T&V
8579		C0905	Somalia	Extension and Training	10.5	32.4	29.9	May-79	Jun-85	Jun-87	Satisfactory	Some form of T&V
11835		L2335	Zimbabwe	Extension and Research—IFAD	13.1	180.9	115.8	Jul-83	Mar-88	Sep-91	Satisfactory	Other methodology[d]
East Asia and Pacific												
	5158	L1267	Indonesia	National Food Crops Extension	22.0	43.5	43.5	Jun-76	Jun-81	Dec-82	Satisfactory	Some form of T&V
7770	11980	C0996	Indonesia	Agriculture Extension II	42.0	81.9	81.9	Mar-80	Mar-86	Mar-87	Satisfactory	Some form of T&V
	7287	L1493	Malaysia	National Extension	19.0	46.5	42.3	Nov-77	Dec-83	Dec-85	Satisfactory	Some form of T&V
8552		L2276	Papua New Guinea	Agriculture Support Service	14.1	24.4	5.4	May-83	Oct-83	Oct-83	Unsatisfactory	Other methodology
	7286	L1626	Philippines	National Extension	35.0	70.1	70.1	Nov-78	Jun-83	Jun-85	Unsatisfactory	Some form of T&V
	6263	L1393	Thailand	National Agriculture Extension	28.0	56.5	56.5	Mar-77	Dec-82	Sep-83	Satisfactory	Some form of T&V
10101	8618	L1752	Thailand	Agriculture Extension II	40.0	70.0	70.0	Aug-79	Dec-85	Dec-87	Satisfactory	Some form of T&V
9912	9615	C1407	Vanuatu	Agriculture Research and Extension	2.0	3.8	3.6	Aug-83	Jun-89	Jun-89	Unsatisfactory	Other methodology
Europe, Central Asia, Middle East, and North Africa												
11731		C1557	Yemen	Agriculture Research and Extension	5.0	7.0	3.8	Mar-85	Dec-90	Dec-91	Satisfactory	Some form of T&V
Latin America and the Caribbea												
	7331	L1568	Brazil	Agriculture Extension	100.0	284.9	284.9	May-78	Dec-82	Dec-85	Satisfactory	Other methodology[e]
10630		L2150	Peru	Agriculture Research and Extension	40.6	83.3	48.1	May-82	Mar-88	Mar-88	Unsatisfactory	Some form of T&V
South Asia												
	5071	C0729	Bangladesh	Agriculture Extension and Research I	10.0	16.3	13.0	Jun-77	Apr-81	Jun-82	Satisfactory	Some form of T&V
11363		C1215	Bangladesh	Agriculture Extension and Research I	27.0	40.9	32.2	Mar-82	Jun-88	Jun-91	Satisfactory	Some form of T&V
6654	8808	C0690	India	West Bengal Extension and Research	12.0	28.1	17.1	Mar-77	Sep-82	Mar-85	Unsatisfactory	Some form of T&V
6800	8808	C0761	India	Extension and Research—Bihar	8.0	16.0	13.8	Dec-77	Oct-83	Mar-85	Unsatisfactory	Some form of T&V
	5618	C0737	India	Extension and Research—Rajas	13.0	26.6	21.5	Jul-77	Jun-83	Jun-83	Satisfactory	Some form of T&V
	6281	C0862	India	Composite Agriculture Extension	25.0	53.4	53.4	Dec-78	Dec-84	Jun-85	Satisfactory	Some form of T&V
8258	8808	C1028	India	Kerala Agriculture Extension	10.0	15.3	15.3	May-80	Jun-86	Jun-86	Satisfactory	Some form of T&V
8258	8808	C1137	India	Tamil Nadu Agriculture Extension	28.8	45.6	45.6	Apr-81	Jun-87	Jun-87	Satisfactory	Some form of T&V
8258	8808	C1135	India	Maharashtra Agriculture Extension	23.0	38.2	38.2	Apr-81	Jun-87	Jun-87	Satisfactory	Some form of T&V
9189		C1138	India	M.P. Agriculture Extension	37.0	60.0	60.0	Apr-81	Jun-87	Jun-89	Satisfactory	Some form of T&V
9033		C1219	India	A.P. Extension	6.0	9.7	9.7	Mar-82	Mar-88	Mar-89	Satisfactory	Some form of T&V
9994	10661	C1100	Nepal	Extension and Research	17.5	20.8	6.3	Feb-81	Jul-87	Jul-90	Satisfactory	Some form of T&V
9994	10661	C1101	Nepal	Hill Food Production I	8.0	9.7	3.2	Feb-91	Jul-87	Jul-90	Unsatisfactory	Some form of T&V

	7288	C0813	Pakistan	Punjab Extension and Agriculture Development	12.5	20.8	15.5	May-78	Jun-84	Jun-85	Satisfactory	Some form of T&V
	7288	C0922	Pakistan	Extension and Adaptation Research (Sind)	9.0	14.3	9.1	May-79	Jun-85	Jun-85	Satisfactory	Some form of T&V
b		C1533	Pakistan	Agriculture Extension and Research (Bal.)	8.3	11.5	9.8	Dec-84	Jun-90	Jun-92	Unsatisfactory	Some form of T&V
7684	10632	C0931	Sri Lanka	National Extension and Research	15.5	22.4	18.1	Jun-79	Jun-85	Jun-86	Satisfactory	Some form of T&V

a. The majority of ex post evaluations done before 1987 are registered as PARs (performance audit reports); PCRs (project completion reports) were subject to a project performance audit memorandum, which was attached to the completion report to become the audit report. Subsequently, the PCR and PAR are presented as separate reports.

b. PCR is in process.

c. T&V = training and visit extension model.

d. This project included T&V as one pilot scheme only, but did include the features of improved programming of services and training.

e. Although not labeled as T&V, this project promoted programming of regular visits to farmer groups and heavy emphasis on small technology demonstrations.

Source: Staff appraisal reports; loan and credit agreements; management information system; Agriculture and Natural Resources Department database; and author's assessments.

ANNEX TABLE 1.2: SAMPLE OF AGRICULTURAL PROJECTS WITH EXTENSION COMPONENTS APPROVED BY FISCAL YEAR 1977 AND COMPLETED BY END FISCAL 1992

PAR Report	PCR number	Loan/ credit number	Country	Description	Loan/ credit ($ mill.)	Project cost ($ mill.)	Approval date	Original closing date	Actual closing date	Subsector	Extension rating	Extension methodology
Africa												
10478		C1127	Benin	Rural Development/Cotton I	21.9	41.0	Apr-81	Dec-88	Dec-88	Area development	Marginally satisfactory	Other methodology
10511		C1165	Burundi	Kirimiro Rural Development	19.3	21.4	Jun-81	Jun-87	Jun-88	Area development	Marginally satisfactory	Some form of T&V
10510		C1192	Burundi	Integrated Rural Development Ngozi III	16.0	28.9	Dec-81	Mar-87	Dec-89	Area development	Marginally satisfactory	Some form of T&V
7904		C1013	Burkina Faso	Niena Dionkele Rice	6.5	7.1	Apr-80	Dec-84	Dec-86	Irrigation and drainage	Satisfactory	Other methodology
6808	8690	C0776	Cameroon	Zapi East Rural Development	8.5	12.2	Mar-78	Jun-84	Dec-84	Area development	Unsatisfactory	Some form of T&V
6962	8690	C0784	Cameroon	Rural Development West High	13.0	25.0	Mar-78	Jun-83	Jun-84	Area development	Satisfactory	Other methodology
9630		C1376	Central African Republic	Rural Development	10.4	51.2	May-83	Mar-88	Sep-89	Area development	Marginally satisfactory	Other methodology
8631		C0959	Kenya	Integrated Agricultural Development	46.0	91.7	Dec-79	Apr-86	Apr-86	Area development	Marginally satisfactory	Some form of T&V
9606		C0786	Liberia	Rubber Development	13.0	29.6	Mar-78	Jun-84	Dec-85	Perennial crops	Unsatisfactory	Other methodology
	6171	C0823	Malawi	Shire Consolidation	10.7	12.6	Jun-78	Dec-82	Dec-82	Area development	Unsatisfactory	Other methodology
6797	9750	C0857	Malawi	National Rural Development I	22.0	66.0	Nov-78	Sep-83	Jun-86	Area development	Unsatisfactory	Other methodology
8638	9750	C1183	Malawi	National Rural Development III	7.3	8.6	Oct-81	Sep-86	Sep-88	Area development	Unsatisfactory	Other methodology
10211	9750	C1343	Malawi	National Rural Development IV	10.6	12.5	Apr-83	Sep-88	Apr-91	Area development	Unsatisfactory	Some form of T&V
7315	8557	L1667	Nigeria	Bida Agriculture Development	23.0	64.4	Mar-79	Jun-85	Jun-86	Area development	Unsatisfactory	Other methodology
10287	12016	L1668	Nigeria	Agricultural Development—Ilorin	27.0	64.4	Mar-79	Jun-85	Jun-88	Area development	Unsatisfactory	Other methodology
10328	12016	L1838	Nigeria	Agricultural Development and Technical Assistance	69.4	28.0	Apr-80	Mar-85	Sep-88	Area development	Unsatisfactory	Other methodology
8520	8557	L1854	Nigeria	Ekiti Akoko Agricultural Development	32.5	80.5	May-80	Sep-85	Sep-85	Area development	Unsatisfactory	Other methodology
10986	12016	L1981	Nigeria	Bauchi Agricultural Development	132.0	350.6	Apr-81	Dec-86	Dec-89	Area development	Marginally satisfactory	Some form of T&V
10980	12016	L1982	Nigeria	Kano Agricultural Development	142.0	482.2	Apr-81	Dec-86	Dec-89	Area development	Marginally satisfactory	Some form of T&V
10981	12016	L2185	Nigeria	Sokoto State Agriculture	147.0	498.7	Jun-82	Jun-87	Dec-90	Area development	Marginally satisfactory	Some form of T&V
9245		C1128	Sierra Leone	Northern Integrated Area Development II	8.5	27.7	Apr-81	Jun-87	Jun-87	Area development	Marginally satisfactory	Some form of T&V
	7262	C0804	Sudan	Mechanized Farming I	16.0	26.4	May-78	Mar-84	Mar-85	Area development	Unsatisfactory	Other methodology
8789		C0945	Togo	Cocoa and Coffee II	14.0	34.2	Jun-79	Dec-85	Jun-87	Perennial crops	Marginally satisfactory	Other methodology

9152		C1193	Zambia	Agriculture III (Southern Province)	18.0	24.6	Dec-81	Dec-87	Jun-91	Area development	Unsatisfactory	Some form of T&V
8582		L2001	Zambia	Eastern Province Agricultural Development	11.0	29.1	May-81	Jun-87	Jun-88	Area development	Marginally satisfactory	Some form of T&V
East Asia and Pacific												
9571		C0835	Myanmar	Lower Burma Paddy Development	34.5	56.0	Jul-78	Apr-86	Apr-90	Irrigation and drainage	Marginally satisfactory	Some form of T&V
10698		C1031	Myanmar	Irrigation II Nyaunggyat	90.0	235.0	May-80	Jun-87	Mar-91	Irrigation and drainage	Marginally satisfactory	Some form of T&V
	7736	C1261	China	North China Plain I	60.0	177.5	Jun-82	Dec-87	Dec-87	Irrigation and drainage	Satisfactory	Other methodology
7771	11431	C0919	Indonesia	Transmigration II	157.0	242.0	May-79	Dec-85	Dec-86	Settlement	Unsatisfactory	Some form of T&V
9246	11981	C0946	Indonesia	Yogyakarta Rural Development	12.0	19.0	Jul-79	Mar-87	Mar-89	Area development	Satisfactory	Other methodology
7794	7995	L1499	Indonesia	NES I	65.0	134.0	Nov-77	Jun-82	Jun-84	Perennial crops	Unsatisfactory	Other methodology
7794	7995	L1604	Indonesia	NES II	65.0	100.5	Jun-78	Dec-83	Dec-86	Perennial crops	Unsatisfactory	Other methodology
8135	9660	L1898	Indonesia	Smallholder Coconut Development	46.0	95.2	Aug-80	Dec-85	Jul-87	Perennial crops	Marginally satisfactory	Some form of T&V
7930	11431	L1958	Indonesia	Swamp Reclamation I	22.0	44.0	Mar-81	Dec-86	Dec-87	Settlement	Unsatisfactory	Some form of T&V
10768	11431	L2288	Indonesia	Transmigration IV (East Kalima)	63.5	121.0	May-83	Dec-87	Mar-91	Settlement	Unsatisfactory	Some form of T&V
8104		C1227	Papua New Guinea	Enga Province Development	8.0	16.0	Apr-82	Sep-86	Sep-88	Area development	Unsatisfactory	Other methodology
	7949	L1815	Philippines	Rainfed Agricultural Development	12.0	21.4	Mar-80	Jun-86	Jun-86	Area development	Satisfactory	Some form of T&V
10430		C0929	Thailand	Northern Agricultural Development	25.0	47.5	Jun-79	Dec-85	Dec-88	Area development	Marginally satisfactory	Some form of T&V
8173	10051	L2078	Thailand	Tree Crops II	142.0	358.8	Jan-82	Mar-87	Mar-87	Perennial crops	Satisfactory	Other methodology
Europe, Central Asia, Middle East and North Africa												
9859	8885	L1988	Cyprus	Fruit and Vegetable	14.0	32.9	May-81	Jun-86	Dec-88	Credit	Unsatisfactory	Other methodology
6013	8885	L1588	Greece	Vegetable Production Marketing	30.0	84.0	Jun-78	Jun-83	Jun-84	Credit	Satisfactory	Other methodology
	6155	L1603	Portugal	Agricultural Credit I	70.0	256.5	Jun-78	Jun-84	Jun-84	Credit	Unsatisfactory	Other methodology
11078		L2175	Portugal	Rural Development	51.0	154.8	Jun-82	Dec-88	Dec-89	Area development	Marginally satisfactory	Some form of T&V
8157	8885	L1967	Turkey	Fruit and Vegetable II	40.0	107.0	Mar-81	Jun-86	Jun-86	Credit	Unsatisfactory	Other methodology
11410		L2094	Turkey	Erzurum Rural Development	40.0	137.0	Feb-82	Jun-87	Dec-89	Area development	Marginally satisfactory	Some form of T&V
10808		L1602	Morocco	Karia-Tissa Rainfed Agriculture	65.0	161.5	Jun-78	Jun-86	Jun-90	Area development	Marginally satisfactory	Some form of T&V
7821	8885	L1757	Morocco	Vegetable Production and Marketing	58.0	129.6	Sep-79	Jun-84	Dec-85	Credit	Satisfactory	Other methodology
8364		C1067	Yemen	South Uplands Rural Development II	17.0	81.6	Sep-80	Dec-85	Jun-87	Area development	Satisfactory	Some form of T&V

(continued on next page)

(Annex Table 1.2 continued)

PAR Report	PCR number	Loan/ credit number	Country	Description	Loan/ credit ($ mill.)	Project cost ($ mill.)	Approval date	Original closing date	Actual closing date	Subsector	Extension rating	Extension methodology
Latin America and Caribbean												
	7331	L1362	Brazil	Minas Gerais Rural Development I	42.0	139.0	Jan-77	Dec-81	Dec-84	Area development	Satisfactory	Other methodology
	7910	L1537	Brazil	Rural Development—Paraiba	24.0	67.3	Aug-78	Sep-83	Sep-86	Area development	Marginally satisfactory	Other methodology
	7910	L1488	Brazil	Rural Development—Ceara	17.0	55.8	Feb-78	Dec-82	Dec-85	Area development	Marginally satisfactory	Other methodology
	7331	L1589	Brazil	Integrated Rural Development IV —-Bahia	37.0	106.6	Oct-78	Dec-83	Dec-85	Area development	Satisfactory	Other methodology
	7910	L1728	Brazil	Rural Development V —Pernambuco	40.0	116.7	Oct-79	Dec-84	Dec-86	Area development	Marginally satisfactory	Other methodology
8380	10636	L1877	Brazil	Minas Gerais II Rural Development	63.0	184.6	Dec-80	Dec-85	Dec-87	Area development	Marginally satisfactory	Other methodology
8380	10636	L1924	Brazil	Ceara II Integrated Rural Development	56.0	163.2	Apr-81	Dec-85	Dec-87	Area development	Unsatisfactory	Other methodology
8488	9700	L2015	Brazil	Piaui Rural Development	29.0	84.4	Nov-81	Dec-86	Dec-86	Area development	Unsatisfactory	Other methodology
10506		L2177	Brazil	Maranhao Rural Development	42.7	122.2	Sep-82	Dec-87	Dec-88	Area development	Unsatisfactory	Other methodology
9382		L2116	Brazil	Northwest Development II —Mato Grosso	26.4	76.4	Aug-82	Dec-86	Dec-88	Area development	Marginally satisfactory	Other methodology
9597		L2269	Brazil	Bahia Rural Development II	67.8	173.6	Aug-83	Dec-88	Dec-89	Area development	Marginally satisfactory	Other methodology
		L2481	Chile	Agricultural Services and Credit	56.0	157.2	Mar-85	Mar-90	Oct-91	Credit	Satisfactory	Other methodology
4240	8860	L1569	Mexico	Livestock Credit VI	200.0	627.2	Dec-78	Jun-82	Jun-82	Credit	Satisfactory	Other methodology
5997		L1553	Mexico	Tropical Agricultural Development	56.0	149.0	Dec-78	Dec-83	Jun-84	Area development	Satisfactory	Other methodology
7931	8860	L1891	Mexico	Agricultural Credit/FIRA VII	325.0	1,179.0	Nov-80	Mar-84	Dec-84	Credit	Satisfactory	Other methodology
8335	8880	L1945	Mexico	Rainfed Agricultural Development	280.0	797.0	Jun-81	Jun-86	Jun-87	Area development	Satisfactory	Other methodology
9175		L2043	Mexico	Pider III Rural Development	175.0	505.7	Feb-82	Sep-85	Dec-88	Area development	Marginally satisfactory	Other methodology
8926	8860	L2454	Mexico	Agricultural Credit/FIRA III	300.0	763.0	Nov-84	Sep-88	Sep-88	Credit	Satisfactory	Other methodology
8926	8860	L2610	Mexico	Agricultural Credit/FIRA VIII-A	180.0	473.0	Jul-85	Dec-86	Sep-87	Credit	Satisfactory	Other methodology
South Asia												
	5746	C0765	Bangladesh	Jute Development I	21.0	33.3	Jan-78	Jun-83	Jun-83	Area development	Marginally satisfactory	Some form of T&V
9020		C1399	Bangladesh	Sugar	20.0	25.7	Jul-83	Dec-88	Jun-89	Agroindustry	Marginally satisfactory	Some form of T&V

	5940	C0736	India	Cad Maharashtra	70.0	140.0	Jul-77	Mar-83	Mar-84	Irrigation and sdrainage	Marginally satisfactory	Some form of T&V
9375		C1034	India	Karnataka Sericulture	54.0	95.1	Jun-80	Dec-85	Sep-88	Sericulture	Marginally satisfactory	Other methodology
9415		C0963	India	Fisheries IV—Inland	20.0	40.8	Dec-79	Sep-85	Sep-88	Fisheries	Satisfactory	Other methodology
9021		C1012	India	Cashew Nut Project	22.0	45.7	Apr-80	Sep-85	Sep-87	Agroindustry	Marginally satisfactory	Other methodology
10477		C1316	Nepal	Irrigation VII (Bhairawa)	16.0	19.4	Jan-83	Oct-88	Oct-90	Irrigation and drainage	Satisfactory	Some form of T&V

Source: Staff appraisal reports; loan and credit agreements; management information system; Agriculture and Natural Resources Department database; and author's assessments.

Annex 2: Review of component projects by region

The text described the basis for selecting the subset of projects, and a list of projects appears in Annex Table 1.2.

South Asia

Of a sample of seven component projects, two were irrigation and drainage projects that employed a T&V model, as did a sugar development project. The remaining projects were commodity-specific and used intensive extension services aligned with credit (and often with input supply and adaptive research) to encourage development.

Of the three *projects designed to use T&V,* the project with a favorable irrigation production environment and appropriate technology (Credit 1316-NEP) had extremely good results, to which the extension program probably contributed significantly. The T&V extension in the second irrigation project (Credit 736-IND) had limited results, largely because of uncertainty about the most appropriate cropping patterns for the local environment. Extension in the third project with T&V (Credit 1399-BD) appeared to have little impact because of the constraints imposed by an inappropriate pricing and profitability environment for sugar as the targeted commodity, although the project completion report (PCR) suggested that some yield increases occurred that could have been linked to the specialized T&V services.

The intensive *commodity-specific* services in the other four projects generally had positive impacts. However, in one (Credit 1012-IND) a lack of attention to the socioeconomic characteristics of the common farming systems in which the commodity (cashew nuts)was grown affected the project's impact. In another (Credit 1034-IND) the service was for commercial inland fisheries, and while effective, the PCR queried the justification for having a public sector service for this type of enterprise as the beneficiaries could well afford to pay for technical services. The intensive commodity extension in a third project (Credit 765-BD) was absorbed into the regular T&V state system toward the end of the project, and the PCR reported reduced effectiveness of extension on jute production (but without any hard evidence to this effect).

East Asia and Pacific

The EAP sample included four area development, three irrigation and drainage, four perennial crop, and three settlement projects.

Of the four area development projects, three were personnel-intensive. Of these, a Papua New Guinea project (Credit 1227-PNG) had separate extension services for food crops and cash crops and suffered from a lack of appropriate technology and from budgetary support problems. The service was unsatisfactory. The extension in an Indonesia project (Credit 946-INS) was accompanied by substantial investment grants and was also extremely staff-intensive, and achieved reasonable results. The system, however, was costly and did not represent a model for replicability on a large scale. A third project (Credit 929-TH) had two separate intensive extension components. One was associated with land development with ethnic Thai farmers in the upland parts of their holdings using a modified T&V approach, while the other was largely with hill tribes and involved reducing shifting cultivation, increasing cash cropping, and introducing vegetative soil conservation measures. The ethnic farmer component achieved some immediate impact with assistance from investment subsidy, but this was substantially diluted on reversion to regular Thai Department of Agriculture T&V services at project closure. The hill tribe component, however, developed (with effective technical assistance) a system of working closely with communities in defining investment and production priorities, including the use of group problem census techniques, and facilitated the creation and successful operation of revolving development credit funds that continue to be supported by farmer and/or community payments for project investments. The extension service by the Hill Tribe Welfare Division of the Ministry of Interior continued its activities after closure of the Bank project with a further technical assistance project from the Australian International Development Assistance Bureau, and has persisted in the same effective program subsequent to the bureau project. The fourth project was modeled on T&V (Loan 815-PH). It was located in a high-potential zone and obtained reasonable results; however, extension did suffer from budgetary support problems and a scarcity of the credit needed to adopt the technologies appropriate for the zone.

Of the *irrigation and drainage* projects, the one in China (Credit 1261-CHA) and its extension component were extremely successful. A project unit of the Ministry of Agriculture worked with and mobilized the recipient communities for construction work, and credit for inputs and capital items was provided to complement the technical extension services, which had technology appropriate for the high-potential production environment. The other two irrigation projects were in Myanmar and used the T&V model to complement the irrigation investments (credits 835-BA and 1351-BA). The evaluators rated these extension components as partially successful without much comment, although one reported problems with a scarcity of production inputs and poor provision of transport.

One of the perennial crop projects was in Thailand (Loan 2078-TH). The project included a total package of investment and production inputs for rubber replanting (financed by a market cess) and relatively intensive technical extension by the specialized rubber agency until the trees reached production. The extension was successful; however, the favorable technical orientation of the service was not matched by awareness of the socioeconomic problems most of the sharecroppers, who formed the main labor force in the industry, were facing. The other three perennial crop projects were in Indonesia. One (Loan 1898-INS) had a packaged delivery of inputs and services by a specialized unit of the Ministry of Agriculture, with financing as credit-in-kind. The project used a T&V model for extension after the planting of the tree crop. This was partially successful, but suffered from standard messages that did not adapt to the circumstances of different clients or consider economic factors. In addition, the use of production inputs (especially fertilizer) after the credit-in-kind period was not good. The two other projects (loans 1499 and 1604-INS) were implemented

through parastatal companies and provided packages of investment inputs and advice on tree crops, also financed by credit-in-kind. The intensive extension services by the parastatals, although relatively successful during the establishment of the tree crops, largely failed with annual food crops. The latter suffered from a lack of appropriate technology to fit the socioeconomic circumstances of smallholders in a difficult soil environment, and from less than full commitment by the management and staff of the specialized tree crop parastatals to this element of the program.

The extension services provided by three voluntary *resettlement* ("transmigration") projects in Indonesia (credits 919, 2288, 1958-INS), which used a T&V model as part of the national extension system, proved to be unsatisfactory. The main problems were a lack of appropriate technology for the settlers' circumstances (in a difficult, upland soil environment), a top-down orientation in recommendations that did not appreciate the real constraints in the farming systems, a lack of practical and economic orientation by extension agents (EAs), and transport difficulties.

Africa

Area development projects formed a major part of the agricultural portfolio in AFR in the late 1970s and the 1980s. Consequently, of a sample of 25 component projects, 22 are area development projects. Of the remainder, two relate to perennial crops and one to irrigation and drainage. In half of the 22 area development projects the extension component was based on T&V, while in the other half a less-organized but intensive service was offered.

Of the 11 *area development projects with T&V,* all included rural infrastructure, all but one supplied production inputs, eight had a research component, seven included credit, and four promoted cooperative development—a typical mix for this type of project. The evaluators rated extension as unsatisfactory in two projects (Credit 776-CAM and Credit 1193-ZAM) and linked this to poor implementation by the institutions involved. They rated the extension components in the nine other projects as partially effective, but cited a number of problems that detracted from performance, namely, seven projects faced budgetary support constraints, three had staff transport difficulties, five suffered from poor linkage with research, and three provided insufficient access to key inputs. Four of the project reports noted inappropriate technology, four indicated inadequate knowledge of the farming systems involved, three highlighted poor appreciation of production economics, and three specified a top-down characteristic in formulating recommendations with consequent relevance problems.

In the *other 11 area development projects*, which had typical component mixes, evaluators judged the extension services in two as unsatisfactory, primarily because of poor management and implementation, compounded by poor technology and limited funding and research support (loans 1667-NIG and 1854-NIG). A well-established coffee cooperative implemented one project (Credit 784-CAM) that provided relatively effective services for cash and food crops in a well-organized program with regular service delivery. Nevertheless, even in this project the services could have been improved by better adaptive research support and a greater knowledge of the resource economics (including labor) of the common farming systems, and the evaluators noted that more attention should have been paid to the food crop systems during project preparation. Two West African projects (credits 1127-BEN and 1376-CAR) provided partially effective, intensive services. Both projects had better results with the dominant

cash crop (cotton) than with food crops. In the Benin project, the food crop extension suffered from poor research backup, insufficient technology, and lack of attention to production economics. In the Central African Republic project, extension was provided by a cotton parastatal, which evaluators linked to excessive attention to cotton. This continued despite the need for diversification as cotton prices collapsed, and, as with the Benin project, insufficient technology support and lack of awareness of production constraints limited effectiveness.

Evaluators judged the remaining six non-T&V, intensive extension components in rural development projects to be unsatisfactory as providers of services to the smallholder subsector. All suffered from inappropriate technology, which was associated with poor linkages in four projects, with inadequate appreciation of farming system circumstances in three projects, and with disregard for production economics in two projects. Budgetary constraints also affected extension operations in four cases. Three of these projects were in Malawi (credits 823, 857, and 1183-MAL) and these did provide relatively successful, intensive services along with production credit and inputs to larger, creditworthy farmers. The problem was that they did not meet the objective of providing services to the majority of smallholders. The Malawi national rural development project (Credit 1343-MAL) did attempt to use a T&V model not exclusively linked to credit in working with farmers' groups. The extension performance in this project was somewhat better than in the other Malawi projects, but the tendency to work with farmers with better resources continued.

The two *perennial crop* development projects had extensive extension services directed at specific commodities (rubber for Credit 786-LIB and cocoa and coffee for Credit 945-TOG), with credit for development and for the provision of production inputs. Extension in the Liberian project was ineffective as price and profitability factors severely limited farmer participation. In the Togo project, a lack of appreciation of the sharecropping characteristics of the farming system hampered the extension in cocoa, but the coffee program succeeded as technology and price incentives were favorable.

A relatively autonomous project management unit implemented the *irrigation* project (Credit 1013-BUR), which had intensive extension, credit, and inputs supplied through service centers. Extension worked relatively well on rice culture, in which the staff were well trained, but obtained poor results in efforts to diversify out of rice, despite water supply problems. The ex post reports did not specify the reasons for this failure, but implied that the staff were not adequately informed about the resource and management implications of a change from rice culture.

Latin America and the Caribbean

The sample includes 20 projects in LAC: 11 in Brazil and eight in Mexico, the dominant regional borrowers, plus one in Chile.

All 11 projects in *Brazil* were *area development* projects. This meant that in addition to extension, in most cases components included rural infrastructure and social services, production input supply, and agricultural credit. In many cases (in areas with poor resources) an investment grant element complemented credit, and specific projects included components for soil conservation, development of cooperatives, and small-scale irrigation.

The extension components of the Brazilian projects were personnel-intensive. Many of the earlier projects operated with only 100 to 200 clients per EA. The technical extension services were usually associated with on-farm development investments supported by grant or credit finance, and the EAs worked with these individual clients who were normally smallholders with a relatively high level of resources. These earlier projects had some success in working with the limited clientele, but they often suffered from long periods of restricted grant or credit availability, which further restricted the scope of activities and also affected staff morale. Evaluators criticized the rigidity of the technology packages promoted and/or financed and noted that often they were not the most appropriate for a client's circumstances. The intensive personnel to client ratio was partly linked to the multitude of functions that EAs had to perform in the area development programs.

Later Brazilian projects attempted to widen client coverage (but still with intensive services—350 to 500 households per EA) by working with groups rather than with individual smallholders (although usually with contact farmer "representatives" of the groups). To this end they emphasized technology demonstrations and introduced the concept of programming the EA visits to the intended clientele, that is, they adopted some of the elements of T&V.[1] Overall, these attempts to develop a broader agricultural extension service were not as effective as expected. Common problems were a scarcity of appropriate technology for the targeted farming systems, poor research-extension linkages, a strong top-down tendency, a lack of practical orientation among the staff, the budgetary constraints that limited operations and affected morale, and the poor results of the contact farmer model.

An overall OED review of the series of area development projects in northeast Brazil (World Bank 1993) points out that the more successful instances of technology dissemination were usually associated with specific campaigns against crop diseases or pests (boll weevil in cotton, an orange disease in Sergipe, and banana root fungi in Paraiba). These campaigns avoided the constraints that affect many general extension services because they (a) addressed a clearly defined, single problem, which is a relatively simple task compared to understanding and dealing with a whole farm situation; (b) dealt with obvious problems that demanded the attention not only of farmers, but also of political entities and officials of all agencies dealing with the rural sector, so that public sector entities (including the extension agencies) mobilized around the program to ensure that all necessary inputs were guaranteed; (c) could be judged on the basis of results rather than inputs delivered; (d) lasted for a limited time, usually one or two crop seasons, which was conducive to a sustained, priority effort; and (e) required technology that was already available, thereby avoiding the need for close research-extension collaboration. Although these are legitimate explanations of the success of the campaigns, they do not offer general solutions to the constraints faced in developing an effective smallholder extension service. The limited possibilities for improvement given the harshness of the environment and the land tenure and smallholding size problems in the semiarid areas of northeast Brazil, however, do raise the issue of the extent to which public funds should be used on agricultural extension relative to their use in other programs that might address the persistent poverty issue more appropriately.

Note also that under the Second Agricultural Research Project in Brazil (Loan 2016-BR) a number of extension subprojects with French bilateral assistance were developed with the participation of both the state extension agencies and staff from research centers of the national research agency. An initial farm system research program evolved into a pilot program of rapid field assessment to define

communities and their farming system characteristics, constraints, and potentials, which was followed by working with groups to define problems and to review and verify technology and an action/adoption program to resolve problems and realize potentials. Evaluators rated these programs as very successful.

Five of the eight *Mexican* component projects were agricultural credit projects and three were area development projects. Although evaluators rated most of the *credit* projects as unsatisfactory, the intensive technical assistance provided with the credit performed reasonably well. The problem was the limited coverage of the smallholder population in this type of credit/extension system, especially those smallholders with fewer resources.

Each of the area development projects had intensive services that were reasonably effective. Two attempted to use the principles of the successful "Plan Puebla" model. This model involved initial technical and socioeconomic diagnostic work in an area by an interdisciplinary project team, followed by testing and promotion of relevant technology in selected communities with heavy community participation. Coordination with credit agencies to facilitate the procurement of inputs by smallholders was organized, and the concept was to work progressively through communities in the area using well-trained university graduates to "educate" the farmers to help themselves. These principles were considerably diluted in the area development projects (loans 1553 and 1945-MX), especially in the latter, extremely large project, which included production and social infrastructure investments and was dominated by subsidized credit. While the projects did undertake diagnostic surveys and adaptive research and extension work were well coordinated, the proportion of experienced staff declined, and reduced effectiveness.[2] Both projects were in areas of relatively high potential. A problem was the relatively high public sector cost of this type of area development (which involved not only extension, but also major infrastructural and credit investments) for a limited number of districts, which limited its ability to reach the majority of the rural poor. Extension in the third area development project was similarly linked to production investments, but did not emphasize diagnostic work or research-extension linkages to the same extent and was not as effective as the models previously described. The technical follow-up to investment subprojects was also less adequate.

The project in *Chile* (Loan 2481-CH) included *credit* with private sector consultants providing the technical extension service to small commercial farmers with holdings of eight to 12 potential irrigated hectare equivalents (a larger farm size than that of the average Asian or African smallholder). The technical assistance was obligatory for credit recipients for three years. It was subsidized by a government agency under a graduated cost sharing formula, and the same agency approved the consultants and monitored their performance. Evaluators rated the service as very effective in achieving technology adoption that increased commodity production levels. Toward the end of the project, the program was redirected to smaller farmers with fewer resources, and an ongoing project (Loan 3473-CH) is continuing to support this clientele. It is yet too early to assess the model's results with this group, but preliminary results are encouraging. However, a need for more adaptive research to provide technological innovations more appropriate to farmers with fewer resources is already apparent.

Europe, Central Asia, Middle East, and North Africa

The sample of nine projects in ECA/MNA included five credit and four area development projects.

Four of the *credit* projects involved intensive public sector credit and extension services to producers of high-value export crops (loans 1988-CYP, 1588-GR, 1967-TK, and 1757-MOR). Evaluators rated the extension component of the Greek project as satisfactory, but rated extension as unsatisfactory in the Turkish and Cypriot projects and as partially effective in the Moroccan project. Common problems included (a) inadequate awareness of the most up-to-date technology suitable for supporting the production, processing, and marketing of the high-value fruit and vegetable crops: (b) staff who were not adequately trained or given incentives to meet the demands of this type of technical and economic service; and (c) lack of cost recovery for this intensive service. The evaluators concluded that beneficiaries should pay for services of this type, and that they would be best provided through private sector entities. The fifth credit project (Loan 1603-POR) was directed at agricultural development of large collective farms and of medium and small private farms, as well as investments in agro-processing and fishing vessels. The extension services were not very effective because (a) the collectives were not viable; (b) the development models were excessively rigid; (c) the staff did not understand the economics of production on private farms; and (d) the staff's diverse duties (which included land reform activities) detracted from the service's technical orientation.

The four *area development* projects used the *T&V model* to provide extension services, with one of those projects (Loan 1602-MOR) featuring more intensive T&V services. All projects had the common array of components for area development projects, although a Turkish project (Loan 2094-TK) did not specifically include production inputs. Evaluators rated extension in the Turkish project and in a project in Portugal (Loan 2175-POR) as partially effective. Both suffered from inadequate practical, technical training of staff and had staff mobility problems, and extension in the Turkish project suffered from budgetary support constraints toward, and subsequent to, the end of the project period. The Moroccan project and a project in Yemen (Credit 1067-YEM) were rated as having satisfactory extension results. The Yemen project, which was in the Republic of Yemen, had problems in linkages with the national research system (whereas this was not reported as a problem in the national extension project in the People's Democratic Republic of Yemen, which had a high proportion of university graduates in its extension service), and also suffered from insufficient transport and limited coverage through the contact farmer approach. The limited coverage, however, was partly overcome by the project's high exposure in villages (through drinking water provision and bilharzia control) and by extension centers that supplied inputs (one center to 20 villages).

Notes

1. These changes reflected Brazil's intention to improve its national extension services and were consistent with the Agricultural Extension Project (Loan 1568-BR, from 1978 to 1985), which supported the federal extension agency in assisting the state extension agencies to improve services. The state agencies provided extension in the area development projects.
2. The T&V method was to be implemented in Loan 1945-MX, but the project's management preferred to stay with the Plan Puebla model.

Annex 3: A review of recent extension experience in the Africa region

Not only is the Bank's Africa region the most active in promoting free-standing national extension projects, but it has also used the T&V model of extension almost exclusively. A number of positive effects are obvious, namely:

- The Bank's support for extension in Africa continues to focus attention on the need for a faster rate of adoption of appropriate technology if agricultural productivity is to be significantly improved.

- The programs are encouraging the adoption of national extension strategies (in place of fragmented projects with "temporary" extension components supported by a multitude of donors, each with its own ideas on technology transfer), which encourages better use of institutional and fiscal resources. Realization of this goal would have the advantage of creating a cadre of career extension personnel with appropriate training and motivation.[1]

- The coverage of smallholders is better, and indications are that the services have been associated with an increase in the rate of adoption of some important technologies.

Recognizing the enormity of the capacity building task in AFR, regional management responded with a number of rational measures as follows:

- It adopted an Agricultural Services Initiative in 1987, whose objective was to broaden the coverage of national projects to include, besides research and extension, other agricultural services, such as supply of improved seeds, credit, marketing and so on. If properly used, this initiative could identify and address the most serious hindrances to technology adoption.

- It appointed agricultural extension services specialists in some 19 countries as part of the efforts to strengthen countries' capacity to implement extension projects. Most of these field staff have been in position since 1989.

- It established a regional extension network and organized a series of extension workshops for Bank staff and national management personnel to promote exchanges of experiences. It also recently initiated an extension newsletter and has been making a concerted effort to develop a "field/implementation" culture.

Despite these positive aspects, extension development in AFR faces a number of serious problems. In 1991 the Bank's AFR staff held a workshop in Malawi for its staff involved in extension to discuss experience in implementing the Agricultural Service Initiative (Venkatesan and Swartz 1992). In 1993 they held two similar workshops in Côte d'Ivoire and Ghana with national extension and

research staff. One of the keynote papers at the Malawi workshop highlighted the following as the main issues affecting the AFR extension program:

- Projects' frequent use of standard packages of recommendations for major agroclimatic zones meant that they were often irrelevant to farmers. This could be avoided if greater emphasis were given to understanding farming systems in project preparation and in the formulation of recommendations during implementation.

- Continuous collaboration between research and extension was essential to ensure that technology was developed that was appropriate for farmers' circumstances.

- Projects needed to place more emphasis on training staff to give them a capacity to diagnose field constraints and to involve farmers directly in resolving defined problems.

- Projects should avoid a standard "template" approach to setting up national extension institutions.

The Bank's agricultural extension field staff who participated in the Malawi workshop reported on the status, problems, and impact of extension projects in 16 countries and recommended improvements. The workshop design encouraged staff to be self-critical, and they mentioned a range of operational problems. The two most frequently mentioned were inadequate technical capacity and poor diagnostic skills on the part of staff and a scarcity of relevant technology on which to base an effective service.

National project staff in the 1993 workshops in West Africa were also encouraged to be constructively critical and expressed a number of concerns about the implementation of the T&V system in their countries, namely: the inadequate provision of funds to operate national services, the need for modifications to suit the sociocultural and administrative contexts of particular countries, the need for congruence with farmers' needs in adopting a unified extension system through T&V, the poor research-extension linkages that were limiting the effectiveness of extension through slow generation of relevant technology, the need for staff training sessions to help them adopt a problem solving approach and to improve their communication skills, and the need for specific diagnostic surveys for special categories of farmers with particular problems (for example, women farmers, pastoralists). The project implementers did, however, support the concept of a single, unified national extension system (as opposed to crop-specific services, which had been common in West Africa) and the acceptance of a strategy to prevent fragmented approaches to extension through enclave projects. The participants agreed that political and economic stability had an overriding influence on the outcome of extension investments, thereby intimating that this should be a prerequisite for major extension investments.

A 1991 review of staff appraisal reports (SARs) by the AFR Technical Department indicated a number of favorable factors about the projects appraised. The most encouraging were that 80 percent of SARs cited support for adaptive, on-farm research, including diagnostic surveys of typical farming systems, and that in one case (Zaire pilot extension project), nongovernmental organizations and cotton companies were involved in adaptive research and technology transfer. However, the report also highlighted the following:

- Some pilot projects (three of seven) were not allowed to mature and indicate lessons before the country embarked on a national project (which suggested to Operations Evaluation Department staff that there was pressure to introduce a national T&V system regardless of pilot experience).
- Half of the SARs did not address the availability of technology for transfer.
- Half of the projects did not address staff training needs.
- The SARs did not address obvious difficulties in meeting recurrent cost funding in earlier projects, while half the SARs did not provide any information on how the key research-extension linkage would be funded.
- Although some SARs indicated the provision of support for mass media facilities and programs, none emphasized the use of professional programming to maximize relevance and cost-effectiveness.
- SARs of most free-standing projects did not analyze the status of complementary services (credit, input supply).
- Most SARs provided some indication of the general smallholder target beneficiaries, but little description of the characteristics of the different major farming systems.

Although one could argue that these apparent deficiencies were associated with attempts to prepare short SARs, the importance of the issues for effective and sustainable extension systems should warrant mention or specific reference to supporting documents.

In 1992 one AFR country department carried out a further review of the current problems confronting T&V extension programs in six East African countries (Swartz and Kampen 1992). This highlighted similar types of constraints to those noted in other internal AFR reviews, made constructive and demanding recommendations, and concluded that the T&V system has not yet demonstrated that it has sustainable answers on how to provide efficient extension services to small-scale farmers, particularly in rainfed agricultural and livestock systems, and that the search for more effective mechanisms for generating and disseminating new technology should continue.

Note

1. In some cases, the rationalization of extension components in numerous projects and programs into a national system has been able to reduce the number of public sector extension personnel (at least in theory), and so, potentially, extension costs. The realization of this potential is awaited. If it were to be substantially realized, however, it is unlikely to alleviate the problem of recurrent cost funding for a comprehensive national service, as the donor-financed projects traditionally carried a large share of costs, or made sufficient contributions to investments to provide adequate incentives for government to allocate extension support costs temporarily under the particular project.

Annex 4: A process for preparing an extension strategy and investment program

The findings suggest that as a development institution, the Bank should allocate more attention and resources to the preparation phase of extension projects. This would raise the cost of processing loans, but should have high development dividends in creating sustainable extension systems, and would provide a valuable training exercise for national personnel who could continue to contribute to the management of responsive services.

The identification and preparation process would initially involve a comprehensive analysis of the following:

- Production conditions:
  - agroecological zones
  - characteristics of the major farming systems in each zone (including resource levels, constraints, labor usage, off-farm activities, influence of gender or caste, education levels, land tenure, and environmental issues)
  - supporting infrastructure,
  - the level and accessibility of private and public sector services in each zone (inputs, markets, credit),
  - relevant demographics
- Technology being used in, and the stock of technology relevant to, the major farming systems; and national capacity for technology generation and/or adaptation, that is, private and public research systems and their external and internal linkages
- Existing institutions for rural services and communication:
  - public sector organizations (resources, operational systems, coverage, linkages, and performance)
  - existing human resources for agricultural services and the capacity of the education system to produce the required skills
  - private sector commercial technical services (coverage of commodities or systems, scale, competence, potential for expansion)
  - nongovernmental organizations working with farming communities (location, scale, specializations, resources, relationships with officialdom)
  - farmer and community organizations (official and unofficial)
  - literacy and education levels of the rural population and their access to various forms of communication (radio, television)
- Macroeconomic and sectoral environment, funding, and commitment
  - extent to which macroeconomic and sectoral policies and market conditions are conducive to the use of improved technology to increase productivity

- expressed commitment by the government to adopt and fund improved services within an agreed strategy and with acceptable terms of service for personnel
- historical analysis of funding of agricultural extension (and research) and ratios against sectoral spending and agricultural gross domestic product to assess historical commitment and consistency of support for these services
- past, current, and anticipated involvement of other donors in the subsector.

Those responsible for project preparation can use various means to undertake the preproject analysis, including collection and collation of primary and secondary data. Rapid rural survey techniques to obtain an initial understanding of farming systems are likely to be required. Strong local participation by the borrower and by implementing agencies to ensure commitment and ownership of the program would be essential.

Assuming that macroeconomic and sectoral policies are conducive to additional investment in technology transfer and the required commitment to improvement exists, then a strategy and investment program can be developed. This would include:

- Agreeing with the government on which kinds of farmers and production systems should have priority for public extension. Considering the normal funding constraint, considering major extension investments to improve services (particularly face-to-face services) to all farmers at once is usually impractical. Food or export commodity production objectives, as well as equity and regional development considerations, may have to be taken into account.

- Determining the justification for additional extension investment in particular areas in view of priority objectives, potential for improvement through improved technology, and existing status of infrastructure and complementary services.[1]

- Developing an extension strategy that accounts for both private and public sector service interventions and mass media and face-to-face communication systems.

- Assessing the availability of trained human resources to implement the envisaged strategy as an important determinant of the rate at which a program could be developed, and accepting that a low basic education level would limit a system's capacity to provide comprehensive services and to be responsive to farmers' needs.

- Ensuring that a capacity to generate and adapt new, appropriate technology continually exists (but realizing that there would be substantial delays before new technology could be produced for environments for which relevant improved technology is scarce or unavailable).

- Defining and agreeing on the role of the private sector and nongovernmental organization entities and their linkages with public extension in an initial program, given that the recurrent costs of public extension services should be as low as possible. Similarly, a mass media and communication system would be developed (to include specialized assistance) to complement and, where appropriate, reduce the intensity of face-to-face services for particular types

ANNEX TABLE 4.1: EXTENSION PRINCIPLES USED IN T&V SYSTEMS

Extension principle	*Application in an improved T&V system*
Programming of activities	Maintain, but program so that activities are determined according to the needs of the farmer group (as agreed with them), and are also based on the availability and appropriate timing for application of specific technologies.
Fixed visit schedule	Maintain, but in accordance with a schedule agreed on as appropriate with farmers, field staff, and supervisors, rather than as a fortnightly standard.
Supervision	Maintain, but with more emphasis on assessing the reactions of farmer clientele than on the mechanics of the visit schedule.
Single line of command	Maintain (not as an essential requirement), but develop an understanding that the extension staff must be responsive to the needs of the farmer clientele, whose reactions will be monitored by supervisory staff as a measure of staff performance.
Concentration on extension of technology	Maintain, but not to the exclusion of facilitating the provision of services by other agencies (private and public) to meet the needs of the farming communities being attended, or of assisting farmers to develop a self-help capacity (for example, seedling production, group marketing).
Technical content and training	Maintain timely training sessions for field staff geared to subjects of proximate visits, but not as districtwide general recommendations associated with dominant commodities. The training officers would take widely applicable recommendations into account, but training would be specific to the requirements of the program previously agreed on by staff and farmer groups. General recommendations would be adapted and incorporated, where possible, into the solutions to the problems identified with farmer groups.
Use of contact farmers or groups for visits and demonstrations	Adopt a concept of identifying existing groups of farmers with similar resource circumstances, problems, and attitudes as the medium for interaction with the extension staff (as groups or subgroups in the recipient community), and use these groups to define major constraints, analyze the relevance of technological solutions, and assume ownership of demonstrations.
Research-extension linkage	Maintain and expand, focusing on ensuring relevance in applied and adaptive research. This implies a farming system perspective in both research and extension, which would benefit from joint farming system diagnostic surveys.

of clientele and subject matter.[2] The capacity of farmers of different socioeconomic status (or of organizations representing them) to contribute to the cost of public services in cash or kind would determine the extent to which this

concept would be introduced to reduce budgetary costs and increase the accountability of staff to their clients. Even small contributions by beneficiaries can have significant benefits through participation and ownership.

- Defining the initial intensity and frequency of programmed face-to-face services for particular areas (and therefore the necessary staffing and support) in accordance with the foregoing points. This implies the possibility of major variations in face-to-face services (reflected in ratios of farmers to extension workers and mode of operation) throughout the areas serviced by public extension.[3] Services to meet the established needs of particular groups according to gender or social class would receive special attention. Application of many of the extension principles commonly used in T&V extension models could be used, with appropriate modification, to develop the initial phase of an improved face-to-face extension program (see Annex Table 4.1).

- Realistically projecting the development and the recurrent cost implications of the extension program and each of its components.

An essential requirement in formulating the extension program would be to assess the availability of human resources and construct a needs-based training program so that staff can attain the required skills in and understanding of all facets of the program (this is distinct from regular technical training sessions for front-line extension staff in T&V models). Training should commence at the start of the investment project (or preproject). Key areas would be (a) practical training of technical specialists; (b) training of trainers in small group dynamics and problem census techniques to show how to increase client participation and use interaction within farmer groups to assist in the technology transfer process in face-to-face services;[4] and (c) education of managers and policymakers in the principles being used to formulate an effective and efficient service.

The program developed would not be seen as a permanent format. The emphasis on local involvement in project preparation provides the opportunity to train personnel in the management and extension principles used in the strategy, so that a capable extension planning unit can be established to monitor and analyze implementation. This unit should recommend program modifications in accordance with experience and changing circumstances to provide a responsive service.

The expenditure of a large amount of scarce resources on extensive surveys to quantify extension impact and economic benefits is of dubious value for many countries. This is because of the extreme difficulty of linking cause and effect, even if investigators can obtain reliable statistical data, and limited local expertise in the necessary economic analytical techniques. It is probably more appropriate to concentrate monitoring and evaluation survey resources on (a) measuring the change in adoption of technologies promoted by the extension agents in their specific areas of influence; (b) understanding the reasons for significant nonadoption (which implies that the procedures to ensure relevant recommendations may have broken down); and (c) questioning the intended farmer clientele on how it perceives the extension services offered by the public extension organizations, by their particular extension agents, and by other private or public service institutions. In other words, monitoring and evaluation resources would be concentrated on improving the effectiveness and efficiency of the extension system and directly asking the intended beneficiaries of the impact it is having. It would be geared to ongoing evaluation rather than to quantitative ex post evaluation, but would contribute to ex post assessment. Nevertheless, the Bank should support the ex post, preferably economic, evaluation of

selected extension programs to test approaches being used and to assist in designing future extension interventions. In view of the frequency of fiscal constraints, these evaluations should focus on verifying the most cost-effective use of available resources.

Surveying of farmers would be complemented by the collation of other primary and secondary data that provide (a) indications of how the program is being implemented, (b) input and output indicators of changes in the use of technology and in production to which the extension program has likely contributed; (c) analysis of factors involved in effectiveness (funding, linkages, training); and (d) sustainability indicators (progressive annual budgets and expenditures, staffing, involvement of the private sector).

Notes

1. The analysis of complementary services may lead to a decision to include the development or encouragement of specific complementary services in a primarily extension investment project or in a parallel project, or to delay increasing extension investment.
2. As for face-to-face services, the relevance of mass media material to the targeted audience is critical. This implies that mass media programming should depend significantly on feedback from face-to-face surveys or services (see Mata 1992).
3. These might include models close to T&V for particular locations and times, extension campaigns on particular issues, commodity-specific extension programs aligned with the delivery of an input package, or highly participatory schemes involving extension workers and farming communities (and often researchers) in an infrequent but scheduled program of interaction to define and resolve problems.
4. Problem census is a process of having farmers define their own objectives and problems through structured group discussion (see Crouch 1984).

Annex 5: Research investments, project ratings, and related agricultural sector data

ANNEX TABLE 5.1: FREE-STANDING RESEARCH PROJECTS APPROVED FROM FISCAL 1977

Report nos. PCR	Report nos. PAR[a]	Loan/ credit no.	Country	Description	Loan/ credit ($ mill.)	Project cost ($ mill.)	Research cost ($ mill.)	Approval date	Original closing date	Actual closing date	Project rating	Project sustainability	Institutional development
Africa													
		C1896	Burkina Faso	Agricultural research	17.9	18.8	18.8	19-Apr-88	31-Mar-94	—	—	—	—
13631		L2766	Cameroon	Agricultural research	17.8	43.2	43.2	18-Nov-86	30-Jun-93	30-Jun-93	Unsat.	Unclear	Moderate
13760		C1521	Ethiopia*	Agricultural research	22.0	32.1	32.1	11-Sep-84	30-Jun-91	30-Jun-94	Sat.	Likely	Moderate
		C2247	Ghana	Agricultural research	22.0	29.5	29.5	23-May-91	31-Mar-97	—	—	—	—
		C1955	Guinea	Research and extension	18.4	30.9	13.3	15-Sep-88	31-Dec-94	—	—	—	—
		C1849	Kenya	Agricultural research	19.6	203.8	203.8	20-Oct-87	30-Jun-93	—	—	—	—
		C2042	Madagascar*	Agricultural research	24.0	70.6	70.6	15-Jun-89	31-Dec-96	—	—	—	—
13634		C1549	Malawi	Agricultural research	23.8	49.9	49.9	19-Feb-85	31-Oct-90	31-Oct-93	Sat.	Unclear	Moderate
		C2514	Malawi	Agricultural services	45.8	64.8	18.1	15-Jun-93	30-Sep-99	—	—	—	—
		C2122	Niger	Agricultural research	19.9	28.0	28.0	10-Apr-90	31-Dec-95	—	—	—	—
		C2261	Nigeria*	Agricultural research	78.0	104.1	104.1	11-Jun-91	31-Dec-98	—	—	—	—
12590		C1546	Rwanda*	Agricultural research	11.5	18.0	18.0	12-Feb-85	31-Dec-88	31-Dec-91	Sat.	Likely	Moderate
11836		C1176	Senegal	Agricultural research	19.5	106.1	106.1	8-Sep-81	30-Jun-88	31-Dec-89	Sat.	Unclear	Moderate
		C2107	Senegal	Agricultural research II	18.5	38.9	38.9	22-Mar-90	31-Dec-95	—	—	—	—
11077	12292	C0834	Sudan	Agricultural research	15.0	45.4	45.4	29-Jun-78	30-Jun-85	31-Dec-87	Unsat.	Unlikely	Moderate
13954		C1639	Sudan	Extension and research	22.0	38.0	21.2	3-Dec-85	30-Jun-93	30-Jun-93	Sat.	Unclear	Moderate
		C1970	Tanzania	National agricultural and livestock research	8.3	25.3	25.3	13-Dec-88	31-Mar-97	—	—	—	—
		C2446	Uganda	Agricultural research and training	25.0	28.9	23.5	15-Dec-92	31-Dec-00	—	—	—	—
13602		C2292	Zaire*	Agricultural research	16.7	65.2	65.2	20-Aug-91	30-Jun-97	4-Mar-94	Unsat.	Unclear	Moderate
		C1746	Zambia*	Agricultural research and extension	13.0	38.8	23.4	9-Dec-86	31-Dec-95	—	—	—	—
11835		L2335	Zimbabwe	Extension and research	13.1	177.1	64.2	7-Jul-83	31-Mar-88	30-Sep-91	Sat.	Unclear	Moderate
More recent projects excluded from the review													
		C2557	Mali	National agricultural research	20.0	111.7	111.7	16-Dec-93	31-Dec-01	—	—	—	—
		C2575	Mauritania	Agricultural services	18.2	19.8	3.4	8-Mar-94	31-Dec-00	—	—	—	—
		C2547	Rwanda	Agricultural research II	15.0	36.5	36.5	14-Oct-93	31-Mar-99	—	—	—	—
		p	Burkina Faso	Agricultural services	55.0	60.0	48.0	—	—	—	—	—	—
		p	Cameroon	Agricultural research II	25.0	—	—	—	—	—	—	—	—
		p	Ethiopia	Research and training	60.0	60.0	60.0	—	—	—	—	—	—
		p	Kenya	Agricultural research II	40.0	60.0	60.0	—	—	—	—	—	—
		p	Madagascar	Agricultural research II	42.8	—	—	—	—	—	—	—	—
		p	Senegal	Agricultural services	35.0	44.0	22.0	—	—	—	—	—	—
East Asia and Pacific													
12228	15220	C1516	China	Agricultural research II	25.0	69.0	55.7	11-Sep-84	30-Jun-90	30-Jun-92	Sat.	Likely	Moderate

8530	9708	C1297	China	Agricultural education and research	75.4	201.6		2-Nov-82	30-Jun-88	31-Mar-89	Sat.	Likely	Substantial
8925	11980	L1840	Indonesia	National research	65.0	101.5	101.5	6-May-80	30-Jun-90	30-Jun-90	Sat.	Likely	Moderate
		L3031	Indonesia	Agricultural research management	35.3	50.4	50.4	28-Mar-89	30-Jun-95	—	—	—	—
	6264	L1115	Malaysia	Agricultural extension and research	26.5	108.6	96.5	13-May-75	30-Jun-82	27-Jan-84	Sat.	—	—
13697		L2828	Malaysia	National forestry research development	9.0	37.3	37.3	4-Jun-87	30-Jun-92	30-Jun-92	Sat.	Likely	Substantial
10658	15223	L2040	Philippines	Agricultural support service	45.0	77.0	45.1	14-Jul-81	31-Dec-88	31-Dec-90	Unsat.	Unclear	Moderate
8552		L2276	Papua New Guinea	Agricultural support service	14.1	24.4	8.1	3-May-83	30-Jun-88	30-Jun-89	Unsat.	Unclear	Moderate
13119		L1922	Thailand	Agricultural research	30.0	91.5	91.5	25-Nov-80	30-Jun-89	30-Jun-92	Sat.	Likely	Substantial
More recent projects excluded from the review													
		L3886	Indonesia	Agricultural research II	63.0	101.8	101.8	16-May-95	30-Apr-02	—	—	—	—
Europe, Central Asia, Middle East, and North Africa													
		L3216	Algeria*	Agricultural research and extension	32.0	74.9	48.8	5-Jun-90	31-Dec-96	—	—	—	—
		L3036	Morocco	Agricultural extension and research	28.0	60.8	30.1	18-Apr-89	30-Jun-95	—	—	—	—
		L3217	Tunisia	Research and extension	17.0	34.0	18.4	5-Jun-90	30-Jun-96	—	—	—	—
13614		L2405	Turkey	Agricultural extension and applied research	72.2	205.9	24.8	17-Apr-84	31-Dec-90	31-Oct-93	Sat.	Unclear	Moderate
		L3177	Turkey	Agricultural extension II	63.0	145.4	14.6	13-Mar-90	30-Jun-97	—	—	—	—
		L3472	Turkey	Agricultural research	55.0	77.6	77.6	21-May-92	31-Dec-99	—	—	—	—
11652	15545	C1259	Yemen Arab Republic	Agricultural research and development	6.0	32.4	31.1	8-Jun-82	30-Jun-88	31-Dec-91	Unsat.	Unclear	Moderate
11731		C1557	Yemen People's Democratic Republic	Agricultural research and extension	5.0	7.0	3.2	14-Mar-85	31-Dec-90	31-Dec-91	Sat.	Unclear	Substantial
		C2299	Yemen, Republic of	National agriculture sector management support	14.4	22.0	10.9	17-Sep-91	31-Dec-99	—	—	—	—
More recent projects excluded from the review													
		L3688	Morocco	Irrigated areas agricultural services	25.0	34.7	11.6	21-Dec-93	30-Jun-00	—	—	—	—
		p	Morocco	Watershed management	60.0	120.0	60.0	—	—	—	—	—	—
		p	Morocco	Agricultural services	40.0	60.0	36.0	—	—	—	—	—	—
Latin America and Caribbean													
		C2216	Bolivia*	Technology development	21.0	29.8	28.5	14-Mar-91	31-Oct-98	—	—	—	—
	5474	L1249	Brazil	Agricultural research	40.0	189.4	189.4	27-Apr-76	31-Dec-81	30-Jun-83	Sat.	—	—
8162	9634	L2016	Brazil	Agricultural research	60.0	150.1	150.1	16-Jun-81	31-Dec-87	31-Dec-87	Sat.	Likely	Substantial
		L3130	Brazil	Agricultural research III	47.0	97.8	97.8	24-Oct-89	30-Jun-95	—	—	—	—

(continued on next page)

(Annex Table 5.1 continued)

Report nos. PCR	Report nos. PAR[a]	Loan/ credit no.	Country	Description	Loan/ credit ($ mill.)	Project cost ($ mill.)	Research cost ($ mill.)	Approval date	Original closing date	Actual closing date	Project rating	Project sustainability	Institutional development
12540		L2303	Colombia	Agricultural research and extension	63.4	206.6	197.7	7-Jun-83	30-Jun-90	30-Jun-92	Sat.	Likely	Moderate
		L3465	Mexico	Agricultural technology	150.0	300.0	195.5	5-May-92	30-Jun-99	—	—	—	—
10630		L2150	Peru	Agricultural research and extension	40.6	83.3	35.2	20-May-82	31-Mar-88	31-Mar-88	Unsat.	Unlikely	Negligible
More recent projects excluded from the review													
		L3871	Colombia	Agricultural technology development	51.0	84.0	—	20-Apr-95	31-Dec-01	—	—	—	—
		p	Ecuador	Agricultural research	21.0	27.0	27.0	—	—	—	—	—	—
South Asia													
	5071	C0729	Bangladesh	Extension and research	10.0	16.3	2.11	28-Jun-77	30-Apr-81	30-Jun-82	Sat.	—	—
6576	13218	C0828	Bangladesh	Agricultural research	6.0	7.4	7.40	13-Jun-78	31-Dec-84	31-Dec-84	Sat.	Unclear	Moderate
11363	13218	C1215	Bangladesh	Agricultural extension and research II	27.0	40.9	8.75	2-Mar-82	30-Jun-88	30-Jun-91	Sat.	Unclear	Moderate
12541	13218	C1455	Bangladesh	Agricultural research II	24.5	32.2	32.20	29-Mar-84	31-Dec-89	30-Jun-92	Unsat.	Unclear	Moderate
6654	8808	C0690	India	Extension and research —Bengal	12.0	28.2	11.10	22-Mar-77	30-Sep-82	31-Mar-85	Unsat.	Unclear	Moderate
6800	8808	C0761	India	Extension and research —Bihar	8.0	16.0	2.19	27-Dec-77	31-Oct-83	31-Mar-85	Unsat.	Unclear	Moderate
	5618	C0737	India	Extension and research —Rajasthan	13.0	26.6	4.90	19-Jul-77	30-Jun-83	30-Jun-83	Sat.	—	—
	6281	C0712	India	Extension and research—MP	10.0	20.9	5.54	12-May-77	30-Sep-83	30-Sep-83	Sat.	—	—
8753	8808	C0855	India	National agricultural research	27.0	54.0	54.00	10-Oct-78	30-Sep-83	30-Sep-85	Sat.	Likely	Moderate
		C1631	India	National agricultural research II	72.1	110.9	110.90	22-Oct-85	30-Jun-93	—	—	—	—
9994	10661	C1100	Nepal	Extension and research	17.5	20.9	3.70	3-Feb-81	15-Jul-87	15-Jul-90	Sat.	Unclear	Moderate
	7288	C0813	Pakistan	Extension and agricultural development (Punjab)	12.5	20.8	4.57	25-May-78	30-Jun-84	30-Jun-85	Sat.	—	—
	7288	C0922	Pakistan	Extension and adaptive research (Sind)	9.0	14.3	2.63	29-May-79	30-Jun-85	30-Jun-85	Sat.	—	—
8444	9228	C1158	Pakistan	Agricultural research	24.0	40.1	40.10	2-Jun-81	31-Dec-86	31-Dec-87	Sat.	Unclear	Substantial
12893		C1533	Pakistan	Extension and research (Baluchistan)	8.3	11.5	1.71	13-Dec-84	30-Jun-90	30-Jun-92	Unsat.	Unclear	Moderate

		C1762	Pakistan	Extension and research (Punjab—Sind)	42.1	58.4	8.05	24-Feb-87	30-Jun-93	30-Jun-94	—	—	—
		C2154	Pakistan	Agricultural research II	57.3	81.9	81.90	12-Jun-90	30-Jun-98	—	—	—	—
7684	10632	C0931	Sri Lanka	National extension and research	15.5	22.4	4.34	12-Jun-79	30-Jun-85	30-Jun-86	Sat.	Unlikely	Moderate
		C1776	Sri Lanka	Agricultural research	18.6	26.5	26.50	7-Apr-87	31-Dec-96	—	—	—	—
More recent projects excluded from the review													
		C2572	India	Forestry research and education	47.0	56.4	45.2	24-Feb-94	31-Dec-99	—	—	—	—
		C2747	Pakistan	Forest sector development (Punjab)	24.9	33.8	6.0	20-Jun-95	31-Dec-01	—	—	—	—
		p	Bangladesh	Agricultural research management	50.0	59.1	59.1	—	—	—	—	—	—
		p	India	National agricultural technology	100.0	160.0	112.0	—	—	—	—	—	—

P = proposed project or in the pipeline.
PAR = performance audit report.
PCR = project completion report.
* = not included in the review sample.
— = not applicable.
Sat. = satisfactory performance rating.
Unsat. = unsatisfactory performance rating.
a. Ex post evaluations done before 1987 are registered only as performance audit reports, as all project completion reports were subject to a PAR memorandum, which was attached to the PCR to become the PAR. Subsequently, the PCR and PAR are presented as separate products.
Source: Staff appraisal reports, loan and credit agreements, management information system, and Agricultural and Natural Resources Department database.

ANNEX TABLE 5.2: COMPONENT RESEARCH PROJECTS, FISCAL 1978–92

Report nos.		Loan/ credit			Loan/ credit	Project cost	Research cost[b]	Approval	Original	Actual
PCR	PAR[a]	no.	Country	Description	($mill.)	($mill.)	($mill.)	date	closing date	closing date
Africa										
9595	9699	C1284	Burkina Faso	Volta Noire agricultural development	6.8	22.1	0.6	27-Jul-82	30-Jun-88	30-Jun-88
9055	9699	C1285	Burkina Faso	Hauts Bassins agricultural development	4.7	20.8	0.3	27-Jul-82	30-Jun-88	30-Jun-88
9296	9699	C1293	Burkina Faso	Koudougou agricultural pilot	7.0	10.8	1.0	21-Sep-82	30-Sep-88	31-Mar-89
13817		C1550	Burkina Faso	Fertilizer credit	13.7	24.1	1.8	26-Feb-85	31-Dec-91	30-Jun-93
6808	8690	C0776	Cameroon	Zapi East rural development	8.5	12.2	0.7	7-Mar-78	30-Jun-84	31-Dec-84
8420	8690	C1075	Cameroon	Northern rural development	37.5	74.7	3.4	18-Nov-80	31-Dec-86	30-Jun-87
11461		L2485	Cameroon	Hevecam rubber	8.3	83.7	1.4	15-Jan-85	30-Jun-90	30-Jun-91
8765		C1009	Ghana	Volta Region agricultural development	29.5	49.8	2.2	22-Apr-80	31-Dec-85	31-Dec-88
13818		C1498	Ghana	Oil palm II	25.0	35.9	2.0	12-Jun-84	31-Dec-90	31-Dec-93
11740		L2323	Côte d'Ivoire	Rubber IV	32.2	98.5	11.9	23-Jun-83	30-Sep-89	30-Sep-91
		L2874	Côte d'Ivoire	Rubber V	11.9	58.9	10.6	6-Oct-87	31-Dec-92	31-Dec-93
7805	8314	C0914	Kenya	Smallholder coffee I	27.0	62.2	1.1	22-May-79	31-Mar-84	31-Mar-87
8631		C0959	Kenya	Integrated agricultural development	46.0	91.7	5.1	4-Dec-79	30-Apr-86	30-Apr-86
9388		C1051	Kenya	Fisheries I	10.0	14.9	2.4	24-Jun-80	30-Sep-87	30-Sep-87
	6171	C0823	Malawi	Shire consolidation	10.7	12.6	0.8	6-Jun-78	31-Dec-82	31-Dec-82
8638	9750	C1183	Malawi	National rural development Program III	7.3	8.6	0.4	13-Oct-81	30-Sep-86	30-Sep-88
10211	9750	C1343	Malawi	National rural development Program IV	10.6	12.5	0.4	5-Apr-83	30-Sep-88	30-Apr-91
	6275	C0851	Niger	Irrigation I	15.0	21.0	0.2	5-Oct-78	30-Jun-83	30-Jun-84
7333		C0967	Niger	Dosso rural development	20.0	39.3	0.7	20-Dec-79	30-Jun-85	30-Jun-85
10986	12016	L1981	Nigeria	Bauchi agricultural development	132.0	350.6	10.1	30-Apr-81	31-Dec-86	31-Dec-89
10980	12016	L1982	Nigeria	Kano agricultural development	142.0	482.2	3.5	30-Apr-81	31-Dec-86	31-Dec-89
10981	12016	L2185	Nigeria	Sokoto agricultural development	147.0	498.7	4.2	17-Jun-82	30-Jun-87	31-Dec-90
		L2436	Nigeria	Kaduna agricultural development	122.0	193.7	6.7	7-Jun-84	31-Dec-89	—
7149		C0775	Senegal	Irrigation III	20.0	35.0	0.7	7-Mar-78	30-Jun-83	31-Mar-86
12546	12791	C1406	Senegal	Eastern Senegal rural development	16.1	44.6	1.2	2-Aug-83	30-Jun-89	30-Jun-91
	7262	C0804	Sudan	Mechanized farming III	16.0	26.4	1.1	18-May-78	31-Mar-84	31-Mar-85
7151		C0904	Sudan	Crop and livestock	15.0	55.9	9.1	8-May-79	30-Jun-84	30-Jun-84
6809		C0803	Tanzania	Rural development III	12.0	30.5	1.4	16-May-78	31-Dec-84	31-Dec-84
8626	9253	C1070	Tanzania	Coconut pilot	6.8	8.5	1.8	7-Oct-80	31-Mar-86	31-Mar-89
		C2050	Tanzania	Tree crops	25.1	42.4	11.1	27-Jun-89	30-Jun-96	
13812		C1539	Uganda	Agricultural development/IFAD II	10.0	31.4	0.9	8-Jan-85	31-Mar-90	30-Sep-93
9562		C1368	Zimbabwe	Rural afforestation	7.3	10.6	1.1	17-May-83	31-Mar-88	31-Mar-89

East Asia and Pacific										
6850		C0745	Myanmar	Seed development	5.5	11.1	1.6	1-Nov-77	31-Dec-82	31-Dec-84
10984		C1417	China	Rubber development	100.0	301.0	2.1	29-Nov-83	31-Dec-89	31-Dec-90
12012		C1605	China	Forestry	47.3	135.8	13.3	11-Jun-85	31-Dec-89	31-Dec-91
12013		C1606	China	Pi Shi Hang area development	92.0	263.5	1.9	11-Jun-85	30-Jun-91	30-Jun-92
13564		C1918	China	Da Xing An Ling forest rehabilitation	56.9	517.0	4.9	9-Jun-88	31-Mar-92	31-Mar-94
		C2462	China	Agricultural support services	115.0	238.3	2.5	23-Feb-93	31-Dec-00	
8241	11431	L2248	Indonesia	Transmigration III	101.0	187.3	3.7	22-Mar-83	30-Jun-87	30-Jun-88
10726		L2344	Indonesia	Nucleus estate and smallholder sugar	79.2	130.2	1.4	30-Aug-83	30-Jun-89	31-Dec-91
13837		L2431	Indonesia	Swamp reclamation II	65.0	108.3	5.1	31-May-84	30-Jun-91	31-Dec-93
		L3305	Indonesia	Yogyakarta upland area development	15.5	25.1	3.2	19-Mar-91	31-Dec-96	
9857		C1395	Lao PDR	Agricultural production support	6.2	24.8	0.5	28-Jun-83	30-Jun-87	31-Dec-89
		C2079	Lao PDR	Upland agricultural development	20.2	34.0	2.7	21-Dec-89	31-Dec-95	
9574		L2220	Malaysia	Kedah agricultural development	56.9	195.1	0.4	16-Dec-82	31-Dec-88	31-Dec-88
11287		L2550	Malaysia	Sabah forestry	6.5	13.1	1.3	21-May-85	31-Dec-89	31-Dec-91
12226		L2608	Papua New Guinea	Milne Bay nucleus estate and smallholder	27.6	68.3	0.8	23-Jul-85	30-Sep-92	30-Sep-92
7950	7949	L1815	Philippines	Rainfed agricultural development	12.0	21.4	1.2	20-Mar-80	30-Jun-86	30-Jun-86
12433		L2360	Philippines	Central Visayas rural development	25.6	44.3	1.4	6-Dec-83	30-Jun-90	30-Jun-92
11930		C1430	Solomon Islands	Rural services	3.5	11.5	0.8	20-Dec-83	31-Dec-90	31-Dec-90
8173	10051	L2078	Thailand	Tree crops II	142.0	358.8	3.9	7-Jan-82	31-Mar-87	31-Mar-87
	7958	L2402	Thailand	Rural development I	50.0	157.2	1.4	29-Mar-84	30-Jun-88	30-Jun-88
11097		L2691	Thailand	Rubber replanting III	60.0	263.5	2.1	13-May-86	30-Sep-91	30-Sep-91
8796		C1080	Western Samoa	Second agricultural development	2.0	10.8	0.5	9-Dec-80	31-Dec-86	31-Dec-87
9615	9912	C1407	Vanuatu	Agricultural extension and training	2.0	3.8	0.5	2-Aug-83	30-Jun-89	30-Jun-89
Europe, Central Asia, Middle East, and North Africa										
10808		L1602	Morocco	Karia-Tissa rainfed agriculture	65.0	161.5	0.9	27-Jun-78	30-Jun-86	30-Jun-90
7821	8885	L1757	Morocco	Vegetable production and marketing	58.0	129.6	3.2	11-Sep-79	30-Jun-84	31-Dec-85
10807		L2082	Morocco	Middle Atlas agricultural development	29.0	92.2	1.4	7-Jan-82	30-Jun-88	31-Dec-90
13699		L2217	Morocco	Oulmes agricultural development	30.0	105.5	2.7	14-Dec-82	31-Dec-89	31-Dec-92
		L3688	Morocco	Irrigation areas agricultural services	25.0	34.7	9.4	21-Dec-93	30-Jun-00	—
9934	12031	L1997	Tunisia	Northwest Region	24.0	61.5	0.5	19-May-81	30-Sep-87	2-Jan-90
11729		L2234	Tunisia	Central Tunisia Irrigation	16.5	43.8	1.0	25-Jan-83	30-Jun-90	31-Dec-90
12817		L2502	Tunisia	Northwest agricultural production	15.0	37.7	0.7	14-Mar-85	30-Jun-91	31-Dec-91
8274	10210	L1585	Turkey	Forest development	86.0	915.0	11.1	1-Jun-78	31-Mar-86	30-Jun-87
8157	8885	L1967	Turkey	Fruits and vegetables II	40.0	107.0	3.0	31-Mar-81	30-Jun-86	30-Jun-86
	7543	C0805	Yemen Arab Republic	Agriculture Tihama II	10.5	39.5	7.4	18-May-78	30-Jun-84	30-Jun-86
9521		C0880	Yemen Arab Republic	Tihama development III (Wadi Mawr)	15.0	87.6	3.5	6-Mar-79	30-Sep-85	30-Sep-88
8364		C1067	Yemen Arab Republic	Southern uplands rural development II	17.0	81.6	1.7	16-Sep-80	31-Dec-85	30-Jun-87
13822		C1584	Yemen Arab Republic	Wadi Al Jawf agricultural development	10.0	38.0	1.1	23-Apr-85	30-Jun-92	30-Jun-92
13065		C1346	Yemen PDR	Wadi Hadramawt II	9.0	36.0	0.1	12-Apr-83	30-Jun-89	30-Jun-92
	7868	L2590	Morocco	Agricultural sectoral adjustment loan (SECAL) I	100.0	—	—	20-Jun-85	31-Dec-87	31-Dec-87

(continued on next page)

(Annex Table 5.2 continued)

Report nos. PCR	Report nos. PAR[a]	Loan/ credit no.	Country	Description	Loan/ credit ($mill.)	Project cost ($mill.)	Research cost[b] ($mill.)	Approval date	Original closing date	Actual closing date
13511		L2885	Morocco	Agricultural SECAL II	225.0	—	—	24-Nov-87	31-Mar-90	1-Apr-92
9308	11654	L2754	Tunisia	Agricultural SECAL	150.0	—	—	18-Sep-86	30-Jun-88	30-Jun-89
11354	12135	L2962	Tunisia	Structural adjustment loan	150.0	—	—	16-Jun-88	30-Apr-90	30-Jun-91
10025	11381	L2585	Turkey	Agricultural SECAL	300.0	—	—	18-Jun-85	31-Dec-87	30-Jun-89
Latin America and Caribbean										
		L3297	Argentina	Agricultural services and institutional development	33.5	82.7	9.1	28-Feb-91	30-Jun-98	—
8380	10636	L1877	Brazil	Minas Gerais rural development II	63.0	184.6	4.1	19-Jun-80	31-Dec-85	31-Dec-87
8380	10636	L1924	Brazil	Ceara II rural development	56.0	163.2	1.9	2-Dec-80	31-Dec-85	31-Dec-87
8488	9700	L2015	Brazil	Piaui rural development	29.0	84.4	2.4	16-Jun-81	31-Dec-86	31-Dec-86
10506		L2177	Brazil	Maranhao rural development	42.7	122.2	3.9	10-Jun-82	31-Dec-87	31-Dec-88
9519		L2060	Brazil	Northwest development I	89.8	199.3	4.4	1-Dec-81	31-Dec-86	31-Mar-90
9382		L2116	Brazil	Northwest development II—Mato Grosso	26.4	76.4	4.4	25-Mar-82	31-Dec-86	31-Dec-88
10553		L2163	Brazil	Amazonas rural development	26.4	77.3	4.2	27-May-82	31-Dec-87	31-Dec-90
9597		L2269	Brazil	Bahia rural development II	67.8	173.6	2.6	26-Apr-83	31-Dec-88	31-Dec-89
12449		L2453	Colombia	Agricultural diversification	50.0	253.4	2.5	27-Jun-84	30-Sep-90	30-Sep-92
5997		L1553	Mexico	Tropical agricultural development	56.0	149.0	33.8	27-Apr-78	31-Dec-83	30-Jun-84
8335	8880	L1945	Mexico	Rainfed agricultural development	280.0	797.0	137.0	22-Jan-81	30-Jun-86	30-Jun-87
7578		L2100	Mexico	Bajo Rio Bravo irrigation	180.0	525.3	13.1	16-Mar-82	31-Dec-88	31-Dec-88
11419		L2191	Mexico	San Fernando agricultural development	138.4	350.7	8.5	1-Jul-82	30-Jun-89	31-Dec-90
13824		L2526	Mexico	Chiapas agricultural development I	90.0	181.6	9.8	30-Apr-85	31-Mar-93	31-Dec-93
13157		L2859	Mexico	Agricultural extension	20.0	73.8	3.0	25-Jun-87	30-Jun-92	30-Jun-93
10810		L2219	Peru	Alto Mayo rural development	30.0	84.0	3.7	14-Dec-82	31-Dec-88	31-Dec-88
10809		L2396	Peru	Rural development III	40.0	67.4	1.5	27-Mar-84	30-Jun-90	30-Jun-90
South Asia										
	7584	C1042	Bangladesh	Mangrove Forests	11.0	17.2	0.5	10-Jun-80	31-Dec-85	30-Jun-86
13043		C1634	Bangladesh	Forestry II	28.0	36.0	0.4	12-Nov-85	30-Jun-91	30-Jun-92
		C2397	Bangladesh	Forest resources management	49.6	58.7	1.3	23-Jun-92	31-Dec-00	—
		C2146	Bangladesh	Fisheries III	44.6	62.7	1.0	29-May-90	31-Dec-96	—
7544	9617	C0788	India	Karnataka irrigation	126.0	284.4	0.9	4-Apr-78	31-Mar-84	31-Mar-86
	6857	C0824	India	National dairy	150.0	363.8	3.0	8-Jun-78	31-Dec-85	31-Dec-85
9375		C1034	India	Karnataka sericulture	54.0	95.1	8.0	3-Jun-80	31-Dec-85	30-Sep-88
9021		C1012	India	Cashew nut project	22.0	45.7	1.0	29-Apr-80	30-Sep-85	30-Sep-87
11468		C1177	India	Madhya Pradesh major irrigation	220.0	439.2	1.6	15-Sep-81	30-Jun-87	30-Jun-91
12543		C1319	India	Haryana irrigation II	150.0	300.3	3.6	25-Jan-83	31-Mar-88	31-Mar-92

12354		C1383	India	Maharashtra water utilization	54.7	78.1	3.1	9-Jun-83	31-Aug-89	31-Aug-91
		C1424	India	Watershed development/rainfed	31.0	45.5	1.3	8-Dec-83	31-Dec-91	31-Dec-93
		C2131	India	Watershed plains	62.0	91.8	1.4	15-May-90	31-Mar-98	—
		C2100	India	Watershed hills	88.0	125.6	1.4	6-Mar-90	30-Jun-97	—
6836		C0816	India	National seeds II	16.0	34.9	0.3	30-May-78	31-Dec-84	31-Dec-85
		C2409	India	Rubber project	92.0	143.8	3.5	2-Jul-92	30-Sep-98	—
		C1859	India	National dairy II	360.0	677.7	3.5	15-Dec-87	31-Dec-94	31-Dec-94
		C2076	India	Irrigation and drainage—Punjab	165.0	246.5	2.8	14-Dec-89	31-Mar-98	—
		C2022	India	National sericulture	177.0	347.1	24.3	18-May-89	31-Dec-96	—
		C2433	India	Agricultural development—Rajasthan	106.0	130.3	18.2	12-Nov-92	30-Sep-99	—
		C2328	India	Maharashtra forestry	124.0	142.0	1.7	14-Jan-92	30-Sep-98	—
9520		C1008	Nepal	Forestry I	17.0	24.8	0.4	22-Apr-80	30-Jun-86	30-Jun-89
9659	10661	C1339	Nepal	Cash crops development	6.0	7.4	0.4	22-Mar-83	31-Dec-88	31-Dec-88
12615		C1400	Nepal	Forestry II (Terai)	18.0	24.0	0.5	12-Jul-83	30-Jun-90	30-Jun-92
		C2028	Nepal	Hill community forestry	30.5	45.4	0.4	30-May-89	30-Jun-97	—
10444		C1157	Pakistan	Grain storage	32.0	68.0	0.5	2-Jun-81	31-Dec-85	31-Dec-89
		C1936	Pakistan	Oilseeds development	51.4	84.2	7.8	23-Jun-88	31-Dec-96	—
10679		C1317	Sri Lanka	Foresty I	9.0	15.0	0.6	18-Jan-83	31-Dec-89	31-Dec-90
		C1909	Sri Lanka	Smallholder rubber rehabilitation II	23.5	73.1	0.7	24-May-88	30-Jun-97	—
		C2260	Sri Lanka	Irrigation rehabilitation	29.6	49.8	1.6	6-Jun-91	30-Jun-98	—

PAR = performance audit report.
PCR = project completion report.
a. Ex post evaluations done before 1987 are registered only as performance audit reports, as all project completion reports were subject to a PAR memorandum, which was attached to the PCR to become the PAR. Subsequently, the PCR and PAR have been presented as separate products.
b. Research costs are approximations.
Source: Staff appraisal reports, management information system, and Agricultural and Natural Resources Department database.

ANNEX TABLE 5.3: NOMINAL LOAN COMMITMENTS TO RESEARCH AND EXTENSION, AND THEIR RELATIONSHIP TO THE BANK'S TOTAL SECTORAL PORTFOLIO, 1977–96

Total Bank and agricultural commitments[a] ($ billion)

Approval years	*Total Bank commitments*	*Total agricultural commitments*	*Total research and extension*
1977–80	37.04	11.56	0.87
1981–84	56.21	14.03	1.29
1985–88	70.73	16.09	1.43
1989–92	87.82	14.75	1.75
1993–96[b]	95.79	13.80	1.94
Total	347.59	70.22	7.27

Agricultural research and extension commitments ($ million)

	Research			*Extension*			*Total research and extension*
Approval years	*Free-standing*	*Component*	*Total*	*Free-standing*	*Component*	*Total*	
1977–80	105.48	119.39	224.88	367.13	278.31	645.44	870.32
1981–84	382.28	241.43	623.71	253.37	408.40	661.77	1,285.47
1985–88	279.67	231.86	511.53	544.83	374.57	919.40	1,430.94
1989–92	546.30	253.24	799.55	489.94	463.48	953.42	1,752.97
1993–96[b]	666.53	308.97	975.51	493.50	466.85	960.35	1,935.86
Total	1,980.27	1,154.9	3,135.17	2,148.78	1,991.61	4,140.39	7,275.56

Regional commitments to free-standing agricultural research projects by region ($ million)

Approval years	*Africa*	*East Asia and Pacific*	*Europe and Central Asia/Middle East and North Africa*	*Latin America and Caribbean*	*South Asia*	*Total*
1977–80	15.00	0.00	0.00	40.00	50.48	105.48
1981–84	24.22	148.15	14.60	136.76	58.56	382.28
1985–88	145.31	29.25	4.05	3.23	97.84	279.67
1989–92	207.34	35.30	114.00	132.37	57.30	546.30
1993–96[b]	330.29	63.00	38.37	52.96	181.91	666.53
Total	722.15	275.70	171.01	365.32	446.09	1,980.27

a. Here and elsewhere in this report commitments refer to the nominal Bank loan and credit funds approved.
b. Estimate.
Source: Staff appraisal reports, loan and credit agreements, management information system, and Agricultural and Natural Resources Department database.

ANNEX TABLE 5.4: FINANCIAL SUPPORT FOR THE CGIAR RESEARCH AGENDA, 1972–95

	World Bank		*Other donors*	*Total*
Year	*$ millions*	*Percentage of total*	*($ millions)*	*($ millions)*
1972	1.3	6	17.9	19.2
1973	2.8	11	22.6	25.4
1974	2.4	7	31.3	33.7
1975	3.2	7	41.0	44.2
1976	6.5	10	55.0	61.5
1977	7.9	10	68.5	76.4
1978	8.7	10	74.8	83.5
1979	10.2	10	87.5	97.7
1980	12.0	10	105.0	117.0
1981	14.6	11	114.6	129.2
1982	16.3	11	124.8	141.1
1983	19.0	12	140.4	159.4
1984	24.3	14	145.1	169.4
1985	28.1	17	141.7	169.8
1986	28.4	15	162.2	192.2
1987	30.0	15	171.6	201.6
1988	30.0	14	178.2	211.5
1989	33.3	15	190.2	224.5
1990	34.3	15	199.8	234.9
1991	35.1	15	194.4	232.0
1992	37.6	15	207.3	247.3
1993	40.0	17	184.7	234.7
1994	50.0	19	218.1	268.1
1995 (estimate)	50.0	18	280.0	280.0

CGIAR = Consultative Group on International Agricultural Research.
Note: Excludes Bank support for the CGIAR Secretariat. Figures for 1994 and 1995 include a special Bank grant of $20 million ($10 million each year) for a two-year financial stabilization.
Source: CGIAR Secretariat.

ANNEX TABLE 5.5: SUMMARY OF ISNAR ACTIVITIES IN NATIONAL AGRICULTURAL RESEARCH SYSTEMS THAT WERE ALSO ASSISTED BY WORLD BANK PROJECTS DURING THE REVIEW PERIOD

Region and country	*Program review*[a]	*Research planning*[b]	*Management information system*[c]	*Outposted expert*	*Human resources*[d]	*Studies*[e]
Africa[f]						
Burkina Faso	*	*		*		*
Cameroon				*		*
Gambia, The			*			*
Ghana			*			*
Guinea					*	
Kenya	*	*			*	
Madagascar	*	*				
Malawi	*				*	
Niger						*
Rwanda	*	*				*
Senegal		*	*			
Sudan			*			*
Tanzania		*		*		*
Uganda		*		*	*	*
Zaire	*	*		*		
Zambia			*			
Zimbabwe						*
East Asia and Pacific						
China		*				
Indonesia	*	*	*	*		
Papua New Guinea	*	*				
Philippines	*	*				
Thailand					*	
Europe, Central Asia, Middle East, and North Africa						
Algeria						*
Morocco		*	*		*	*
Tunisia		*				*
Yemen, Republic of						*

(Annex Table 5.5 continued)

Region and country	Program review[a]	Research planning[b]	Management information system[c]	Outposted expert	Human resources[d]	Studies[e]
Latin America and the Caribbean						
Bolivia	*	*				
Brazil	*					
Colombia	*					
Peru	*					
South Asia						
Bangladesh	*		*	*	*	
India			*			*
Nepal			*		*	
Pakistan	*	*				
Sri Lanka			*			

a. Program review included reviews of research programs with agency staff and participation in external reviews, where a team of (often expatriate) experts is contracted to do the analysis and make recommendations on the research program and its management.
b. Planning includes participation in development of long-term research strategies and medium-term (often five-year) plans.
c. MIS activities involve assistance with the introduction of management information systems. INFORM is an ISNAR model developed in the Asian context as a tool for program planning and budgeting. It is now being extended to several AFR countries.
d. Human resources includes training programs for research management and personnel development, including manpower needs assessments and planning.
e. Studies cover analysis of existing research management, system restructuring, links between research organizations and with end-users of technology, employment conditions for researchers, and researcher performance.
f. In Africa, ISNAR has prepared an Indicator Series for NARS as part of its worldwide documentation of agricultural research systems. This is a useful source of information on organizational structure, research sources, and funding. This has been undertaken with support from Italy, the Special Program for African Agricultural Research, and ISNAR's core budget.
Source: ISNAR, personal communication with director general, 1995.

ANNEX TABLE 5.6: EDUCATION PROJECTS THAT ENCOMPASS AGRICULTURAL RESEARCH

Report nos.		Loan/ credit			Loan/ credit	Project cost	Approval	Original closing	Actual closing
PCR	PAR	no.	Country	Description	($ mill.)	($ mill.)	date	date	date
Africa									
7209		C1141	Ethiopia	Education V	35.0	53.7	14-May-81	30-Sep-85	30-Sep-85
		C1873	Ethiopia	Education VII	70.0	95.2	26-Jan-88	30-Sep-94	
	6712	C0797	Kenya	Education IV	23.0	31.0	9-May-78	31-Dec-82	31-Dec-84
10766		C1107	Kenya	Education V	40.0	55.0	17-Mar-81	30-Jun-86	30-Sep-91
7242	10044	C0908	Senegal	Education III	22.0	33.2	15-May-79	31-Dec-84	31-Dec-86
East Asia and the Pacific									
7561		C1167	China	University development	100.0	295.3	23-Jun-81	30-Jun-86	30-Jun-86
8530	9708	C1297	China	Agricultural education and research	75.4	201.6	2-Nov-82	30-Jun-88	31-Mar-89
13146		C1671	China	Provincial universities	120.0	477.0	25-Mar-86	31-Dec-91	31-Dec-92
9247		L1904	Indonesia	University development	45.0	63.2	16-Sep-80	31-Dec-86	31-Dec-87
13639		L2547	Indonesia	University development II	147.0	244.5	21-May-85	31-Dec-91	31-Dec-93
		L2944	Indonesia	Higher education development	140.3	257.3	31-May-88	31-Dec-91	31-Dec-93
		L3311	Indonesia	Higher education development II	150.0	282.4	26-Mar-91	31-Dec-94	—
		L3612	Korea	Environmental research and education	60.0	97.3	3-Jun-93	31-Dec-98	—
	6348	L1374	Philippines	Education IV	25.0	45.3	1-Mar-77	31-Dec-81	31-Dec-83
	8788	L1786	Philippines	Fishery training	38.0	70.6	18-Dec-79	26-Jun-81	31-Dec-87
Europe, Central Asia, Middle East, and North Africa									
		L2867	Portugal	Technology education	32.0	77.1	21-Jul-87	31-Mar-95	31-Mar-95
Latin America and the Caribbean									
8658		L2208	Peru	Education II	17.3	34.8	9-Nov-82	1-Apr-87	31-Dec-88

Source: OED annual review database.

ANNEX TABLE 5.7: IRRIGATION DATA BY REGION, 1990 AND 1980–90

Region and country	*Arable and permanent crop land, 1990 ('000 ha)*	*Irrigated land, 1990 ('000 ha)*	*Percentage irrigated, 1990*	*Irrigated land growth, 1980-90 (%)*
Africa				
Burkina Faso	3,563	20	0.6	7.2
Cameroon	7,008	30	0.4	7.9
Ethiopia	13,930	162	1.2	0.1
Ghana	2,720	8	0.3	1.3
Guinea	728	25	3.4	12.1
Kenya	2,430	54	2.2	3.0
Madagascar	3,102	920	29.7	3.6
Malawi	2,419	20	0.8	1.1
Mali	2,093	205	9.8	3.0
Niger	3,610	40	1.1	5.7
Nigeria	32,300	870	2.7	0.5
Rwanda	1,155	4	0.3	0.0
Senegal	2,350	180	7.7	0.6
Sudan	12,900	1,900	14.7	0.7
Tanzania	3,367	150	4.5	2.3
Zaire	7,860	10	0.1	3.6
Zambia	5,268	32	0.6	5.4
Zimbabwe	2,812	220	7.8	3.4
East Asia and Pacific				
China	96,563	47,837	49.5	0.5
Indonesia	22,000	7,600	34.5	3.4
Malaysia	4,880	342	7.0	0.7
Philippines	7,970	1,560	19.6	2.5
Thailand	20,000	4,300	21.5	3.6
Europe, Central Asia, Middle East, and North Africa				
Morocco	9,327	1,270	13.6	0.4
Tunisia	4,576	280	6.1	6.0
Turkey	27,530	2,370	8.6	1.3
Yemen	1,529	310	20.3	0.7
Latin America and Caribbean				
Bolivia	2,308	165	7.1	1.7
Brazil	60,000	2,700	4.5	5.4
Colombia	5,420	520	9.6	2.7
Mexico	24,710	5,180	21.0	0.4
Peru	3,730	1,260	33.8	0.8
South Asia				
Bangladesh	9,126	2,933	32.1	6.5
India	169,080	43,050	25.5	1.1
Nepal	2,653	1,000	37.7	6.8
Pakistan	20,750	16,500	79.5	1.2
Sri Lanka	1,900	520	27.4	-0.1

Source: FAO yearbook, various years.

ANNEX TABLE 5.8: AGRICULTURE IN RELATION TO SELECTED ECONOMIC INDICATORS BY REGION, SELECTED YEARS

(percent)

Agricultural GDP as a share of total GDP

Region	*1965*	*1985*	*1990*
Africa	42	32	31
excluding Nigeria	38	31	32
East Asia and Pacific	42	25	23
Europe and Central Asia	23	13	13
Latin America and Caribbean	17	10	10
excluding Brazil and Mexico	19	13	12
Middle East and North Africa	27	14	15
South Asia	44	30	27
excluding India	44	32	29
Total	36	20	19

Government expenditure on agriculture as a share of total expenditure

Region	*1980*	*1985*	*1990*[a]
Africa	4.7	6.3	6.3
excluding Nigeria	6.6	7.6	7.4
East Asia and the Pacific	8.3	6.9	8.2
Europe and Central Asia	3.8	3.7	4.6
Latin America and the Caribbean	4.0	3.6	1.8
excluding Brazil and Mexico	1.0	1.5	3.1
Middle East and North Africa	5.0	4.8	4.8
South Asia	6.3	7.7	7.4
excluding India	8.5	6.7	6.2
Total	4.9	5.3	3.9

Agricultural exports as a share of total exports

Region	*1980*	*1985*	*1990*
Africa	20	29	25
excluding Nigeria	48	56	46
East Asia and Pacific	24	22	15
Europe and Central Asia	18	14	14
Latin America and Caribbean	36	30	25
excluding Brazil and Mexico	43	43	34
Middle East and North Africa	8	7	10
South Asia	33	28	18
excluding India	40	33	21
Total	24	22	18

Economically active population in agriculture

Region	*1980*	*1985*	*1990*
Africa	75	73	70
excluding Nigeria	78	75	72
East Asia and Pacific	71	67	64
Europe and Central Asia	37	33	29
Latin America and Caribbean	31	28	25
excluding Brazil and Mexico	32	29	26
Middle East and North Africa	42	39	36
South Asia	69	67	65
excluding India	66	64	61
Total	66	63	60

a. Information for 1990 is incomplete.

Source: FAO 1991; IMF, various years; U.S. Department of Agriculture 1993; and World Bank, various years.

Annex 6: Regional research assistance strategies and performance in each region

This annex describes the research assistance strategies adopted by the Bank in each region and assesses performance of projects in the institutional development framework elaborated in Chapter 9.

Regional assistance strategies

South Asia

The Bank has adopted a policy of long-term assistance in most of the supported national agricultural research systems (NARSs) in South Asia (SAS) to achieve the intended level of institutional development. In India until 1978, the Bank provided support through combined extension and research projects in specific states. Two national research projects were approved in 1978 and 1985. The Bank has also supported research on specific commodities in component projects, and a further research project is under consideration (annex tables 5.1 and 5.2). Pakistan has benefited from two research projects (1982 and 1990), as well as adaptive research support in four extension and research projects. Similarly, the Bank has supported two research (1978 and 1984) and two extension and research projects in Bangladesh. Component projects were less supportive of research in Pakistan (only oilseeds) and in Bangladesh (mainly forestry). Sri Lanka had an extension and research project (1979) and a research project (1987), and component projects provided some research support for forestry and water management. Nepal alone has not had a specific NARS development project. There have been piecemeal interventions at selected institutes through an extension and research project and a cash crop commodity project, as well as in the forestry sector.

Other donors have provided substantial support for NARSs, and in most cases, the assistance has complemented Bank assistance. The only cofinancing with other donors was for a technical assistance component with German aid in Sri Lanka, and for United Nations Development Programme (UNDP) training in Bangladesh, and, to a lesser extent, in Nepal and Pakistan (Figure 8.3). The U.S. Agency for International Development (USAID) has been active in all the countries. The Canadian International Development Agency has provided considerable support in Bangladesh, India, and Pakistan, and the Overseas Development Administration, the Swedish International Development Authority, the Australian International Development Assistance Bureau (AIDAB), Swiss Aid, the Danish International Development Agency, the Japan International Cooperation Agency, the German Agency for Technical Cooperation (GTZ), and Italian Aid have also contributed. The Asian Development Bank (ADB) has provided some support in Sri Lanka, and GTZ has funded International Service for National Agricultural Research (ISNAR) participation there. The CGIAR centers have

made important contributions to collaborative research and training and to improving research management in most countries. USAID has been particularly supportive of these centers, often financing their participation, by contracting with them to implement USAID project components. Without generous funding of recurrent costs for the Bangladesh NARS from 1983–93 (marked PL480 funds from USAID), that system would have had great difficulty in functioning.

East Asia and Pacific

In East Asia and Pacific (EAP), the Bank's support for NARSs has been substantial in six countries, and has supported some areas of agricultural research in five others, including Pacific island countries (annex tables 5.1 and 5.2). However, except in Indonesia, and to a lesser extent in China, intervention in the six countries to which the Bank has given major support has not been in the form of the continuous series of projects so evident in SAS. Indonesia has had three projects since 1976 and China has had an education and research project (1982) and a second research project (1984). Malaysia's second project was restricted to forestry research. Papua New Guinea, the Philippines, and Thailand had only one free-standing research project.

EAP is a leading producer of export crops; however, institutions that carry out research on annual crops (which still dominate land use) have received the most attention, while the Bank has assisted specific tree crops (rubber, oil palm, cocoa, and coconut) through component projects. Export crops have traditionally received more attention, and the common practice of obtaining industry financing for research through export cesses has favored research investment in these crops.

Other donors have provided support for NARS development. The ADB has been active in all six countries receiving major Bank assistance except Thailand. The UNDP and the Food and Agriculture Organization of the United Nations (FAO) have intervened in technical assistance, and the International Fund for Agricultural Development (IFAD) has supported specific research areas in four countries. Of the many bilateral donors, Australia and Japan have provided the most widespread assistance, undoubtedly because of their proximity to EAP.[1] Japan cofinanced the research management project in Indonesia (1989) with the Bank, IFAD and Australia cofinanced the research project in Thailand, and the ADB cofinanced a project in Vanuatu.

Africa

In Africa (AFR), the Bank's support for agricultural research started later than in SAS, but expanded to dominate the NARS support portfolio (Figure 8.2). During the review period, the Bank approved 21 free-standing research projects in 18 countries and included research components in 160 other agricultural projects in 32 countries. Repeater projects occurred in only three countries (Malawi, Senegal, Sudan). However, the small number of repeater projects is a symptom of the delay in providing Bank support to NARS rather than evidence of a lack of commitment to long-term institutional assistance. By the end of fiscal 1995, three of the five countries that had had a research loan approved before the end of fiscal 1985 had benefited from a second project (Annex Table 5.1), and a fourth country had a new research project in an advanced stage of processing. Improving the capacity for technology development is one of the key components of the Bank's sectoral support strategy for AFR. In commodity development projects with significant research components, tree crops were prominent, especially in West Africa.

Other donor support to NARSs in the region has been substantial. Cofinancing in Bank-supported projects has been much more common than in other regions (Figure 8.2). Eleven of 14 cofinanced projects included bilateral donors and seven involved multilateral donors (Table 8.1). Bilateral entities have often funded self-contained enclave projects, which have not always been congruent with the priorities of the research system in which they operated. The British and French governments have tended to favor their former colonies in providing support. Participation by Consultative Group on International Agricultural Research (CGIAR) centers has been important, both in technical and management support for NARSs (the region absorbed about 40 percent of CGIAR's budget in 1994). At the end of the 1980s, more than 200 of the CGIAR's scientists had been placed in either CG sublocations or in cooperating NARSs in AFR. Kenya has by far the strongest representation of regional and international agricultural organizations in the region.

The generally poor state of most NARSs in terms of facilities, human resources, and funding capacity has led to a number of initiatives that attempt to rationalize the use of scarce research resources on a subregional basis. The Bank strongly supports these projects.

Latin America and the Caribbean

In Latin America and the Caribbean (LAC) only Brazil has received repeater projects (a total of three). The NARSs in Colombia and Peru benefited from a single project in the 1980s, while the Bolivian and Mexican NARSs were supported by research projects in the 1990s. However, Mexico benefited from three substantial component research projects in the 1980s (annex tables 5.1 and 5.2). Other than in Brazil, all the free-standing research projects had a complementary extension component. The Bank's involvement in agricultural research in the Caribbean has been negligible, with minor component projects in Barbados, Haiti, and Jamaica. Of 61 research component projects in LAC, Brazil and Mexico dominated with a total of 40 projects. Despite the low number of Bank interventions in free-standing projects, in value terms its contribution to research investment has been substantial, especially in the first two quadrenniums of the review period (Figure 8.2), because of the relatively large size of the loans (Annex Table 5.1).

The objective of the research projects in Brazil, Colombia, and Peru was not only to increase the overall efficiency of the NARSs, but also to fund specific investments by agroecological region (Brazil), by area (Peru), or by commodity (Brazil and Colombia). The major component project in Mexico emphasized research in particular agroecological zones (such as humid tropics) or farming systems (such as rainfed agriculture and smallholders with limited resources).

Multilateral and bilateral agencies have actively supported the NARS in LAC, although none has been involved in cofinancing Bank projects (other than the recent project in Bolivia). Inter-American Development Bank investment has approached that of the Bank in value, has involved more NARSs, and has heavily supported the Brazilian NARS. The FAO and UNDP contributed to specific programs, and among the bilaterals the Canadian International Development Agency, the United Kingdom, and USAID have dominated, although USAID support for research declined drastically in the latter part of the review period. France (through the International Cooperation Center in Agronomic Research for Development) has supported research in Brazil. The CGIAR centers have made major contributions to NARS development in the region, and the headquarters of three major centers are located in LAC: the International

Center for Tropical Agriculture, the International Center for Improvement of Maize and Wheat (CIMMYT), and the International Potato Center (CIP). The Peruvian project was exceptional in that researchers from these three centers led programs in the new research and extension institution, the National Institute for Research in Agriculture and Livestock (INIPA), in the mid-1980s. Although not specified in legal agreements, the Bank and each center agreed to this arrangement at appraisal.

Europe, Central Asia, Middle East, and North Africa

In Europe, Central Asia, Middle East, and North Africa (ECA/MNA), with the exception of the Yemens, the Bank did not emphasize institutional development of NARSs until late in the review period. Earlier interventions supported research on specific commodities or in particular localities in research component projects (Annex Table 5.2). Other interventions were directed at providing technology for a dominant extension investment. In Turkey, for example, following a series of component projects in the 1970s and early 1980s, the Bank approved two extension and research projects in 1984 and 1990. It was not until 1992 that the Bank undertook a major institution-building project in Turkey, although an agricultural sector loan in 1985 provided for a sectoral review (by the FAO and local consultants) that assisted the preparation of the 1992 project. USAID had provided substantial support to Turkish institutions in the 1950s and 1960s, and IFAD cofinanced the 1984 extension and research project.

The UNDP and the FAO were active in supporting research in the two Yemens in the 1970s and early 1980s. The Bank then followed with parallel projects in the Republic of Yemen in 1984 and in the People's Democratic Republic of Yemen in 1985. These institution-building projects capitalized on earlier UNDP and FAO efforts, and provided a basis for the 1990 project after the two countries were united. IFAD, Italy, and the FAO were cofinanciers in the Republic of Yemen project, and the Netherlands participated in the 1990 project.

The Bank provided minor support in component projects in Morocco in the 1980s, and it was not until 1989 that an extension and research project provided institutional support for the dominant institute, the National Institute for Agricultural Research (INRA). A research review by ISNAR included in the 1985 sectoral adjustment loan, however, contributed to the preparation of the 1989 project. Subsequent component projects financed significant research in forestry (1990) and irrigation (1993). France and Germany (through the German Credit Institution for Reconstruction and GTZ) cofinanced the 1989 project, and USAID has separately funded research programs in arid and semiarid zones. In Tunisia, a 1990 project provided the first substantial research support. A technical assistance loan in 1982 and sectoral adjustment loans in 1986 and 1988 provided significant groundwork for the research reforms included in the project.[2]

ISNAR assisted with research reviews in Morocco, Tunisia, and the Yemens.

Research structure and coordination

South Asia

Structural arrangements for public sector research vary considerably in SAS. India, following strong USAID support in the 1950s, adopted a model with similarities to the U.S. system in that state agricultural universities (SAUs) became responsible for research in the states. India also has a strong central research

capability in the Indian Council of Agricultural Research (ICAR) and its institutes, and ICAR has an overall research coordination function. This structure results in reasonably effective coordination of major ICAR programs, but linkages among researchers in different commodity institutes are less well developed. The involvement of SAUs in the All India Coordinated Research Program funded through ICAR has encouraged linkages among SAU and ICAR researchers concerned with the program, but linkages among SAUs in general are relatively poor. In 1994 ISNAR undertook a program to improve networking among institutes and SAUs that may reduce the isolation of many SAUs. In Pakistan, applied research is the domain of provincial departments of agriculture, although provincial universities do carry out considerable agricultural research, and in one province the university has taken over research responsibility from the Department of Agriculture (with project support from USAID). Pakistan also has a strong central research capacity: the Pakistan Agricultural Research Council (PARC) and its institutes. PARC is responsible for overall coordination. Linkages are good among PARC institutes, but are weak for other parts of the NARS, in part because of weak capacities at the provincial level. Elsewhere in SAS there is no federal/provincial division, universities play a lesser role in research, and ministries and departments are involved in agricultural research.[3] Bangladesh and Sri Lanka have coordinating councils, the Bangladesh Agricultural Research Council (BARC) and the Council for Agricultural Research Policy (CARP), respectively, although the latter was founded only in 1987, which do not have their own research facilities. However, BARC has not yet been able to fully realize its intended function, as institutes are not obliged to coordinate their activities unless they have received funding through BARC. CARP has also been unable to develop its coordination functions properly. In Nepal, the research functions of the agriculture and livestock departments were placed under joint management in 1987 and the management was elevated to a council (National Agricultural Research Council) with an oversight board in 1991.

Consequently, in SAS each of the NARSs has some form of coordinating body that, at a minimum, provides the opportunity for linkages to enhance research quality and promote the efficient use of research resources, even though this coordination is rarely entirely successful. ICAR in India was well established before the review period, and the Bank projects did not focus on the research linkage issue. However, the Bank projects gave strong support to coordinating councils in Bangladesh, Pakistan, and Sri Lanka. In these three countries, the Bank also funded research based on open competitive grants or contracts. This mechanism allows the coordinating institute to fund research within defined themes or programs, which any research institute or university can undertake, and promotes linkages within the NARS. Unfortunately, in Pakistan PARC failed to appreciate the intent of the scheme, so the program was not particularly successful, and in Bangladesh the program was used largely to replace deficient funding from the regular budget. In Sri Lanka the program was successful, and in 1995 was expanded to invite private sector participation. In Nepal USAID rather than the Bank was instrumental in introducing the coordination and planning mechanism in the late 1980s.

East Asia and Pacific

Structural arrangements for public sector research also vary in the countries receiving assistance in EAP. China, Indonesia, and the Philippines each have some form of apex organization to coordinate research and promote linkages; Malaysia, Papua New Guinea, and Thailand do not. China, which has the largest NARS in the world, has agricultural research institutes at the national, provincial, and prefectural levels, as well as 67 agricultural universities that are

engaged in research and five basic science institutes within the Chinese Academy of Sciences that have an agricultural orientation. It is a multiministry, multiagency system for which the State Science and Technology Commission (SSTC) provides a broad strategy and some coordination. The Chinese Academy of Agricultural Sciences has adopted this strategy in planning the programs for its 38 institutes, and has some influence over the eight key agricultural universities that receive funds from the central government. However, the mechanism is top-down and few linkages exist. Indonesia has an agricultural research board that is responsible for research policy and coordination and one semiautonomous agency, the Agency for Agricultural Research and Development (AARD), which is linked to the Ministry of Agriculture (MOA). The AARD is responsible for all agricultural research other than research into forestry and estate crops. The Ministry of Forestry is responsible for forestry research and public companies linked to the AARD at the board level are responsible for estate crop research. Universities' capacities for agricultural research are not strong, but projects are encouraging linkages between the AARD and universities through a successful contract research program. The Philippines has a coordinating council, the Philippines Council for Agriculture and Resources Research Development, for overall agricultural research, and another for fisheries, the Philippines Council for Aquaculture and Marine Research and Development. In addition, the authorities established the Bureau of Agricultural Research (BAR) in 1988 to coordinate the research bureaus and agencies and the 13 regional institutes of the major player, the Department of Agriculture. Although 39 of the country's 50 universities are involved in agricultural research, funding constraints limit their activities. Regional research consortia in which the Philippines Council for Agriculture and Resources Research Development and BAR participate ensure linkages between the different regions of the Philippines. In addition, there are two autonomous institutes for rice and postharvest technology that are not effectively linked to the regional institutes.

In Malaysia, a single semi-autonomous institute, the Malaysian Agricultural Research and Development Institute (MARDI), is responsible for research on most crops other than rubber, palm oil, cocoa, livestock, and fresh fish, which have their own institutes supported by cesses. Coordination at the federal level is through an interagency coordination and liaison committee set up in the early 1980s, but linkages between food crop and tree crop research are weak. The Forestry Research Institute of Malaysia (FRIM) was created in 1985 to manage forestry research at the federal level. However, states also have forestry research activities, and linkages between these institutes and FRIM are deficient. Agricultural research in Thailand is fragmented among government departments and universities, with agriculture and livestock research under separate departments in the MOA, but coordination of cropping research within the Department of Agriculture (the dominant participant) is satisfactory. However, with one exception (rubber research), the universities are not properly linked with the ministry's institutes. In Papua New Guinea, agricultural research is also fragmented among government departments and two universities, although a joint planning committee is in place. In the 1980s the authorities created four autonomous institutes for export tree crops commodities with cess funding.

The Bank did not intervene in the basic research structure in China. In Indonesia it further developed the AARD. In the Philippines, with the help of ISNAR, the research project facilitated the establishment of BAR to coordinate research within the Department of Agriculture. In Malaysia the Bank project promoted the liaison committee at the federal level, but did not adequately address the linkage problem between FRIM and the states in the forestry project. The Bank did not promote any structural changes in Papua New Guinea, in that research

for other than export crops remained in the Department of Agriculture and Livestock, although a separate crop research division was created. Effectiveness continued to be poor, and at the end of 1995 an ADB loan was identified to support the creation of an autonomous institute to handle research on food crops. An attempt to introduce a coordinating council within the MOA in the Thailand project failed, because the government did not consider such a council necessary.

Africa

Agricultural sector institutions, research and science entities, and in some francophone countries, education ministries or semiautonomous institutions linked to these ministries, carry out the bulk of agricultural research in AFR. (However, having agricultural research and education in the same ministry has generally not led to better integration of university and research establishments.) As a carryover from the colonial period, many countries also have semipublic commodity boards with their own research capacity for export crops that are usually funded, at least partially, by cesses on marketed production. All but the smallest countries (such as Djibouti) have universities with some agricultural research functions, but their contribution to research output is minimal with a few exceptions (for instance, Côte d'Ivoire, Uganda, and Zimbabwe). Funding constraints are a common and serious issue in university systems that limit not only research, but also the systems' ability to maintain an acceptable level of teaching capacity and curriculum development.

A variety of arrangements is in place for coordinating research agencies within NARSs. Some countries use research councils, committees, or commissions (Burkina Faso, Ethiopia, Ghana, Kenya, Nigeria, Sudan, and Zambia); others have a single semiautonomous institute responsible for all nonuniversity research (Burundi and Uganda); and the remainder tend to rely on the dominance of one institution to avoid unnecessary overlap in publicly funded research programs (Côte d'Ivoire, Madagascar, Rwanda, and Zimbabwe). Bank projects have generally attempted to strengthen coordination arrangements.

Most of the Bank's projects in AFR have adopted the contract research concept in an effort to promote linkages and increase university systems' involvement in research activities. The Bank has also funded joint research institute-university programs in Ghana and provided for joint university-institute staff appointments in an innovative project in Uganda. In Malawi, the Bank project supported public funding of private research on coffee to encourage linkages with private sector research entities.

Latin America and the Caribbean

In LAC, all the assisted countries adopted an autonomous or semiautonomous institute model linked to sectoral ministries. In the largest NARS in the region, Brazil, a Bank project supported a shift in the major public federal institute, the Brazilian Agricultural Research Corporation (EMBRAPA), from a model based on disciplinary research and regional institutes to one dominated by multidisciplinary commodity institutes and institutes pertaining to agroecological regions. EMBRAPA is responsible for coordinating Brazil's cooperative agricultural research system, which includes its own capacity as well as that of the states and the universities. However, the state of Sao Paulo has a well-established research system that operates largely outside the EMBRAPA framework, as does private sector research. Linkages within EMBRAPA work through the program planning and review process. However, the project completion report on the first Bank project considered that the federal-state linkage was poor, and

EMBRAPA was obliged to channel 8 percent of funds under the second loan to the states to improve this linkage. According to an internal Bank report, universities absorb about 30 percent of research funding in Brazil and the contract research components under the second and third projects enhanced linkages between faculty researchers and the state and federal institutions. Unfortunately, by the end of 1995 a scarcity of federal funding meant that little money was being made available for distribution to universities and state research entities through EMBRAPA, which led to a severe weakening of EMBRAPA's coordination function.

In Colombia, research funded by producers has always been important, and private sector research carried out by growers and commercial seed and input supply organizations currently accounts for about 40 percent of research. The largest of the six public sector institutes, the Colombian Agriculture and Livestock Institute (ICA), was divided in 1993. ICA now has a national research coordination role and a corporation, the Colombian Company for Agriculture and Livestock Research, has taken over ICA's research facilities and function. Because of their limited participation in agricultural research, universities have not been closely linked to the ICA institutes. However, a new project in Colombia provides for contract research in an attempt to enhance participation by university researchers and allow private sector researchers to compete for available funds.[4] In Mexico, the many research institutions created in the 1950s and 1960s were progressively merged, and in 1985 the authorities created the Mexican National Institute for Forestry, Agriculture, and Livestock Research (INIFAP) to combine crop, livestock, and forestry research in one organization. Mexico also has commodity research activities in separate parastatals for coffee and sugar, other institutes that specialize in different aspects of biotechnology and ecology, six universities with serious agricultural research programs, and 25 private sector seed companies that undertake some applied research. INIFAP's size and coverage allow it to assume responsibility for coordinating most sectoral research, but no overall coordinating entity exists. Nevertheless, linkages among institutions are fairly well developed through networks, collaborative research, and contract research. The ongoing Bank project provides funds for all three of these activities.

In Peru, substantial support for research by producer organizations virtually ceased in the early 1970s after agrarian reform altered the structure of farming. In 1979 public institutions were amalgamated into an autonomous agency, National Institute for Agricultural and Livestock Research, and with support from a Bank loan, research and extension functions were subsequently united in a single institution (INIPA). Unfortunately, political and administration changes led to the return of extension to the MOA in 1988 and to major funding problems for research. More recently, the authorities have turned over some of the public research institutes to a private producer organization (Fundación Perú) in response to the public funding difficulties. The National Agricultural University was important in agricultural research in the first half of the century, and although its involvement has now been drastically reduced, some universities still do agricultural research. The Bank project included contract research, but the general demise of the project inhibited its implementation.

Europe, Central Asia, Middle East, and North Africa

In Turkey and Yemen the NARSs were made up of institutions that were part of the sectoral ministries, while the Magreb countries used an autonomous institute model.[5] Most universities have contributed little to agricultural research, although the agricultural universities in Morocco and Tunisia and, to a lesser

extent in Turkey, undertake some research. Public sector research dominates, although commercial companies are beginning to do some research of high value export crops in Morocco and Turkey. During the review period, Turkey experienced frequent institutional upheavals in its fragmented research system. In 1987 the High Council for Research and Development was formed to coordinate and plan research programs in an attempt to address the problems created by fragmentation. In 1991 some institutes were merged when the General Directorate of Agricultural Research was formed again after being abolished in 1981. The ongoing Bank project supports both the High Council for Research and Development and the General Directorate of Agricultural Research as a way to improve linkages among institutions and includes a contract research component to foster linkages. In the Yemens, institutes attached to their respective ministries were joined to form the Agricultural Research and Extension Authority after unification of the two countries, and the creation of a national council further facilitated coordination. As in the earlier projects, the current Bank project is supporting these mechanisms.

In Morocco and Tunisia, the favorable areas where most French settlers had been farming used the institute model for research. Following independence in Morocco, institutes were absorbed into the MOA as programs expanded to cover less favorable environments. In 1980 the institute model was reintroduced by means of INRA, leaving only livestock research with the MOA. The ongoing Bank project is supporting INRA's role in coordination and evaluation, and INRA is contracting out adaptive research and advisory work in vegetable production to a private service firm with established expertise in this area. In Tunisia, the main autonomous institute, the National Institute for Agricultural Research, is responsible for most crop and livestock research, while research in forestry, the arid zone, olives, and rural engineering are in separate institutes. Two major and seven other universities and colleges also undertake agricultural research. Linkages among the various institutes were weak through most of the 1980s, but the coordinating institution, the Institute of Agricultural Research and Higher Education (IRESA), was created at the inception of the current Bank project in 1991 to enable the coordination of all public sector agricultural research. However, the Magreb NARSs have generally made little progress in bringing universities into a coordinated system to enhance their contribution to research.

Human resource development

South Asia

India is by far the largest NARS in SAS (with close to 10,000 full-time equivalent researchers), followed by Pakistan (more than 3,000 researchers), and Bangladesh (about 1,500 researchers). Sri Lanka and Nepal are smaller, with around 445 and 360 researchers, respectively. The proportion with graduate degrees is exceptionally high in India (95 percent), Pakistan (82 percent), and Bangladesh (74 percent), but lower in Nepal (41 percent). About half of India's researchers have doctorates, around 10 times the proportion in Nepal and about three times the proportion in other SAS countries. In India and Pakistan, federal institutions have a higher percentage of postgraduates than provincial or state institutions.

In India, Bank projects have not contributed significantly to human resource development in terms of scholarship support or human resource planning initiatives. While Indian researchers trained in the 1950s and 1960s had some overseas education, since then most training has been completed locally. ICAR and

U.S. research institutions had a collaborative scientist interchange program in the 1980s, but there has been some concern about the degree of scientific "inbreeding," especially at the level of SAUs, where education and research staff tend to be recruited from graduates of the same institutions. In all other countries, Bank projects have supported postgraduate training and additional recruitment, although to a lesser extent in Nepal. USAID has historically been much more important for training researchers in Nepal, but has also contributed significantly in Bangladesh and Pakistan. Unfortunately, Bangladesh has lost a good number of scientists with doctorates to industrial countries because of dissatisfaction with the local working environment.

None of the staff appraisal reports for the Bank projects specified human resource development planning, and attempts to establish training cells to organize training programs in Bangladesh and Pakistan were not effective in matching courses and candidates with real needs. The lack of capacity for needs-based, human resource development planning has led to some imbalances, with a shortage of skills in the basic sciences, biotechnology, animal science, and social sciences in India; the domination of plant breeding in Pakistan; and some mismatches of expertise with needs in Bangladesh and Sri Lanka. The current project in Pakistan has identified needs in specific skill areas, and is placing much less emphasis on plant breeding. With one exception (the Balochistan Area Development Project in 1992), Bank projects have not attempted to influence universities' undergraduate curricula to improve the quality of training in the biological sciences by making students aware that technology development must be responsive to both social and economic constraints and to the potential for improvement in major farming systems.

East Asia and Pacific

The China NARS has more than 55,000 researchers, more than any other country in the world. However, Indonesia, the Philippines, and Thailand also have large agricultural research establishments of between 2,000 and 4,000 researchers. Malaysia is smaller, with about 850 researchers, and Papua New Guinea has fewer than 200 researchers. The proportion of researchers with postgraduate degrees, less than 10 percent, is especially low in China, partly because of the cultural revolution. Malaysia has a high proportion of postgraduates (about 65 percent), followed by Indonesia (42 percent), and the Philippines and Thailand (about 30 percent). Papua New Guinea also has close to 30 percent postgraduates, but many of these are expatriate researchers. Malaysia has a relatively high ratio of researchers with doctorates to researchers with masters' degrees (about one to two), although not as high as India (where the ratio is one to one).

Through its projects, the Bank has contributed significantly to human resource development in the NARSs in all countries in EAP. In Malaysia, it also strongly supported increased recruitment, especially in forestry research. Support for staff expansion in Papua New Guinea and Thailand was not as successful, because fiscal constraints limited recruitment in Thailand and the NARS in Papua New Guinea did not have the capacity to manage the program.

Most projects in EAP did not give sufficient attention to human resource development planning. This shortcoming has resulted in mismatches of skills and requirements in Indonesia and the Philippines, although emphasis is now being given to improved human resource planning in both countries. China is relatively weak in postharvest technology expertise at a time when it is especially needed. Thailand had a particularly successful postgraduate training relationship with Australia (through AIDAB) in the national research project that tai-

lored courses to the needs of researchers and promoted effective networking arrangements with faculties at participating Australian universities. The Thai research project was planned for implementation over nine years so that the training program could be completed. A research project in Indonesia also had a ten-year implementation period for the training component that would allow many graduates of the program to return to service during the project period. Organizational problems and attractive private sector salaries in the NARS in the Philippines led many trained researchers to move from research to nonresearch activities. In China, a major issue has been the number of researchers that do not return after graduating from schools in other countries.

Both China and Malaysia were loathe to employ expatriate researchers on long-term contracts as provided for in the loans. China did invite some notable academic scientists for short visits, but did not use the loan facility to undertake program reviews. Malaysia did engage researchers for external reviews and appreciated the benefits, not only for the research programs, but also for staff development.

Africa

Most AFR national agricultural research systems are smaller than NARSs in other regions except for the Pacific island and Caribbean countries. While South Africa has more than 1,300 full-time equivalent researchers, Nigeria has more than 1,000, and Kenya has about 800, for most of the 1980s, 18 of 43 NARSs had research establishments of less than 50 (Pardey, Roseboom, and Anderson 1991a). Only one of the very small NARSs (Rwanda) received Bank support during the review period. However, most NARSs have more than doubled their staffs since the mid-1970s, and most also have a respectable proportion of staff with postgraduate qualifications—some have extremely high proportions (Annex Table 6.1)—although those degrees are of uneven quality, and in many cases overstate qualification levels.[6] The number of researchers with doctorates, however, has been particularly low in Ethiopia, Kenya, and Zambia. Those countries that have relatively few national staff with postgraduate qualifications, such as Côte d'Ivoire and Zambia, tend to have relatively high levels of expatriate staff. NARSs in the former French and Belgian colonies tend to have higher levels of expatriate staff than other NARSs.

ANNEX TABLE 6.1: POSTGRADUATE QUALIFICATIONS IN AFRICAN NARSs, 1991

		National researchers			
Country	*Number*	*Doctorate (%)*	*Master's (%)*	*Doctorate and Master's (%)*	*Expatriates (%)*
Burkina Faso	98	40	57	97	18
Côte d'Ivoire	212	13	12	25	33
Ethiopia	363	8	30	38	6
Ghana	263	28	43	71	5
Kenya	749	7	42	49	9
Madagascar	141	14	59	73	16
Niger	74	17	55	72	18
Nigeria	1,002	32	56	88	1
Rwanda	42	14	84	98	26
Senegal	124	21	44	65	29
Sudan	424	51	35	86	0
Zambia	218	2	15	17	19
Zimbabwe	252	16	32	48	13

Source: ISNAR 1993/94.

All Bank projects in AFR have contributed to staff training. However, most borrowers have preferred to use bilateral funds for training, even though most make use of International Development Association (IDA) funds in research projects, a preference that is at least partly associated with these countries' colonial heritage. Links with former colonial powers have been much stronger in francophone than in anglophone Africa. Universities tend to have a higher proportion of postgraduate staff than the sectoral research institutes, but the quality of the faculties is poor in most cases, and universities depend heavily on overseas scholarships for postgraduate training. In the 1992 research project in Uganda, the Bank attempted to improve the university research and teaching capacity. Bank projects placed little emphasis on human resource development planning in AFR during the review period.

The Bank has contributed to the expansion of research staff. However, this policy has not always been effective, and rationalization of staffing would often have been more appropriate (see the section "Funding of research" in this annex). In addition, in higher education projects that involved agricultural training in AFR, the Bank became aware that estimates of sectoral human resource requirements were often exaggerated, but was unable to contain the intake of students. The result was frequently an excess of science graduates in the market.

Latin America and the Caribbean

Brazil has the largest NARS in LAC (nearly 4,000 researchers), followed by Argentina and Mexico, (almost 2,000 researchers), Colombia (700 researchers), Venezuela (more than 500 researchers), and the remaining NARS in Central and South America (each with less than 500 researchers). The Caribbean countries have extremely small research establishments; only the Dominican Republic has more 100 researchers (Pardey, Roseboom, and Anderson 1991a). Although the number of researchers increased during the review period, the NARSs with more than 100 researchers grew less than in other regions. Smaller increases occurred in some of the more substantial NARSs, including those in Argentina, Chile, Colombia, Peru, and Venezuela. In most cases, the limited growth was linked to LAC's serious fiscal constraints during this period.

The proportion of researchers with postgraduate qualifications varies across countries. Some 50 to 80 percent of researchers in major NARS such as those in Brazil, Colombia, and Mexico have postgraduate degrees, but in Peru the proportion is 12 percent. In addition, while as many as 10 to 25 percent of researchers in these countries hold doctorates, Peru has only a negligible number of staff with doctorates. The universities in the major LAC countries have good postgraduate training facilities, although students generally undertake doctoral studies in industrial countries. Chile and Colombia do not have doctoral programs, but they do have high quality undergraduate programs that include research design and require a thesis.

The Bank has made major contributions to developing the capabilities of researchers in the countries it has assisted. However, only four LAC countries received NARS support in the 1980s (Brazil, Colombia, Mexico, and Peru), and Bolivia had a project approved in 1991. Unfortunately, training was not founded on needs-based human resource development planning in either the Brazilian or the Peruvian project, although this type of planning was adopted in later projects in Brazil and in the 1992 Mexican project. The Peruvian project met only 22 percent of its training target for masters degrees because of political and institutional changes during the implementation period. The Inter-American Devel-

opment Bank has supported research in more LAC countries than the Bank, with a consequent major impact on human resource development. Bilateral donors (Canada, the United Kingdom, the United States, and France in the case of Brazil) have also been active in training programs, although the high level of USAID support declined substantially in the latter part of the review period. CGIAR institutions provided practical training for researchers that has enhanced networking. Similarly, the Inter-American Institute for Agricultural Cooperation has been involved in improving researchers' awareness of scientific progress by facilitating networking. In Colombia, the technical support staff to researcher ratio appears inappropriate at about one to one, as a higher proportion of technical support staff should allow better use of scientific resources.

Fiscal constraints meant that the planned staff expansions in Brazil and Colombia fell short of their targets. In Brazil, a large program of long-term technical assistance was successfully implemented to temporarily replace researchers away on training and to contribute generally to the development of national staff. The CGIAR centers participated in this program, and were even more involved through Bank funding in the Peruvian project, for which CIP, CIMMYT, and the International Center for Tropical Agriculture provided research program leaders, with complementary support from North Carolina State University through USAID. In the Peruvian institution, this intensive support was necessary to provide leadership to the relatively inexperienced body of researchers.

Europe, Central Asia, Middle East, and North Africa

Apart from the East European countries and the republics of the former Soviet Union, the only large NARSs in ECA/MNA are in Egypt (with nearly 5,000 researchers) and Turkey (nearly 2,000 researchers). Three countries (Iran, Iraq, and Israel) have more than 500 researchers each, and the other North African countries plus Saudi Arabia and Syria have 150 to 500 each. The remaining Middle East countries have extremely small NARSs. Overall, the proportion of researchers with postgraduate degrees in North African NARSs (about 50 percent), approaches that of other regions, but is lower in the Middle East countries (about 40 percent). The latter figure would be even lower were it were not for the relatively high percentage of expatriate researchers in many of these NARSs (Pardey, Roseboom, and Anderson 1991b). In ECA/MNA countries where the Bank has been active (Turkey, Yemen, and the Magreb countries), the proportion of researchers with postgraduate qualifications is between 50 and 60 percent.

The Bank has successfully supported postgraduate training in all projects except the last one in People's Democratic Republic of Yemen and the most recent project (1991) in the united Yemen. In the former project, funding was provided but not used because of the country's strong preference for bilateral support for such training. For this reason, and because of the generally held belief that the country already had an acceptable proportion of researchers with graduate degrees, postgraduate training was excluded from the ongoing Yemen project. IFAD, the UNDP, and the United Kingdom also funded substantial training in the early 1980s in the Yemens (and the FAO was a useful contractor to organize training and technical assistance in the earlier Bank-supported projects in the Yemens), and USAID had a major program in Turkey. Bank-supported projects placed no particular emphasis on needs-based human resource development planning. Bank projects provided for incremental scientists and technical support staff in the Magreb projects and in the more recent projects in Turkey and Yemen; none of the projects, however, included loan financing for incremental salaries. Turkey has a particularly low ratio of technical support staff to

researchers (0.4:1), which suggests that research resources are being used inefficiently. The number of administrative and technical support personnel in the Magreb tends to be excessively high (more than seven per researcher in INRA in Morocco).

Civil works and equipment

South Asia

All projects in SAS financed research infrastructure and equipment. The planned civil works were largely completed, although often with delays associated with insufficient counterpart funds. Preproject design of facilities did not receive enough attention in Pakistan, and problems occurred in Bangladesh because not enough land was available, which suggests that preparation had been inadequate. In Bangladesh, which has a large NARS with serious local funding problems, the projects added new facilities for commodities that warrant increased research attention; however, the Bank failed to examine the programs and facilities of all institutes with a view to rationalizing their use (as the proposals for the latest project suggest). Support for the development of library facilities in the projects was reasonable.

Scientific and farming equipment and vehicles were also a project staple. Procurement delays were common, and were often caused by administrative inefficiencies resulting from cumbersome local regulations and by lack of familiarity with Bank procurement guidelines, especially in Pakistan, Sri Lanka, and even Bangladesh, despite the creation of a procurement cell in the coordinating institution (BARC). A scarcity of counterpart funds also contributed to delays in Bangladesh, Nepal, and Pakistan

Delays in implementing civil works and procuring equipment were the main reasons for postponing loan closing dates in 11 of 15 completed projects, or 67 percent (Annex Table 5.1).

East Asia and Pacific

Civil works and equipment procurement were important components in all EAP projects. Civil works often did not begin or end on time: decreased competence of local contractors in the outer islands was a problem in Indonesia, government insistence on ethnic preferences in awarding contracts was an issue in the first project in Malaysia, and counterpart funding constraints negatively affected the Philippines program. In Malaysia, the Bank also insisted (uncharacteristically) on international competitive bidding for relatively small and scattered civil works, so that in the end only half of the loan funds for civil works were utilized.

In China, the large amount of scientific equipment that was procured was especially beneficial to the institutes concerned. However, some inappropriate equipment was purchased, and the capacity to maintain some of the most sophisticated pieces has not been adequately developed. The Bank should have provided specialized expertise at or before appraisal to review this dominant component carefully and to provide technical guidance. Insufficient planning for equipment procurement was also reported in Indonesia. In both countries an efficiency problem occurred in inappropriate sequencing of civil works and equipment delivery and having trained scientists in post who could specify equipment for the lines of research to be undertaken. In the Philippines, apart

from causing procurement delays, funding shortfalls led to maintenance problems and underutilization of the equipment.

The closing date had to be postponed for five of the seven completed projects (71 percent) to permit civil works and completion of equipment procurement programs (Annex Table 5.1).

Africa

In AFR, infrastructure, equipment, transport, and library facilities were important in terms of establishing research resources rather than expanding already operating systems.[7] However, because of the need for assistance with practically all aspects of NARS development (including loan support for incremental operating costs in 77 percent of projects), the civil works and equipment categories as a percentage of total loan funds (43 percent) were not any higher than the average for all regions (Table 9.4).

Implementation delays occurred frequently, and the Bank postponed closing dates for five of the seven completed projects (71 percent). However, the projects undoubtedly helped improve the research infrastructure, thereby increasing eventual research output. Despite this positive impact, the lack of appropriate research strategies and programs in some cases led to inappropriate procurement of expensive and sophisticated equipment that was not properly utilized (Ghana and Malawi).

Latin America and the Caribbean

In LAC, equipment procurement absorbed more loan funds than civil works in all projects, as could be expected with the relatively mature NARSs in the countries reviewed. However, in the third research project in Brazil, civil works rose from 13 to 15 percent of the loan, partly because two new institutes were established in the states of Piaui and Ceara (a decision that appears to have been influenced more by political concerns than by efficiency considerations). All projects supported library and scientific communication facilities. The Bank had to postpone closing in half of the completed projects.

Europe, Central Asia, Middle East, and North Africa

As a group, projects in ECA/MNA were allocated a higher proportion of loan funds for civil works and equipment (50 percent) than in other regions (Table 9.4), largely because of projects in the Magreb countries, where facilities had to expanded to extend research beyond export crops. In the 1984 extension and research project in Turkey, however, the planned infrastructure investment at six institutes did not materialize because of a lack of government commitment, institutional changes, and poor administration. In Tunisia, the procurement of research equipment was delayed until research teams were assembled and could help define requirements, which led to justifiable delays in the projected disbursement of the loan. All projects in this region had to postpone their closing dates.

Research management

South Asia

In India, ICAR interacts with the Planning Commission to agree on broad research guidelines for five-year plans, and then chairs programming sessions

with each of its institutes. The program of the All India Coordinated Research Projects, which the ICAR administers, is also planned within this framework. The SAUs follow the broad guidelines, and some have developed master plans. However, India does not have a system that provides reliable information on how research funds should be allocated (by commodity or type of research, for example) which hinders rational planning. In addition, while some informal scoring methods are generally used to analyze proposals, little account is taken of economic and social benefits and costs in establishing priorities. While relatively educated farmers can influence programs through their contact with researchers, a system to ensure that the technology needs of the different farming systems in the smallholder sector are addressed is not generally in place, despite the innovative activities in some states where farmer groups set priorities for zonal research stations. In essence, the scientific body in India still determines its own program. This situation is acceptable only if the scientists (a) are aware of production constraints and potentials in the many different types of production systems; (b) accept that the NARS should be responsive to these constraints and demands; and (c) are able and willing to undertake applied and adaptive research in the local environment.

Bank projects in India have tried to address these issues by supporting the development of applied and adaptive research capabilities of SAUs to work in different agroecological zones and the preparation of zonal reviews. This policy has succeeded to some extent, but has been limited by those researchers who do not accept the need for programs to be demand driven, by difficulties in staffing zonal stations adequately, and by insufficient attention to socioeconomic considerations. Independent reviews of ICAR's program have been undertaken periodically, and ICAR staff participate in five-year reviews of its institutes' programs. Most SAUs still do not undertake independent program reviews on a regular basis.

The 1981 research project in Pakistan supported PARC in the preparation of a national research plan (with help from the FAO), but did not address ranking or prioritization issues. USAID helped the National Agricultural Research Center, the major institute of PARC, to develop a master research plan. The later Bank project (Agricultural Research II in 1990) provided for an improved national research plan and provincial plans, but the initiation of planning was seriously delayed because of the general demise of this project, which did not receive the expected support from the provincial research institutions. These institutions believed that they had not been sufficiently involved in project design, even though the project's focus was development of the provincial systems. In 1994–95, however, each of the four principal systems produced master plans and PARC prepared a national plan. The provincial plans varied in quality and a number of pervasive deficiencies were evident, namely: they did not take into account PARC's research activities, university or private sector research, or research programs in other provinces; they used program ranking approaches that were not always appropriate and made insufficient use of cost-benefit analysis; they had been prepared mostly by consultants with little institutionalization of the process; they did not appreciably affect the existing research programs; and they did not have the intended impact on the research priority setting process even though diagnostic surveys had been carried out. The national plan provided some overview information, but focused on increasing research investment rather than on addressing research productivity and efficiency.

In Bangladesh, the Bank's support for BARC as a coordinating council has not been very successful because of the reluctance of many research institutes to accept BARC's authority, despite improved enabling ordinances instigated by

the Bank and USAID. An initial national research plan written largely by BARC staff without sufficient involvement from national institutes did not address prioritization and human resources issues adequately. Furthermore, the institutes did not prepare the intended complementary three-year plans under the first project. A slightly better national plan was prepared under the second research project, and each of the institutes prepared a five-year plan as a condition for receiving USAID PL480 fund support. ISNAR, with USAID support, has recently initiated a management information system (MIS) for research at some institutes and a more analytical approach for considering research proposals. The 1996 research management project is addressing the management commitment and extensive staff training that will be necessary to install these concepts.

In Sri Lanka, the coordinating council's (CARP's) lack of control over the budgetary funds allocated to the many ministries and institutes and the cess funds derived from export crops has limited its effectiveness. However, CARP does have input into the Ministry of Finance's budgetary process. A national research plan has not been finalized (reflecting CARP's lack of authority), and although status reports on agroecological regions have been prepared, research managers do not use them sufficiently. ISNAR support has established an MIS at some institutes and has helped CARP with its submissions to the Ministry of Finance. However, retaining trained staff to operate the MIS is a problem.

In Nepal, the piecemeal interventions aimed at establishing an adaptive research capacity at some institutes and undertaking research on specific cash crops were generally not successful. The lack of a sound institutional framework and research strategy was undoubtedly partly to blame. The hope is that the coordination facility recently created with USAID support will develop effective coordinating and planning capabilities. Forestry research is excluded, but the Bank's forestry projects did encourage the development of a master plan and the adoption of some progressive policies.

East Asia and Pacific

China has a relatively centralized research planning system. The central SSTC dictates five-year research strategies that lead commodity and discipline institutes translate into programs. In turn, the lead institutes prepare annual work programs for each participating institute. At year's end, each participating institute reports on progress to the lead institute, which consolidates the information in a report submitted to the SSTC. A study in the 1982 Bank project identified problems in this process and recommended that consultants be engaged to design improvements in research planning and review, but the funds allocated for this purpose in the 1984 project were not used. Some individual institutes have tried to identify and focus on priority technical problems.

In Indonesia, the governments' system of five-year plans also influences research planning. Broad research priorities are indicated in the government's plans, but these are influenced by the major commodity research entities, especially AARD. The 1980 project enabled independent program reviews by national and expatriate scientists, who recommended improvements in research management and planning, especially in project prioritization and justification. The 1989 project concentrated on research management and supported the establishment of the Center for Research Programming within the AARD to help its institutes improve these processes. ISNAR has also been involved. A peer review system for project proposals and progress reports has been introduced, but all researchers do not yet accept the idea that research must be relevant to farmers' problem. Although the AARD operated within a broad 25-year strategy

in the 1980s, it was not until the end of 1994 that it completed an overall master research plan. This plan should increase the emphasis on regional research and lead to the reallocation of many senior staff away from Java. The AARD has also introduced an MIS, but its use by staff and managers is still limited.

In the Philippines, the coordinating councils for agriculture and fisheries have influenced the government's five-year agricultural development plans, which tend to be commodity oriented. Supported by the Bank project, the coordinating bureau (BAR) within the Department of Agriculture was responsible for generating detailed plans for the research institutes under its supervision. The most recent (1994–2000) BAR plan lacks the regional orientation of the earlier plan and relies on regional research consortia to develop priorities in response to local conditions. The Philippines case illustrated the problems that can arise when the entity responsible for planning and prioritizing research is not also the one responsible for allocating funds to specific programs.

The Malaysian government failed to make use of the consultancy funds provided in the 1975 project to (among other things) advise on research programming deficiencies in MARDI. These problems continue. Forestry research is of a high standard in FRIM, and the Bank project contributed significantly to this capacity. However, the absence of an apex organization to rationalize forestry research activities at the federal and state levels has led to significant duplication in research and some failures in technology dissemination. In addition, in its early years FRIM did not have the well-balanced program it now enjoys, and the Bank could have provided the institute with more assistance in developing a strategic research agenda during project start-up.

In Thailand, the Bank's research project (with considerable AIDAB technical assistance) made substantial improvements in the planning and management of the crop research program in the Department of Agriculture. This includes satisfactory program planning and review procedures. However, livestock and other agencies are engaged in agricultural research without any formal linkages to the Department of Agriculture. The MOA did not establish the intended research council under the Bank project, apparently because of unwillingness to tackle questions of ministerial authority over specific research areas.

In the Papua New Guinea project, the Bank supported a crop research division in the MOA that included both full-time staff and consultants whose objective was to establish medium- and long-term crop research programs and to introduce progress review procedures. These measures have not eventuated, as the improved systems proved to be beyond the capacity of the division's management, but have been addressed in the preparatory work for further research support (probably from the ADB) carried out at the end of 1995.

Africa

Nearly all Bank research projects in AFR have attempted to address the NARSs' management and planning constraints. This is partly because most of the projects were initiated in 1985–90, when Bank staff generally appreciated the importance of institutional management reforms (in contrast to some of the earlier projects in SAS and EAP), and partly a response to the poor preproject status of most NARS.[8] As part of the human resource development program, most projects included at least short-term management training in addition to training in technical fields. In most cases, however, this was insufficient for the management needs of the inefficient, expanding, and often reorganizing NARSs.[9]

All projects except those in Zimbabwe stipulated substantial changes in planning methodology. This stipulation usually meant adopting some variation of the following planning sequence: preparing a research strategy (policies, priorities, and resource requirements), and then translating this into a medium-term action plan and finally into annual programs in accordance with priorities, available resources, and benefit-cost considerations. All projects received technical assistance (supported by loan funds) to help develop the plans. ISNAR has been especially active in this area (Annex Table 5.5). Some projects used consultancy firms to help draft plans (in Malawi, Sudan, and Tanzania), and the FAO was used in Burkina Faso, with ISNAR, and in the early Sudan project.

As in other regions, the quality of the plans produced has been poor in many cases, and there is little evidence to suggest that master plans will lead to more appropriate allocations of resources. The most common deficiency was the assumption of a favorable resource scenario. The plans gave little attention to alternative scenarios that responded to limited resources, and therefore did not address prioritization and sustainability issues adequately. Certainly governments' development objectives had to be considered, but in general NARs made no attempt to review policies critically or to interact with policymakers. The Bank should have queried some self-sufficiency goals, in particular, those involving food crops such as wheat. There was no comparative advantage in producing wheat, and thus the decision to allocate scarce research resources to wheat was a questionable one (Morris and Byerlee 1993). Insufficient consideration was given to the prospects of proposed research programs or the ability of subprograms to address identified issues, and diagnostic surveys of farming system constraints and development potential were often either inadequate or were not used in the prioritization process. Lack of collaboration across programs often led to duplication.

Most NARSs in AFR are still relatively immature in terms of research management planning and review and will need continued assistance. Countries that have used consultancy firms have usually provided comprehensive research plans more rapidly, but sometimes at the expense of local ownership, and thus of commitment to implementing the plans, as in Malawi.

Many NARS also suffer from poor financial and accounting management. This problem is often systemic in government agencies and interferes with the smooth flow of Bank and donor funds essential to the functioning of the research system, as experience in Kenya and Senegal has shown.

Latin America and Caribbean

In contrast to other regions, Bank projects in LAC did not usually stipulate the preparation of specific research strategies or plans, but tended to emphasize appropriate planning procedures. Most had some kind of strategy at project inception, although the Peruvian project required the preparation of a master plan for any expansion of infrastructure as a precaution against the unwarranted expansion of facilities under the new autonomous institution, INIPA. Despite the existence of various types of research planning in the NARSs, this did not always result in more rational allocation of resources. The emphasis on research on tropical rainfed farming in Mexico in the earlier research component projects was slow to gain acceptance and had to be reaffirmed in the 1992 project. Some research imbalances have emerged in Mexico, for instance, the adaptive agroeconomic research needed to support the availability of new genetic material has been inadequate. In Brazil, despite some recent progress (with French assistance through the International Cooperation Center in Agronomic Research for Devel-

opment) in identifying the real needs of resource-poor smallholders, planning had not ensured that this subsector received enough attention. Similarly, the ex post evaluation of the Colombian project noted that research was not responsive to the needs of many smallholder communities. A less than satisfactory feedback mechanism in the extension service and the failure to adopt the farming system research program constrained programming in Peru.

Most projects promoted regular review and evaluation procedures, which were already fairly well developed in Brazil and Mexico. In Colombia, effective review and evaluation was obligatory for the high percentage of research funded by end-users. Colombia's ICA has not had a formal evaluation system, but the transfer of review responsibilities to the regional level (with private and public sector participation) envisaged in a new project being processed should be conducive to effective evaluation procedures. In Peru, the demise of the research project precluded the use of the planned review mechanism.

External reviews of research programs have been undertaken regularly in Argentina and Brazil, although they have not covered all institute programs. Colombia has also recently used external reviews. Monitoring of research expenditures is fairly well developed in most countries, and both the National Institute for Agriculture and Livestock Research in Argentina and EMBRAPA in Brazil have computerized MISs. The Mexican research information system is being further developed under the ongoing project.

Europe, Central Asia, Middle East, and North Africa

ECA/MNA is unusual in its use of structural adjustment loans to fund analysis, initiate policies, and lay the groundwork for more effective programming of agricultural research under subsequent projects (as in Morocco, Tunisia, and Turkey). In Turkey, the 1992 research project calls for the preparation of a rolling master plan, with annual reviews for all programs pertaining to the MOA. Forestry has a separate coordination and planning unit under the Ministry of Forestry. The regrouping of institutes under the General Directorate of Agricultural Research has allowed program working groups to be established for categories of commodities such as field crops, horticulture, and livestock. These working groups are intended to be key actors in designing and reviewing programs (to be led by national coordinators at major institutes). Also envisaged are independent, biennial reviews of each major institute by two scientists from the MOA and national universities. However, the Bank-supported research project's guidelines for master plans have not emphasized prioritization.

In the Yemens, the Bank projects introduced the concept of multidisciplinary scientific teams to address production problems and to be involved in planning and review. The ongoing 1991 project provides for CG center involvement in the external review of programs. This project also calls for formal five-year rolling master plans (as in Turkey). In Morocco and Tunisia, in supporting the governments' medium-term development programs, the sectoral adjustment loans have also assisted research development. In Morocco, studies identified the need to rationalize the NARS, to "plan by objectives," to provide greater autonomy for INRA, and to improve personnel conditions. While some of these recommendations were implemented as early as 1987, the 1989 project consolidated many changes, including annual programming for priority commodities by multidisciplinary teams and new monitoring and evaluation procedures, and addressed problems in financial management. The research master plan prepared through the adjustment loans in Tunisia led to the creation of IRESA as a coordinating agency in the 1990 Bank project. IRESA has introduced plan-

ning by objectives, improved financial management, and taken responsibility for appointing independent review commissions.

Linkages with external institutions

South Asia

Beneficial linkages with CG centers have been developed in India and Pakistan through ICAR and PARC. ICAR also recently adopted a USAID-supported program that facilitates reciprocal visits by U.S. and Indian scientists that should greatly enhance networking, but this program does not involve the SAUs. The remaining NARSs in SAS have also collaborated extensively with the international institutes: the International Rice Research Institute provided continuous support to the Bangladeshi rice institute from 1966 to 1993, and Nepal has relied heavily on germplasm from the CG system. Nepal has also actively sought germplasm from other Asian countries and the United States, which is appropriate considering the small size of Nepal's NARS and its need to acquire and adapt as much new technology as possible. Rubber institutes in SAS generally maintain contact with the International Rubber Research and Development Board. In the second research project in Pakistan, the Bank provided funds for collaborative research with international institutions, with 60 percent of the funds being linked to collaboration between international and provincial institutes; however, PARC has been slow to promote this activity.

East Asia

All NARSs receiving Bank support in EAP have developed effective linkages with the CGIAR. Tree crop institutes, especially for rubber, maintain international links. In China, the large overseas training program has encouraged a substantial scientific network among local and foreign researchers, especially in outstanding agricultural universities.

Africa

The CGIAR has been active in all the countries reviewed in AFR. ISNAR has been especially active (Annex Table 5.5), and AFR has emerged as the largest consumer of CG expenditures. The NARSs in the francophone countries have generally maintained close links with France, although less so in Madagascar.

Despite the agroecological similarities of many AFR countries, linkages among the NARSs in the region have been especially poor. Intraregional visits have increased in recent years, but electronic information systems and networking are poorly developed. After 1985, the need to make more efficient use of scarce research resources led to the establishment of special programs by groups of donors, including the Bank, to encourage intercountry collaboration. However, these initiatives have made slow progress, as the tendency for each NARS to emphasize national peculiarities rather than regional similarities persists. Unfortunately, there also appears to have been more participation in meetings than in collaborative action.

Latin America and the Caribbean

In LAC, the four countries reviewed developed effective working relationships with the CG centers through technical assistance, collaborative research, and international research networks. In Peru, three of the centers supplied INIPA

with research program leaders as part of the Bank's project in the mid-1980s, but the general problems affecting INIPA and the project caused this relationship to deteriorate. However, INIPA still maintains a relationship with CIP and CIMMYT. Brazil has developed an impressive number of linkages with research institutions of international repute.

Europe, Central Asia, Middle East, and North Africa

Most of the major institutes in the supported NARSs in ECA/MNA maintain a beneficial liaison with relevant CG centers. The International Center for Agricultural Research in the Dry Areas and CIMMYT have long participated effectively in Morocco's pulse and cereal programs.

Research relevance and linkages with end-users

South Asia

Bank projects in SAS included measures to improve the relevance of research. Combined extension and research projects focused on improving adaptive research by providing local facilities and mobility for on-farm research, and usually promoted a farming system perspective to promote responsiveness to local problems. Even those projects aimed exclusively at research emphasized linkages with extension and encouraged researchers to use farming system diagnostic techniques to make them aware of local constraints and potentials. However, these efforts have not been completely successful. Regular meetings among research and extension staff, intended as a feedback mechanism, have had mixed results. The meetings became routine exercises without the intended interactions, resulting in poor performance.

In India, the focus on agroecological zones in applied and adaptive research has been beneficial, and linkages with extension staff through regular review meetings and during the training of subject matter specialists for the extension service have brought the research system closer to farmers' problems. Some states use diagnostic surveys of farming systems in conjunction with the extension service more widely than others, which is unfortunate considering the potential strength of this tool in promoting relevant research. This issue is linked in part to the continued reluctance of many established researchers to accept the principle of demand-driven research, and in part to the insufficient emphasis given to the social sciences as an integral part of the system. (Undergraduate courses in agricultural sciences also give inadequate attention to the social sciences.)

The Pakistani research projects used the concept of agricultural economic research units in each province to encourage a farming system perspective. A parallel USAID project with CIMMYT promoted cropping system research. These programs have had a positive impact, but have been constrained by the same traditional attitudes that have affected their acceptance in the Indian NARS, and much of the farming system data that are used today date from the earlier CIMMYT assistance programs rather than being the result of additional diagnostic work. The adaptive research farms funded under the extension and research project were not fully effective, as researchers tended to use them as replication trial plots for programs at agricultural stations rather than as a way to interact with local farmers and adapt technology to local conditions. In addition, retaining research staff in these units, which had relatively little prestige in the NARS, was difficult.

Despite a series of research projects and combined extension and research projects in Bangladesh, the NARS has not been sufficiently responsive to the needs of the more difficult production environments or to the technological needs for crop diversification. The four projects devoted little attention to linkages between research and extension, although one project supported the On-Farm Research Division of the Bangladesh Agricultural Research Institute (the major crop institute), which produced relevant homestead agricultural packages. Most of the support for farming and cropping system research came from USAID and its implementation contractors. In 1994 farming system research units had a substantial staff of 150 people, which should be able to influence the direction of research programs if the researchers are properly integrated into the system. However, here again researchers with traditional attitudes are resisting this integration in some quarters.

In Sri Lanka, the Bank's emphasis on on-farm research suffered because of the poor capabilities of staff at adaptive research centers and the overall lack of suitable staff. However, by using more economists and focusing on agroecological regions and zonal analysis and reporting, the project has helped to improve research relevance. Unfortunately, the economists have not been integrated into the research team under institute management, and thus have not been involved significantly in research planning.

In Nepal, the Bank's project introduced specialist research outreach officers at regional stations to carry out on-farm trials and form linkages with extension staff and farmers. Although on-farm trials were expanded, this program did not generally increase researchers' awareness of farming system needs, and the task of establishing linkages was left to the specialists, who were not fully integrated into the program formulation process. USAID sponsored the creation of the Farming System Division and the Socioeconomics Division, but these covered limited areas, and also were not properly integrated into research operations.

East Asia and Pacific

As in SAS, all projects in EAP have attempted to improve linkages among researchers, extension staff, and the farming community or among researchers and the extension staff expected to represent farmers. The results have varied.

In China, the Bank project supported 10 model agrotechnical extension centers that appear to be providing strong linkages among research, extension, and farming communities. Although research planning in China has a strong top-down element, applied researchers are generally well aware of the need to be responsive to practical production problems. This awareness may be associated with the strong peasant orientation in Chinese culture and with the fact that a relatively low proportion of researchers have higher degrees.

In Indonesia, regular meetings between research and extension staff have been more fruitful in the inner islands, where agriculture is relatively advanced, than in the outer islands. The traditional focus on commodities tended to divert attention from the problems of smallholders, as did competing demands for available resources. However, in the late 1980s, some commodity research institutes undertook farming system diagnostic surveys, usually with bilateral aid support. The Bank is currently promoting greater emphasis on regional research to make the research system more responsive to local conditions.

In the Philippines, the Bank project promoted an effective linkage system among researchers, technology verification teams working on farmers' fields,

and extension staff that was organized according to agroecological regions. This system broke down following decentralization to the provincial level in 1987, and the core regional research staff was disbursed to provincial offices. A new system should be established.

The early research project in Malaysia included an extension liaison unit to promote linkages between the semiautonomous MARDI and extension staff in the Department of Agriculture and extended the on-farm trial program. The extension project formalized linkages between research and extension staff through the formulation of technical recommendations and through researchers' participation in extension staff training.

In Thailand, proposed provincial coordination committees to link research and extension were impractical, as no framework existed for linking provinces with regional research stations. This led to the appointment in 1993 of two specialized technology transfer officers for each regional station (as in Nepal in SAS), but their effectiveness is unknown. Staff in the farming system research unit were not integrated into the overall research programming process and suffered from a lack of economists. In 1992, staff from this unit were made part of the regional research centers and should be more effective in influencing research to reflect farmers' concerns identified through diagnostic farming system surveys.

In Papua New Guinea, the Bank project attempted to impose a farming system research model to link research (which traditionally had had a strong plantation crop bias) with crop and livestock extension services and farmers in the southern highlands. However, the project accomplished relatively little because of the weak management of both the project and the research system, a lack of clear and agreed objectives, and a refusal to incorporate indigenous knowledge into the design of research (Crittenden and Lea 1990).

Africa

Nearly all research projects and parallel extension projects in AFR have promoted improved research-extension linkages. This component has been especially necessary because of the weakness of most NARSs and the poor linkages that existed with both extension staff and smallholder farmers.[10]The Agriculture Services Initiative the Bank introduced in the region in 1986 has strongly promoted linkages. Interventions have included specialized liaison agronomists (Kenya, Senegal, and Sudan), joint participation in farming system research (Cameroon and Tanzania), joint activities in adaptive research or the formulation of recommendations (Ghana, Kenya, Malawi, and Zimbabwe), and training of extension staff by researchers (Ghana, Kenya, Malawi, and Sudan). Despite these efforts, the linkages between research and extension remain poor in most countries. It is difficult for researchers to accept the principle that their programs must be responsive to the needs of smallholder farmers, and the status gap between most research and extension staff continues to militate against effective interaction.

Latin America and the Caribbean

On-farm adaptive research involving research and extension staff and the adoption of a farming system perspective in the design of research programs have promoted linkages in LAC. While these efforts have had positive results, they have often been constrained by one or more of three factors: (a) on-farm research responsibility is often given to specific researchers, thereby removing the obligation for on-station researchers (the majority) to face farming system realities;

(b) on-farm trials are not subject to scientific rigor and are often poorly supervised, so that the validity of results is doubtful; and (c) travel costs associated with on-farm work make the operations highly susceptible to budget cuts.

The Brazilian and Peruvian projects promoted a farming system perspective. In Brazil, the three regional EMBRAPA centers adopted the concept of farming system diagnosis and responsive applied and adaptive research programming to a greater degree than the commodity institutes. The concept was most developed in the Research Center for Agriculture in the Semiarid Tropics located in the resource-poor northeast of Brazil, but less so in the Amazon regional center, the Research Center for Agriculture in the Humid Tropics. The extensive rural development project in Brazil, which had significant state research and extension components, also promoted linkages. With few exceptions, such as the Amazonas area development project, these linkages were not developed for the benefit of resource-poor farmers in the project areas for two reasons: (a) the extension services were mostly concerned with promoting production packages linked to a credit program or had little interest in understanding smallholders' problems; and (b) the state research entities did not have a farming system perspective and did not try to adapt the technologies developed by EMBRAPA's regional centers, for instance, the Minas Gerais area development project. In Peru, the general demise of the research project and of INIPA as an institution meant that the farming system research component was not developed.

The Colombian and Mexican research projects placed less emphasis on linkages between extension staff and farmers, and concentrated instead on improving commodity and discipline research. Some of the earlier area development projects in Mexico used an adaptation of the "Plan Puebla" model developed by CIMMYT and carried on by the Chapingo Postgraduate College, which included diagnostic surveys and adaptive research that involved extension staff. These projects were, however, carried out in areas with relatively high production potential. To promote greater responsiveness to the circumstances of resource-poor farmers, the ongoing Mexican project could have given more emphasis to the needs of this target group. The 1995 project in Colombia focuses on smallholder technology and relies heavily on on-farm trials and the articulation of technology needs through municipal committees to ensure that research is relevant, but the project is suffering from severe funding problems.

Europe, Central Asia, Middle East, and North Africa

Projects in ECA/MNA adopted a number of different approaches to promote linkages with end-users and relevant research early in the review period. However, the mechanisms used have evolved so that virtually all current projects emphasize the farming system perspective, farming system research, and those agroecological zones that have been relatively neglected in terms of technology development.

The earliest intervention in Turkey included training for extension staff by researchers (but this initiative was not very effective in ensuring feedback to research staff) and special research-extension coordinators at regional stations (but only one of the four was in post at project completion). The second project included joint diagnostic surveys, emphasis on farming system research, attention to neglected agroecological zones, and the possibility of creating an economic research institute in the current research project.

In the Yemens, the project in the south was more successful in developing linkages between extension staff and farmers through joint research and extension

planning and recommendation formulation, joint on-farm adaptive research, and researcher involvement in training. The current project in the united Yemen has a farming system perspective and is programmed to cover all agroecological zones.

In the Magreb countries, linkages remained weak during the earlier, small component project interventions. After 1989, however, linkage units were developed at each regional research center, the focus on farming system research and agroecological zones was adapted, and on-farm adaptive research was increased.

Funding of research

South Asia

All the public sector research agencies in the South Asia NARSs faced growing problems in funding recurrent costs during the review period, and most also faced counterpart funding problems for capital investment items. Where data are available, they show that recurrent cost constraints meant declining operational support per researcher as salaries absorbed an increasing proportion of noncapital expenditure (with the exception of Nepal, where salaries are extremely low and no change has occurred). In most cases, this problem reflects generally scarce fiscal resources, but it is also associated with the expansion of the NARSs in the 1980s. The expansion was deemed necessary to meet technology needs and Bank projects supported it, but has been hindered by attitudes that put staff and facilities ahead of quality and efficiency.

Public research expenditure as a percentage of agricultural gross domestic product (GDP)—known as the agricultural research intensity ratio (ARI)—during the review period has been relatively low, ranging from 0.26 to 0.50 percent in different NARSs at different times, although this is typical of developing countries. Toward the end of the 1980s, Pakistan's ARI rose temporarily to 0.8 percent as a result of heavy donor investment support, but subsequently declined. Considering the importance of the agricultural sector to employment (it accounts for 51 to 92 percent of all employment in SAS countries) and its contribution to GDP (23 to 56 percent) and to export income (10 to 32 percent), this relatively low level of funding suggests that the responsible authorities do not anticipate high social benefits from further research development. However, in India, a low ARI translates into large annual allocations of $200 to $300 million because of the size of both the sector and the research establishment.

Because of the funding constraints and the poor prospects for any major improvements, for the Bank to have emphasized efficiency (through the coordination and rationalization of research systems), planning processes, and funding sources outside the government would have been appropriate in SAS.

In most cases, Bank projects promoted coordination and planning mechanisms to avoid unnecessary overlap in the use of research resources, although these mechanisms did not always perform as expected. In India, where the project did not emphasize organizational structure, considerable overlap exists between SAU zonal research and ICAR substations. Rationalizing these research investments would likely reduce the number of ICAR facilities and call for improved coordination of the ICAR and SAU programs. The ratio of support staff to researchers in the Indian system is also high (4.5:1), which suggests that the NARS has too many support staff. In Bangladesh, chronic funding problems and heavy reliance on donor support (which accounted for 70 percent of funding in the late 1980s) should have led to rationalization of the use of existing

facilities as part of the expanded program to cover new regional and commodity research requirements. However, this step was not taken and BARC's coordinating role has not advanced enough to ensure that scarce resources are allocated to programs efficiently. In Sri Lanka, some rationalization of research facilities was undertaken, but the proportion of total research investment allocated to the tree crop sector far outweighs its importance to the economy. This distortion is associated with cess funding and the traditional research emphasis on export crops, but could be corrected to make better use of resources.

The need for public funds would be reduced if some research responsibilities were transferred to the private sector or if users of the technology developed by the NARS paid for it in some way. The private sector has made significant investments in research in India (an estimated 5 to 10 percent of total NARS investment) through incentives such as tax credits; import loans; and large, profitable markets. Other SAS countries have much less private sector funding. In most parts of SAS, the smallholder sector is poor and markets little of its production, so farmers cannot fund food crop research themselves. However, cesses imposed on cash crops that pass through processing or marketing mechanisms are a possible funding source. Similarly, relatively large landlord farmers such as in Pakistan might contribute to the development of technology they felt would meet their needs through, for example, farmers' associations.

East Asia and Pacific

China, Indonesia, and the Philippines faced increasing funding problems during the review period. Research in Malaysia, and to a lesser extent in Thailand, continued to receive satisfactory budgetary support. Funding was not the biggest constraint in Papua New Guinea during most of the 1980s, as other factors limited the development of research capacity; more recently, however, funding has become a severe problem.

The ARI for China has been about 0.4 percent, but has been lower for Indonesia (less than 0.3 percent) and the Philippines (about 0.2 percent). Thailand approached 0.5 percent, and Malaysia had an exceptionally high ARI of about 2.0 percent. Papua New Guinea, despite its poor performance, had an ARI of about 0.8 percent. The Pacific islands' NARSs generally have a relatively high ARI. Agricultural and nonagricultural growth rates have varied considerably in the region, but agriculture remains an important source of employment in all countries, ranging from 33 percent of total employment in Malaysia to 80 percent in Papua New Guinea. The sector's contribution to GDP has ranged from 20 percent in Malaysia to 30 percent in China. Agricultural exports have been important, especially in Indonesia, Malaysia, Papua New Guinea, and Thailand.

The relatively high level of support for research in Malaysia and Thailand may be partly linked to their relatively high GDP per capita ($2,000 to $3,000) combined with good growth in GDP per capita during the review period (5.7 percent in Malaysia and 8.4 percent in Thailand). The Philippines, with the lowest level of support, not only has a relatively low GDP per capita ($830), but also had poor economic growth during the review period (only 1.6 percent). The ARI for the Pacific island NARSs are high in part because of their small output and diseconomies of scale. Papua New Guinea's high ARI is similarly influenced, but is also affected by the high donor support and heavy expatriate participation.

In the countries with serious funding problems, the number of researchers has expanded much faster than budgetary support for the NARSs. This imbalance did not emerge in China until after 1985, but then the system had to rely increas-

ingly on commercial production to support research costs, using the system's physical and human resources. In 1993 some 38 percent of research funding came from incomes generated by the institutes themselves, and the central authorities are encouraging an increase to 70 percent. China has not used funding through cesses on processed cash crops; however, the potential use of this mechanism is complicated by high taxes (in the form of price controls on many crops suitable for this user pay mechanism) and by the government's reluctance to consider linking taxes on specific commodities to support for those commodities.

In Indonesia, the tree crop sector is better off than the remainder of the research system because of the support it receives from the public tree crop companies, and the ARI of less than 0.3 percent is not indicative of the attention given to other crops, as the dominant lowland crop (rice) benefits substantially from international research at the International Rice Research Institute. However, in the late 1980s, AARD institutes' reliance on external funding increased to an unhealthy 70 percent, and the Bank is supporting AARD's expansion with regional research investments in a new project that will further increase the eventual demands for budgetary support. With the help of ISNAR, the AARD has been able to demonstrate high returns to its rice and soybean research investment programs, but this has been insufficient to attract the desired budgetary support. In recent years, the AARD has started to solicit support from commercial end-users for particular programs that benefit these entities (for instance, for fisheries programs).

In the Philippines, the government has indicated its intention to increase greatly its support for research so that its ARI will rise from a dismal 0.2 percent to 1.0 percent by the year 2000. Thailand has expanded its regional research investment and rationalized its research program in the Department of Agriculture with Bank support, but has not attempted to rationalize the significant research investments of the MOA's other departments with those of the Department of Agriculture. Malaysian research is well supported, although rationalizing state and federal forestry research could produce some economies.

Africa

Almost all NARSs in AFR expanded significantly during the review period. In eight of the 12 NARSs included in the review for which ISNAR's Indicator Series provides data (ISNAR 1993/94), the total number of researchers nearly doubled, which resulted in large increases in investment and operational funding requirements. AFR countries have maintained ARIs at a higher level than EAP and SAS countries and five of the eight countries have maintained or increased their ARIs. Two of the three countries with declining ARIs (Senegal and Zimbabwe) had relatively high ARIs to begin with, and they were still 1.3 and 1.9 percent, respectively, in 1991.

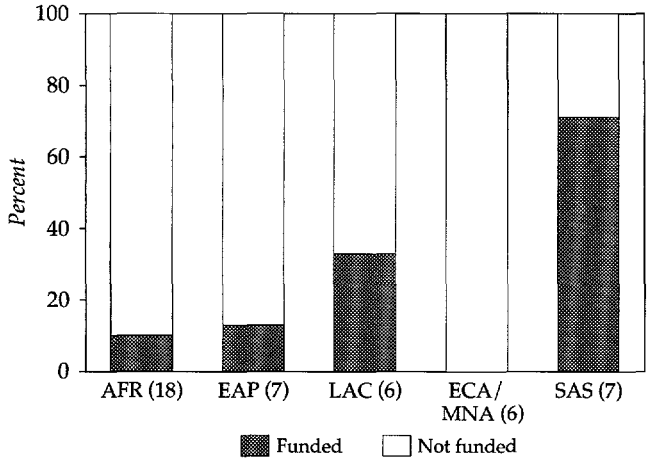
The relatively favorable ARIs have been enabled by heavy support from the donor community and the Bank (Figure 8.5). However, this support has been insufficient to counter a declining trend in expenditure per researcher in all countries. This decline has been reflected in reduced operational support for research, which in turn affects system efficiency, and particularly hinders on-farm adaptive research activities. Individual institutes without donor support have been especially badly affected. In Ghana, institutes without donor support in the 1990s used 90 percent of their funds for salaries, and supervision reports on projects in Cameroon and Kenya indicated that the only fully operational institutes were donor funded. Of the eight sample countries supported by the

Bank for which data are available, salaries in three of them consumed 79 percent or more of noncapital expenditure in 1991.

The Bank has attempted to enhance system efficiency by improving research coordination and planning. However, none of the projects approved in the 1980s proposed rationalizing the NARSs, although staff members in the Malawi project were limited by an expenditure ceiling. On the contrary, Bank projects in such countries as Burkina Faso and Senegal appear to have expanded the networks of research stations beyond governments' capacity or willingness to support them. Mid-term reviews in Cameroon and Kenya recommended staff reductions, and a more recent strategy agreed to by the Tanzanian NARS and the donor community required significant rationalization measures, but these have not occurred. Kenya, however, currently has a redundancy program directed at the excessive numbers of lower-level support staff. More recently, the Uganda (1993) and Mali (1994) projects have initiated personnel reductions by creating new institutions with an improved salary structure in accordance with new research strategies.

The Bank has also helped to fund incremental operational costs in AFR (nearly 80 percent of projects), and even salaries in some cases, although less so than in SAS (annex figures 6.1 and 6.2). However, in the recent Mali project, the Bank classified all recurrent costs as a capital good eligible for donor financing and is recommending this approach in a proposed project in Cameroon. The Bank has also provided complete funding for certain important research programs (in Ghana, Malawi, and Senegal II projects) as many donors have done in the past. This shift is consistent with the ultimate objective of Bank assistance, which is to produce relevant technology for important production systems. However, it also indicates that the Bank appreciates the difficulties in getting local funding even for priority programs, and raises questions about the scale of the total research investment in relation to fiscal constraints in the countries concerned.

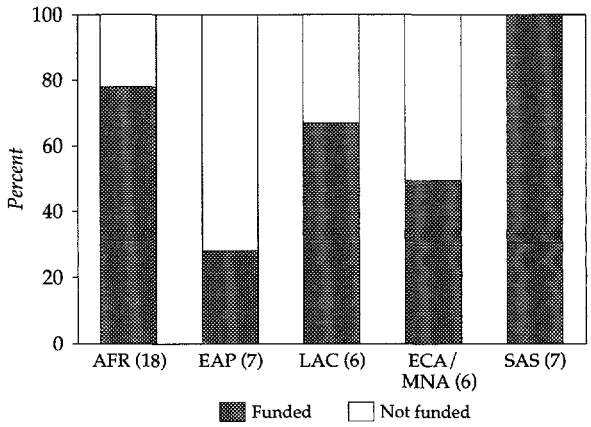
ANNEX FIGURE 6.1: FUNDING OF SALARY COSTS FOR FREE-STANDING RESEARCH PROJECTS WITH MORE THAN 50 PERCENT OF COSTS ALLOCATED TO RESEARCH, 1977–92



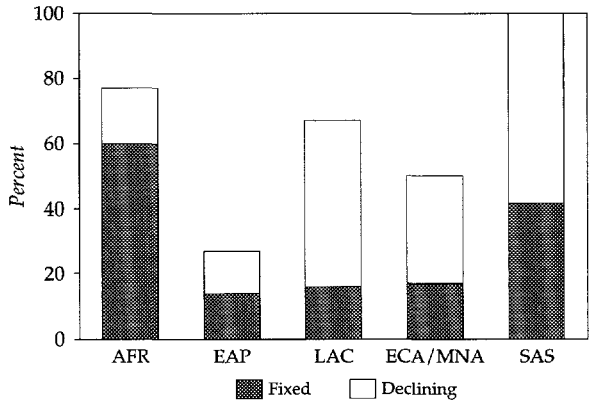
Note: Figures in parentheses represent the number of projects with at least 50 percent of costs allocated to research.
Source: Staff appraisal reports and loan and credit agreements.

ANNEX FIGURE 6.2: FUNDING OF OPERATING COSTS FOR FREE-STANDING RESEARCH PROJECTS WITH MORE THAN 50 PERCENT OF COSTS ALLOCATED TO RESEARCH, 1977–92

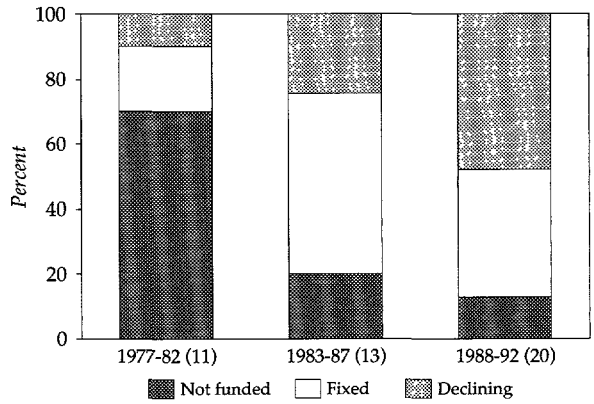
Funding of operating costs



Nature of funding of operating costs as a fixed or declining percentage over the life of a project



Changes in funding over time



Note: Figures in parentheses represent the number of projects with at least 50 percent of costs allocated to research.
Source: Loan and credit agreements.

The intensive donor support for NARSs in the region has resulted in heavy dependence on external funding in many systems. Burkina Faso, Burundi, Madagascar, Rwanda, Senegal, Uganda, and Zambia depend on external support for more than 70 percent of funding.

The Bank has also attempted to address the funding problem in AFR by supporting initiatives that promote regional coordination of research and of donor support for regional programs (Box 9.1). This concept has particular relevance in AFR, where the average size of the agricultural sector is much smaller than in other regions (apart from the Caribbean and Pacific island countries), which makes it difficult to justify spending large sums of public money on agricultural research.

Other than through cesses on processed crops, most AFR countries seem to have few opportunities for producer-pay systems to fund research because of the widespread poverty in the smallholder sector. However, where larger commercial farming is practiced, such systems are possible, especially in southern AFR. In Zimbabwe, commercial farmers have established a trust fund to finance their own research, and a similar initiative is under way in Zambia.

Latin America and the Caribbean

The weighted ARI in 1981–85 was 0.65 percent for South America and 0.43 percent for Central America (Roe and Pardey 1991). In Brazil, funding through EMBRAPA (the largest entity of the country's NARS) peaked in 1981 and 1982, when the ARI for funding through this institution alone reached 0.95 and 1.40 percent, respectively, before dropping to around 0.6 percent for the rest of the 1980s; however, funding has been severely constrained in the 1990s. Mexico similarly reached a high level in 1983 (close to 1.0 percent for INIFAP, which is estimated to absorb a little more than half of public research expenditure), then declined to about 0.5 percent for the national system by the end of the 1980s. The ongoing Mexican agricultural technology project is operating in a tight fiscal environment and has been receiving minimal local funding. Colombia has given less support to public research, and its ARI fluctuated at around 0.35 percent in the 1980s (despite Bank project support), and dropped even lower in the 1990s. However, the private sector generates about 40 percent of total research funding in Colombia through cesses on processed products and commercial sector investment (as opposed to about 8 percent in Mexico and Brazil). The Peruvian NARS had little support in the early 1980s (0.2 percent ARI). Support increased temporarily with the Bank project and USAID funding in the mid-1980s, but then declined to critical levels in line with Peru's general economic and fiscal deterioration.

Although LAC saw smaller increases in the number of researchers than other regions, the general decline and fluctuations in funding during the review period particularly affected the nonsalary portion of recurrent costs. EMBRAPA in Brazil has developed a capability in research impact evaluation that has demonstrated the favorable returns to research, but this has not been sufficient to attract a continued high level of public funding.

LAC's agricultural sector contributes less to GDP than in the other regions (about 10 percent at the end of the 1980s), and its share of employment (about 25 percent) is also lower. LAC has the lowest proportion of government expenditure for agriculture, and is the only region in which this proportion declined during the review period (Annex Table 5.8). Although economic diversification in the region may explain much of the decline in public emphasis on agriculture,

the sector is still important for export earnings, generating about 27 percent of total exports overall, and as much as 60 percent in Argentina.

The Bank's efforts to promote research coordination, planning, and review should help improve system efficiency, but these efforts do not appear to be sufficient to eliminate funding problems. In sympathy with fiscal difficulties, the Bank funded incremental operating costs in all research projects approved after 1982, including salaries in half of them (Annex Figure 6.1).

Commercial agriculture is more highly developed in LAC than in other developing regions, which suggests that a greater share of research funding should be passed on to users. As indicated earlier, private sector funding for agricultural research is already significant, particularly in Colombia, to a lesser extent in Brazil, and Mexico, and more recently in Peru.[11] EMBRAPA in Brazil has a specific department charged with attracting funding support from producers, processors, and input suppliers for research programs that will be to the firms' advantage. Despite these successes, the potential for direct user financing of research carried out by public and private research entities is much greater, especially for the highly commercial production systems. The large populations of smallholders in LAC, especially in Central America and the Caribbean, cannot be expected to pay a significant amount of the costs of research, however, and substantial public support will continue to be warranted for this target group.

Europe, Central Asia, Middle East, and North Africa

Of the ECA/MNA national agricultural research systems in the sample, Tunisia's appears to be in the most favorable position. Its ARI exceeded 1.0 percent in the late 1980s, but even here the staff appraisal report on the 1990 project refers to "local funding risks." The other countries have low ARIs, about 0.2 percent for the MOA in Turkey, which makes up the bulk of the research establishment, and 0.3 percent for Morocco's INRA, which dominates research other than livestock.[12] The low level of Moroccan support is rather surprising, considering the government's relatively favorable allocations to sectoral expenditures (Annex Table 6.2). Funding for recurrent costs has been problematic, as evidenced by the high proportion of operating costs allocated to salaries: 86 percent in Morocco, 81 percent in Tunisia, and 80 percent in Turkey in the late 1980s and 90 percent currently in Yemen.

Despite significant growth rates in agricultural production in the supported countries in the region, the sector's contributions to GDP, exports, and employment have been falling (Annex Table 5.8), so that shares in GDP and exports are similar to those in LAC. The share of employment, however, remains higher (about 40 percent, compared with 25 percent in LAC). Nevertheless, agriculture features prominently in national development plans.

As it has in the other regions, the Bank has supported coordination, planning, and review systems to improve resource allocation and system efficiency. The borrower has been responsible for an unusually low percentage of project costs in Morocco (16 percent) and Turkey (29 percent) (these were loans rather than credits), which raises questions about borrower commitment, especially considering the relatively low ARIs.[13] All loans funded incremental operating costs, but none funded incremental salaries (Annex Figure 6.1).

None of the staff appraisal reports for Bank projects encourages private sector research or user-pay funding support systems. There has been some private sector research in Morocco and Turkey for high-value export crops. In Morocco,

one cost of liberalizing exports has been a significant loss of income for the producer marketing association that had helped to finance vegetable research.

Component projects

South Asia

Most research components in SAS were in projects aimed at developing particular commodities or industries, such as silk, rubber, forestry, fisheries, and dairy farming. Many (though not all) of these components succeeded in improving the capacity of the research system to develop appropriate technology. A component's success depended on the degree to which the research was integrated into the established research system (as occurred with fisheries in Bangladesh, rubber in India, and oil seeds in Pakistan) or linked with the extension system it was designed to service (as were dairy in India and rubber in Sri Lanka) and through which technology demands were clearly articulated. Making special units, usually in line ministries, rather than existing research institutions responsible for research proved to be inadvisable in mangrove forestry in Sri Lanka. Piecemeal support for research at particular institutes that did not have an established planning and implementation capacity also produced poor results in a cash crops project in Nepal. Research components in irrigation projects were negatively affected if the components were minor (as in Haryana in India) and positively affected if they were integrated into the SAU structure (as in Maharashtra in India).

East Asia

Research components in forestry, area development, and irrigation in China were linked to established research systems and had satisfactory results. Research in a rubber project failed because of an overall project design fault: the inappropriateness of the production environment for this commodity. In Indonesia, the research components associated with transmigration projects were part of the AARD system and made reasonable contributions, although they suffered somewhat from the isolation of their sites. The AARD has also undertaken research in the ongoing Yogyakarta project, which has a strong on-farm adaptive research component. In the Philippines, the regular research institutions in two area development projects successfully carried out adaptive research components for local farming systems. In Malaysia, research by MARDI in an area development project produced useful results, as did well-focused adaptive research by the state forestry research center in Sabah. In Thailand, two rubber development projects satisfactorily supported applied research by the Thai Rubber Research Institute. A minor research component in a palm oil nucleus estate project in Papua New Guinea did not rate a mention in the ex post review of the project, nor did a small adaptive research component in a Thai rural development project.

A seeds project in Myanmar provided facilities and training to support the country's applied research entity, but suffered from the general deficiencies of this entity in weak on-farm research and poor experimental design. Two agricultural development projects in the Lao People's Democratic Republic provided some training and upland crop research facilities that should contribute to the MOA's research capacity. In research in Pacific island projects, the rural services project in the Solomon Islands provided adaptive research facilities. However, these facilities were not well integrated with provincial services, and their productivity declined after project completion. An agricultural development

project in Western Samoa that focused largely on tree crops fared better in improving research capacity, but suffered from researchers' lack of appreciation of the constraints local farming systems faced. The research component of a small project in Vanuatu attempted to develop adaptive research and demonstration centers to introduce cash crops (mostly tree crops) into the traditional garden-bush fallow farming system. The program was only partially implemented, lacked qualified and experienced staff, and as a result did little adaptive research.

Africa

Two area development projects and one fertilizer project in Burkina Faso used the national research agency, the National Institute of Agricultural Research, to implement applied research components successfully and obtain some useful results. Problems with inadequate research-extension linkages and the questionable relevance of some of the research were symptomatic of general deficiencies in the research system that a national research project is targeting. A minor research component in a third area development project was inconsequential. Two rural development projects in Cameroon in the early 1980s contributed to the institutional development of research prior to the national research project in 1986, although one of these projects was seriously affected by delays in the effectiveness of the research project on which it depended for continuity. The Volta agricultural development project in Ghana was unusual in that the project authority developed an effective adaptive research function, which many feared might be lost as the Bank's emphasis shifted to supporting national research strategies and programs. The project arrangements were dismantled at closure, but an adaptive research capacity is being developed in the area through the mainstream national program.

An area development project in Kenya in the early 1980s with an adaptive research component for sunflower and cotton did not receive the necessary support from the MOA's research division. Adaptive research efforts in rural development projects in Malawi were not as productive as intended, as they were only minor components from which too much had been expected within the short project periods and did not adequately reflect the constraints most farmers faced. A similar component in a Niger project also failed to produce relevant research. A rural development project in Senegal included a successful applied research program that complemented the ongoing national research projects. In Uganda, the establishment of a research station concentrating on cereals and tubers was not adequately funded as a minor component in an area development project, but apparently received further support under the subsequent national research project. The Nigerian rural development projects had their own adaptive research units that interacted with the national institutes, but much of the adaptive research did not take into account common mixed cropping practices, thereby limiting its effectiveness. However, the projects did eventually increase national researchers' exposure to practical farming conditions and significantly expanded the number of on-farm trials involving the research institutes (severe funding constraints had limited this activity under regular budgets).

The most significant research components in AFR pertained to tree crops. In Côte d'Ivoire, two projects supported a new, financially autonomous rubber research institute jointly owned by industry and the government. Although the institute had serious initiation problems and has suffered from falling rubber prices, the concept was legitimate. A Kenyan coffee project successfully supported the Coffee Research Foundation, which now operates without govern-

ment financial assistance. In Tanzania, a pilot project on coconut development initiated research that became an integral part of the national program and was further supported under a follow-on tree crop project (coconuts and cashews). The agroforestry research program in the Zimbabwe forestry project was hampered by insurgence, political conflicts, and drought. Most of the other research components in AFR were minor and did not have major impacts.

Latin America and the Caribbean

Mexico included major applied research components in many of its agricultural development projects in the absence of a national project. These components generally encouraged a farming system perspective that led to some useful research results from cooperating state and federal research institutions. The rural development projects in northeast Brazil mostly relied on the state agricultural research systems to provide research support. In general, these projects failed to take into account the constraints most local farmers faced, thereby limiting the relevance of the research output in the difficult socioeconomic and production environments in these states. Research in one project (Bahia II), which was designed to be more responsive to local farming conditions and to create effective links with the national research projects, did provide appropriate technology. The rural development projects in the northwest and in Amazonas had research components that were also relatively successful in testing and confirming the applicability of diversified cropping (particularly tree crops). This success was possible, despite serious funding and staffing problems, because of the close integration of national and state research programs and the focus on local constraints and potentials.

In Colombia, the agricultural diversification project successfully used the established producer organization, the Federation of Coffee Producers, to carry out its own applied research. In Peru, the Alto Mayo project established two research stations under the national research organization, INIPA, in this isolated area, and both produced applicable results. INIPA was given responsibility for applied research in another rural development project and contracted it out to La Molina University. Funding for both subprojects suffered when the Bank suspended disbursements to Peru in 1987.

Europe, Central Asia, Middle East, and North Africa

Most of the 14 projects completed in the sample ECA/MNA countries (six in area development, five in irrigation, and three in commodity development) contained minor research components that were not given much attention during implementation or ex post evaluation. An exception was the Tihama II project in the Republic of Yemen, which had a relatively significant research component that complemented the research investments under the UNDP/FAO projects. The project contributed to national research capacity, but was unable to develop useful technology during the project period.

Although the Bank did not participate in free-standing projects in Eastern Europe in the 1980s, it did finance significant research components in projects in Hungary and Romania. Research made up less than 2 percent of costs in the Irrigation VII and Livestock IV projects in Romania, but each involved more than $5 million and gave significant support to the further development of existing institutes responsible for higher value crop and livestock technology. Similarly, livestock and crop production projects in Hungary each had significant (greater than $7 million) research components that supported a new agricultural biotechnology center. The livestock project also supported research in genetics,

grasslands, and animal nutrition at Dannon University, and the crop project provided for key equipment at the Agricultural Research Institute of the Academy of Sciences.

Notes

1. The bilateral donors include Australia, Canada, the European Union, France, Germany, Japan, the Netherlands, the United Kingdom, the United States, and, to a lesser extent, Denmark and Sweden. The Rockefeller Foundation provided assistance in China and Thailand and the Ford Foundation in Thailand.
2. In Algeria, which is not included in the reviewed countries, the first research support by the Bank came in 1990. Subsequently, the Bank also supported two research component projects (Sahara Development and Forestry and Watershed projects).
3. Bangladesh, for example, has 10 institutions in four ministries; Sri Lanka has 15 institutions in seven ministries and the President's Office; and Nepal had 52 facilities in two departments prior to the 1987 amalgamation of responsibilities.
4. The establishment of accounts for funds that can receive financing from internal budgetary resources, external sources, and local private sector organizations for use in competitive research grant programs has been widely adopted in the LAC countries. The extensive use of this system in Chile has increased the participation of universities, so that in the 1990s they conducted about 20 percent of agricultural research (Venezian 1995).
5. In the Republic of Yemen, semiautonomous institute models evolved after the Bank's 1982 project, in which the establishment of a semiautonomous institute was a condition of effectiveness.
6. In some NARSs, researchers obtained their postgraduate qualifications from East European countries and the former Soviet Union, where training standards varied more than in academic institutions in Organization for Economic Development and Cooperation countries.
7. Surveys of AFR NARSs by the Special Program for African Agricultural Research in 1991/92 compared research characteristics in the region with Asian standards. The surveys indicated that these characteristics were inferior by Asian standards, with only seven out of 47 NARSs meeting minimal criteria for worthwhile performance (Cleaver 1993).
8. Even the earliest AFR research project (Credit 834 in Sudan in 1978) followed a master plan that identified the need for much greater resources in the western region. Unfortunately, the project components were not adequately linked to the master plan, and the resources required to adopt the plan were not properly analyzed. Lack of resources and a different perspective by the technical assistance team of the cofinancier (USAID) meant that the plan was not implemented.
9. For example, the Tanzanian project stipulated the dissolution of existing institutions and the adoption of a new organizational structure; research on crops and livestock was to be integrated in Senegal; and in Kenya separate departmental research activities were to be integrated in a semiautonomous agency (with the research units derived from the breakup of the East African community).
10. Note that in some AFR countries the traditional linkages among researchers, mid-level extension workers, and progressive farmers were reasonably good. The introduction of the training and visit extension system as part of the Agricultural Services Initiative initially upset this traditional arrangement to some extent. The initiative has the task of replacing or modifying traditional systems and expanding their coverage of smallholder communities.
11. Producer organizations such as CEPLAC (agricultural cooperative) in Brazil have undertaken their own research (in this case on cocoa), while others, such as Sonora Patronato in Mexico, which is involved in irrigated cereal research, fund the NARS.
12. The ARI for Yemen is unknown. However, circumstances are conducive to funding difficulties: it has the lowest per capita income of the group, the highest dependence on the agricultural sector, and the lowest share of government spending on agriculture. At the end of 1995, funding difficulties were extreme.
13. The borrower's share in the Yemen project was only 20 percent, but this was an IDA credit.

Annex 7: Evaluation of agricultural research

Despite its long history of support for agricultural research, the Bank has not conducted formal economic analysis of its agricultural research projects, either ex ante or ex post. This remarkable situation warrants some comment and analysis, as only the social sectors (and not comprehensively so) have escaped such requisite attention within the Bank.

The review of economic analysis of investments in agricultural research in Chapter 7 revealed the high rates of return that such studies have typically found. The analyses reviewed were programwide analyses and are unlike the bulk of studies on rates of return within the agricultural research sphere, which have mostly examined specific commodities in particular geographical areas. The latter are subject to selection bias and probably suffer from a systematically high bias in terms of returns on investment. The programwide perspective ensures that successes and failures in particular projects and commodity efforts are averaged out, and the generally favorable findings reported in Chapter 7 thus pertain to broadly based public sector investments in this field.

"Fair" treatment of agricultural research in the Bank's project cycle

The standard line in World Bank staff appraisal reports for agricultural research projects is that the Bank has made no effort to assess rates of return in the particular proposed project because of the widely acknowledged high rates of return to such investment in this and other parts of the world. Many things have changed in the agricultural research sector in recent times, however, and the future may well differ greatly from the past.

On the institutional side, the funding crisis pervasive in so many systems means that the resources available to researchers are now in some cases so meager as to be effectively nil. Moreover, one could make a case that the "easy gains" in many fields of research, for example, in plant breeding for broadly adapted, higher yielding, and pest-resistant germplasm, have already been made. According to this reasoning, the potential gains from further investment in such traditional research work, may have to come at a progressively higher cost.[1]

So many factors in the contemporary and recent agricultural situation of a number of countries could compromise the intended achievements of investment in NARSs that asking about the likely payoff and sustainability of further investment is a legitimate question. The institutional difficulties addressed in Chapter 9 auger badly for high rates of return in projects where the consumable research resources available to research workers are trivial and not conducive to high productivity, both in a research sense and in the wider agricultural productivity sense.

The reality is that most aspects of agricultural research, on both the input and output sides, are measurable, and thus the case for treating agricultural research

in the same way as several social sectors that are bedeviled by extremely difficult measurement problems is neither clear-cut nor justified. The Bank should treat research in much the same way as any other mainstream investment activity. If this were done well and the evaluative process was used to define those investments that would be most profitable, the returns to such investment would likely increase. The continued "soft" treatment of agricultural research in the Bank's project cycle does not appear to be justified. The Bank needs to institutionalize practical approaches for economic analyses that would allow it to evaluate its interventions reliably, and at the same time contribute to the development of an evaluation capacity in the NARSs, which is the more important objective.

Difficulties to be overcome in agricultural research evaluation

Of course, analysts have "good" reasons to explain further their reluctance to undertake ex ante evaluative assessments of agricultural research. These fall into two broad groups, first, the uncertain nature of the research process itself, and second, the reality that many other factors beyond the research subsector impinge on it and determine its ultimate results.

In World Bank project appraisal, grappling explicitly with uncertainty is somewhat of a peripheral and minor activity (World Bank 1996a). Thus the reluctance to pursue detailed, ex ante economic analysis of agricultural research projects is not surprising given the significant uncertainties involved.

An inextricable link exists between the uncertainty at any one period of observation of a research project and the temporal perspective. The nature of some research problems is that if sufficient resources are devoted to them over a sufficiently long period, researchers can eventually crack them and, in that sense, the risk of failure may be small, although the uncertainty about the timing of the outcome may be great. Other research problems may be less susceptible to successful resolution even over long periods (finding stable resistance to trypanosomiasis in African bovines is one such illustration), and certainly well beyond the length of the typical World Bank project cycle. Research systems are, of course, usually engaged in a wide range of research themes, and there is inevitably a certain amount of averaging of successes and failures across the portfolio. Thus the usual presumption is that in a well-selected portfolio, significant achievements will be realized somewhere in the set of prioritized research investments. All these considerations, however, involve considerable analytical challenges to identify the nature of the uncertainties and the potential returns.

The appropriate perspective for an investment analyst of what are largely purely public investments is one of risk neutrality, largely on the grounds of risk pooling and the social imperative of seeking to maximize the expected economic return from an investment portfolio (Arrow and Lind 1970). In this sense, the intrinsic riskiness of research should not be a major impediment to a substantial investment commitment to worthwhile activities. Thus the key analytical task is to derive reasonable estimates of the expected economic rate of return to such investments, and this can be reasonably easily done at modest cost as sketched out below on the basis of recent expository works, especially with the increasing availability of cutting edge software to facilitate such analyses.

The second set of uncertainties relates to what farmers actually do with the products of a research system. Their decisions depend greatly on whether adopting particular innovations and innovative practices linked to a set of research products is profitable or not. Profitability, in turn, depends on many

other factors, especially prices, which depend on international commodity markets, domestic agricultural policy, and the effectiveness of agricultural infrastructure in linking local prices to border prices. In many situations productive research systems will have little effect because adopting the products of such systems under prevalent economic conditions is not profitable, for example, in the republics of the former Soviet Union under recent circumstances.

Evaluating research may be challenging in general, but evaluating the significance of Bank investments presents even greater difficulties. The problems lie in "attribution" in a field that involves many actors, international agricultural research centers, national systems, private sector organizations, innovative farmers, and the complex interplay of domestic and international policies. Just how the contributions of particular players are attributed in this field is seldom clear and is inevitably controversial, particularly given the elegant claims about the virtues of particular forms of intervention, such as the well-orchestrated arguments of the Consultative Group on International Agricultural Research and its many supporters (including the Bank as a significant "shareholder"). For Bank-supported research projects, quantitative assessment of returns could only reasonably be considered for the project as a whole or for specific programs, not for the contribution of Bank support alone.

Research evaluation and priority setting: from theory to practice

The economic approach to research evaluation is demonstrably the most important approach from a disciplinary perspective, because it provides the means for valuing the major contributions of research to society. Certainly, other aspects of evaluation may also be of interest, including the scientific perspectives of particular research programs under way and the wider social perspectives that permit linking the contributions of research to aspects of society beyond the narrower issues of economics. A feature of agricultural research and its associated productivity enhancement is that it does contribute clearly and directly to economic growth. As an instrument for targeting resources differentially to particular groups, such as the very poor, however, it is much less than ideal, and other instruments are available that are more efficient in this regard. Thus agricultural research is best seen as a major contributor to agricultural productivity and to economic growth in the agricultural sector in general. It is best not to seek to use it as an instrument for other objectives, particularly distributional objectives, because it is such a blunt instrument.

Even within the narrow confines of economics, the measurement issues involved in linking investment in agricultural research to ultimate economic outcomes are problematic. Economists have used many different approaches, but the most widely used methods are those based on measures of economic surplus of both consumers and producers.

The measurement issues thus relate to quantifying the links between investment in different types of research programs and the effects that these may eventually have on supply and demand relationships in the sector. Taking even broader perspectives and tracking the economywide effects of research-induced changes, which are usually construed in a partial framework, is also possible. Such general equilibrium work relies, however, on having computable models of sectors and economies and on being able to calibrate these appropriately in the links to the research investments under consideration. This has seldom been done.

Although both supply and demand shifts may eventuate from research investments, the predominant source of benefits in developing countries is on the supply side, which translates into a downward shift in the aggregate supply function, as well as in the supply functions for particular commodities. This is associated with reduced marginal costs of producing both aggregate output and particular commodities. The reduced marginal costs derive from increased factor productivity in the relevant parts of the production process. Quantifying all the shifts is a task that can be tackled in many ways, ranging from the more or less formal data-based econometric methods that tend to be used in ex post assessments, to the subjective estimates of such shifts that usually have to be used in ex ante methods. The latter methods play a major role in underpinning formal efforts in priority setting.

The art of measuring these research-based shifts, both in ex ante and ex post contexts, has been developing rapidly in recent years and has reached a high point through the recent publication of a detailed manual (Alston, Norton, and Pardey 1995). The availability of this work greatly simplifies the exposition here, because details on the many subtleties of conceptual origins, market structure, and the empirical issues of where research contributes to productivity or other changes in the sector are available therein. Accordingly, the approach this report takes is to regard the methods now available to be highly relevant to future assessment of Bank support to investments in agricultural research, including both ex post evaluation and ex ante planning work. Much more important, these methods are now readily available to the professionals working on allocative issues in NARSs. Thus, because these methods are now so readily accessible and the number of professionals familiar with them is growing rapidly, the future need not be like the past. The next time that the Operations Evaluation Department has occasion to review investments in this field, the goal posts will have moved and a much richer base of well-founded economic data will be available on which to build a retrospective evaluation of investment in agricultural research.

Confusion may arise about the role of management information systems in research planning and priority setting, as opposed to research management. An MIS can be a valuable tool in such work, because it should be able to provide dated cost data and other project implementation details, as well as overviews of the overall research program. However, an MIS does not a priority setting system make! Apart from cogent details on commodity market and trade structures, the major relevant elements usually absent from an MIS pertain to aspects of "research opportunity," aspects that are typically difficult to pin down and that must rely largely on (hopefully "expert") informed judgment.

Those measuring the benefits of research should take account of the market setting, but the economic surplus measurement formulas (Alston, Norton, and Pardey 1995, Chapter 4) all involve some function of these core elements:

- Commodity unit price, P.
- Volume of commodity production, Q.
- Proportional reduction in marginal cost of production, k.

The first two elements combine to give the value of production, PQ. The third element combines many considerations about research opportunity and effectiveness over time; technology spillover and adoption over time; and the nature of supply and demand relationships, including their dynamics (Alston, Norton,

and Pardey 1995, Chapter 5; Anderson 1991). Subjective judgments about research opportunity determine k, and also play a central role in research priority setting.

Quantifying research opportunity in a transparent and defensible manner is a serious matter. Some of the important component questions that require good judgment and experience to answer will include the following:

- What would constitute a success in a particular research effort (activity, project, program, and so on) during a designated period?
- What is the probability of the designated success?
- What would be the potential proportional reduction in unit costs of production that could be induced by that success?
- Will adoption of the fruits of the success be profitable and who (and where and when) will adopt?
- What will the research effort cost over its life?
- How and when might the research success depreciate in the sense that it is replaced by a superior innovation?

The list could (and should) go on, but enough has been noted to illustrate the nature of the judgmental and measurement challenges involved, as well as, by implication, the obvious advantages of using a consistent framework and facilitating software (Alston, Norton, and Pardey 1995, Appendix A5.1; Wood and Wood-Sichra 1995) to deal with the conceptual complexities and the arithmetic burdens of such work. Authors associated with ISNAR were preparing nontechnical explanations of these methods as of mid-1996.

Needless to say, any rough and ready approach that tries to short-cut such complexities, such as the widely used scoring models (for a cutting critique, see Alston, Norton, and Pardey 1995, Chapter 7), is bound to encounter conceptual, empirical, and consequently plausibility problems, and may be quite misleading because of the poor guidance on priorities that results. Bank task managers and their national agricultural research system colleagues will thus need to approach pragmatic priority setting efforts cautiously, no matter how well-intentioned they may be, and to seek rigorously the installation within national agricultural research systems of appropriate, state-of-the-art analytical methods and skills.

Despite this warning, there is evidently a desire for simple, undemanding guidelines for use until the more consistent and comprehensive methods, such as those advocated here, can be implemented routinely. A simple rule of thumb that could be tentatively entertained would be to apply the following criterion for each potential commodity research program: invest the budgeted resources if $kPQ > 20c$, where PQ is projected annual gross revenue over the next few years, k is the expected proportional reduction in the marginal cost of production associated with a research program that may take, say, five to 10 years to accomplish at an annual cost of about c. As noted, the subtlety and challenge lie in estimating k, which in a crude manner (based on unit elastic supply), can be approximated by the proportional increase in average on-farm yield attributable to the research. Adoption of this criterion when applicable, would lead to acceptable economic rates of return on research investments of the order of 20 to

40 percent. Noting that the ratio c/PQ is approximately the same as the agricultural research intensity and taking an agricultural research intensity of 0.005 or 0.5 percent as typical of that found in most borrowing countries, the crude criterion is equivalent to requiring that the expected cost reduction factor k for such an hypothetical research program be greater than 0.1, or 10 percent. While the described rule of thumb analysis would suffice to screen programs, final inclusion in a prioritized research agenda should depend on the comparative net benefits of feasible candidate programs.

Note

1. Major breakthroughs in biotechnology, of course, could provide some cost-effective research that is not "traditional."

References

Alston, J. M., and P. G. Pardey. 1996. *Making Science Pay: The Economics of Agricultural R&D Policy.* Washington, D.C.: American Enterprise Institute Press.

Alston, J. M., G. W. Norton, and P. G. Pardey. 1995. *Science under Scarcity: Principles and Practice for Agricultural Research Evaluation and Priority Setting.* Ithaca, New York: Cornell University Press.

Anderson, J. R. 1991. "Agricultural Research in a Variable and Unpredictable World." In P. G. Pardey, J. Roseboom, and J. R. Anderson, eds., *Agricultural Research Policy: International Quantitative Perspectives.* Cambridge, U.K.: Cambridge University Press.

Anderson, J. R., and K. A. Parton. 1983. "Techniques for Guiding the Allocation of Resources among Rural Research Projects: The State of the Art." *Prometheus* 1(1):180-201.

Anderson, J. R., R. W. Herdt, and G. M. Scobie. 1988. *Science and Food: The CGIAR and its Partners.* Washington, D.C.: World Bank.

Anderson, J. R., P. G. Pardey, and J. Roseboom. 1994. "Sustaining Growth in Agriculture: A Quantitative Review of National and International Agricultural Research Investments." *Agricultural Economics* 10(2):107-123.

Antholt, C. H. 1991. "Agricultural Extension in the 21st Century: Lessons from South Asia." In W. Rivera and D. Gustafsen, eds., *Agricultural Extension: Worldwide International Evolution and Forces for Change.* New York: Elsevier.

Antony, G., and J. R. Anderson. 1991. "Modeling Technology Replacement over Time for the Ex Ante Analysis of Agricultural Research Projects." *Agricultural Systems* 37(2):183-92.

Arrow, K. J., and R. C. Lind. 1970. "Uncertainty and the Evaluation of Public Investment Decisions." *American Economic Review* 60(3):364-78.

Ashby, J. A., T. Garcia, M. P. Guerrero, C. A. Quiros, R. I. Roa, and J. A. Beltran. 1995. *Institutionalizing Farmer Participation in Adaptive Technology Testing with the "CIAL."* Colombia: International Center for Tropical Agriculture.

Axinn, G. 1988. *Guide on Alternative Extension Approaches.* Rome: FAO.

Baxter, M., R. Slade, and J. Howell. 1989. *Aid for Extension.* Washington, D.C.: World Bank.

Benor, D., and M. Baxter. 1984. *Training and Visit Extension.* Washington, D.C.: World Bank.

Benor, D., and J. Q. Harrison. 1977. *Agricultural Extension: The Training and Visit System.* Washington, D.C.: World Bank.

Bindlish, V., and R. Evenson. 1993. *Evaluation of the Performance of T&V Extension in Kenya.* Technical Paper No. 208, Africa Technical Department Series. Washington, D.C.: World Bank.

Bindlish, V., R. Evenson, and M. Gbetibouo. 1993. *Evaluation of T&V-Based Extension in Burkina Faso.* Technical Paper No. 226, Africa Technical Department Series. Washington, D.C.: World Bank.

Binswanger, H. P., M.-C. Yang, A. Bowers, and Y. Mundlak. 1987. "On the Determinants of Cross-Country Aggregate Agricultural Supply." *Journal of Econometrics* 36(1):111-31.

Birkhaeuser, D., R. E. Evenson, and G. Feder. 1991. "The Economic Impact of Agricultural Extension: A Review." *Economic Development and Cultural Change* 39(3): 607-50.

Bottomley, A., and R. Contant. 1988. *Methods for Setting Priorities among Different Lines of Research.* The Hague, Netherlands: ISNAR.

Bruneau, H. 1994. *Managing Financial Resources: Principles and Recommendations for Agricultural Research Managers (1994).* Discussion Paper No. 94-13. The Hague, Netherlands: ISNAR.

Brush, E. G., D. Merrill-Sands, D. P. Gapasin, and V. L. Mabessa. 1995. *Women Scientists and Managers in Agricultural Research in the Philippines.* Research Report No. 7. The Hague, Netherlands: ISNAR.

Cernea, M. M., J. K. Coulter, and J. F. Russell, eds. 1983. "Strengthening Extension for Development: Current Issues and Prospects." In *Agricultural Extension by Training and Visit: The Asian Experience.* Washington, D.C.: World Bank.

Cleaver, K. M. 1993. *A Strategy to Develop Agriculture in Sub-Saharan Africa and a Focus for the World Bank.* Technical Paper No. 203, Africa Technical Department. Washington, D.C.: World Bank.

Collion, M.-H. 1989. "Strategic Planning for National Agricultural Research Systems: An Overview." Working Paper No. 26. The Hague, Netherlands: ISNAR.

———. 1991. *Collaborations with National Agricultural Research Systems in Planning: A Review of ISNAR Experiences.* Background Paper No. 5. The Hague, Netherlands: ISNAR.

———. 1995. *On Building a Partnership in Mali between Farmers and Researchers.* Network Paper No. 0952-2468; 54. London: Overseas Development Institute.

Craig, B. J., P. G. Pardey, and J. Roseboom. 1996. "International Productivity Patterns: Accounting for Input Quality, Infrastructure, and Research." Washington, D.C.: International Food Policy Research Institute and ISNAR.

Crittenden, R., and D. Lea. 1990. "Linking Research to Extension in the Southern Highlands of Papua New Guinea: The Problems of a Modified Farming Systems Approach." *Agricultural Systems* 34 (2):151-67.

Crosson, P., and J. R. Anderson. 1992. *Resources and Global Food Prospects: Supply and Demand for Cereals in 2030.* Technical Paper No. 184. Washington, D.C.: World Bank.

———. 1994. "Demand and Supply: Trends in Global Agriculture." *Food Policy* 19(2):105-119.

Crouch, B. 1984. *Problem Census: Farmer-Centered Problem Identification.* Training for Agriculture and Rural Development. Rome: FAO.

CSIRO (Commonwealth Scientific and Industrial Research Organisation). 1993. *Setting Priorities for Research Purposes and Research Projects: A Case Study Involving the CSIRO Division of Animal Health.* Canberra, Australia: CSIRO Corporate Planning Office.

Dagg, M. 1991. *Priority Setting at the Project Level (or Station, Experiment Level).* The Hague, Netherlands: ISNAR.

de Haan, C. 1993. "An Overview of Livestock Development Funding by the World Bank." In Blackburn, H., and C. de Haan, eds., *Livestock Development Projects: Past, Present, and Future.* USAID/IBRD Meeting Proceedings. Washington, D.C.: U.S. Agency for International Development.

de Janvry, A., G. Nores, J. R. Anderson, R. E. Evenson, and Z. Altaf. 1996. *Perspectives on Policy and Management Research in the CGIAR.* SDR/TAC: IAR/05/26.1. Washington, D.C.: CGIAR Secretariat.

Echeverría, R. G. 1990. "Assessing the Impact of Agricultural Research." In R. G. Echeverría, ed., *Methods for Diagnosing Research System Constraints and Assessing the Impact of Agricultural Research,* vol. 2, *Assessing the Impact of Agricultural Research.* The Hague, Netherlands: ISNAR.

Evenson, R. E. 1987. *The International Agricultural Research Centers: Their Impact on Spending for National Agricultural Research and Extension.* CGIAR Study Paper 22. Washington, D.C.: World Bank.

———. 1991. *Research and Extension in Agricultural Development.* Occasional Paper No. 25. Panama: International Center for Economic Growth .

———. 1996. "Two Blades of Grass: Research for U.S. Agriculture." In J. M. Antle and D. A. Sumner, eds., *The Economics of Agriculture,* vol. 2, *Papers in Honor of D. Gale Johnson.* Chicago: University of Chicago Press.

Evenson, R. E. and M. W. Rosegrant. 1995. *Total Factor Productivity and Sources of Long-Term Growth in Indian Agriculture.* Environment and Production Technology Division Discussion Paper No. 7. Washington, D.C.: International Food Policy Research Institute.

Fan, S., and P. G. Pardey. Forthcoming. "Research, Productivity, and Output Growth in Chinese Agriculture." *Journal of Development Economics.*

FAO (Food and Agriculture Organization of the United Nations). Various years, 1991. *Production Yearbook.* Rome.

FAO Investment Centre. 1991. *China: Development of Low-Lying Lands in Baicheng Prefecture (Jilin Province).* Socioeconomic and Farming Systems Study. FAO/IFAD Cooperative Programme. Report No. 1/91 IF-CPR 42. Rome.

———. 1992a. *China: Yunnan (Simao) Minority Areas Agricultural Development Project.* Socioeconomic and Production Systems Diagnostic Study. FAO/IFAD Cooperative Programme. Report No. 63/92 IFAD-CPR 47. Rome.

———. 1992b. *Myanmar: Border Hills Area Development Project Socioeconomic and Production System Study.* Identification Mission. FAO/IFAD Cooperative Programme. Report No. 41/92 IFAD-MYA 35. Rome.

———. 1992c. *Sociological Analysis in Agricultural Investment Project Design.* Technical Paper No. 9. Rome.

———. 1993. *Zambia: Southern Province Food Security Project.* Socioeconomic and Production Systems Study. FAO/IFAD Cooperative Programme. Report No. 137/93 IFAD-ZAM SEPSS. Rome.

Feder, G., L. J. Lau, and R. H. Slade. 1985. "The Impact of Agricultural Extension. A Case Study of the Training and Visit System in Haryana, India." Staff Working Paper No. 756. Washington, D.C.: World Bank.

Getaneh, G. K., P. Gooch, C. Hamilton, and L. Woolley. 1995. *Evaluation of the Impact of CAB International's CD-ROM Databases on Sustainable Development in Africa.* Wallingford, U.K.: CAB International.

Griliches, Z. 1958. "Research Costs and Social Returns: Hybrid Corn and Related Innovations." *Journal of Political Economy* 66(5):419-31.

———. 1964. "Research Expenditures, Education, and the Aggregate Production Function." *American Economic Review* 54(6):961-74.

Gryseels, G., and J. R. Anderson. 1991. "International Agricultural Research." In P. G. Pardey, J. Roseboom, and J. R. Anderson, eds., *Agricultural Research Policy: International Quantitative Perspectives.* Cambridge, U.K.: Cambridge University Press.

Hazell, P. B. R., and C. Ramasamy. 1991. *The Green Revolution Reconsidered: The Impact of the High-Yielding Rice Varieties in South India.* Baltimore, Maryland: Johns Hopkins University Press.

Horton, D., P. Ballantyne, W. Peterson, B. Uribe, D. Gapasin, and K. Sheridan. 1993. *Monitoring and Evaluating Agricultural Research: A Sourcebook.* The Hague, Netherlands: ISNAR.

IMF (International Monetary Fund). Various years. *Government Financial Statistics Yearbook.* Washington, D.C.

ISNAR (International Service for National Agricultural Research). 1993/94. *Statistical Briefs on the National Agricultural Research Systems—Africa.* ISNAR Indicator Series Project: Phase II. The Hague, Netherlands.

Jayne, T. S., Y. Khatri, C. Thirtle, and T. Reardon. 1994. "Determinants of Productivity Change Using a Profit Function: Smallholder Agriculture in Zimbabwe." *American Journal of Agricultural Economics* 76(3):613-18.

Johnston, B., T. Healy, J. l'Ons, and M. McGregor. 1992. *Rural Research–The Pay-Off: The Returns from Research Undertaken by the CSIRO Institute of Plant Production and Processing.* Occasional Paper No. 7. Canberra, Australia: CSIRO.

Klitgaard, R. 1995. *Institutional Adjustment and Adjusting to Institutions*. Discussion Paper No. 303. Washington, D.C.: World Bank.

Lipton, M., with R. Longhurst. 1989. *New Seeds and Poor People*. Baltimore, Maryland: Johns Hopkins University Press.

Lloyd, A. G., M. Harris, and D. E. Tribe. 1990. *Australian Agricultural Research: Some Policy Issues*. Melbourne, Australia: Crawford Fund for International Agricultural Research.

Lynam, J. K., and M. J. Blackie. 1994. "Building Effective Agricultural Research Capacity: The African Challenge." In J. R. Anderson, ed., *Agricultural Technology: Policy Issues for the International Community*. Wallingford, U.K.: CAB International.

Macklin, M. 1992. *Agricultural Extension in India*. Technical Paper No. 190. Washington, D.C.: World Bank.

Manning, R. C. 1995. "Action Planning, Adjustment, and Research System Reform." In Steven R. Tabor, ed., *Agricultural Research in an Era of Adjustment: Policies, Institutions, and Progress*. Washington, D.C.: Economic Development Institute of the World Bank and ISNAR.

Mata, J. I. 1992. "CTTA: A Method for the Transfer of Technology to Farmers: A Guide for Planning and Implementation." Washington, D.C.: U.S. Agency for International Development and the Academy for Educational Development Publication. (Also available in Spanish.)

Merrill-Sands, D., and P. Sachdeva. 1992. "Status of Internationally-Recruited Women in the International Agricultural Research Centers of the CGIAR: A Quantitative Perspective." CGIAR Gender Program Working Paper No. 1. Washington, D.C.: CGIAR Secretariat.

Morris, M., and D. Byerlee. 1993. "Narrowing the Wheat Gap in Sub-Saharan Africa: A Review of Consumption and Production Issues." *Economic Development and Cultural Change* 41(4):737-61.

Mundlak, Y. 1996. "On the Aggregate Agricultural Supply." In J. M. Antle and D. A. Sumner, eds., *The Economics of Agriculture*, vol. 2, *Papers in Honor of D. Gale Johnson*. Chicago: University of Chicago Press.

Murphy, J. 1995. "Monitoring and Evaluation in Agricultural Research: Concepts, Organization, and Methods." Informal report. The Hague, Netherlands: ISNAR.

Norton, G. W, V. G. Ganoza, and C. Pomerada. 1987. "Potential Benefits to Agricultural Research and Extension in Peru." *American Journal of Agricultural Economics* 69(2):247-57.

Pardey, P. G. 1989. "The Agricultural Knowledge Production Function: An Empirical Look." *Review of Economics and Statistics* 71(3):453-61.

Pardey, P. G., J. Roseboom, and J. R. Anderson, eds. 1991a. *Agricultural Research Policy: International Quantitative Perspectives*. Cambridge, U.K.: Cambridge University Press.

———. 1991b. "Regional Perspectives on National Agricultural Research." In *Agricultural Research Policy: International Quantitative Perspectives.* Cambridge, U.K.: Cambridge University Press.

———. 1991c. "Topical Perspectives on National Agricultural Research." In *Agricultural Research Policy: International Quantitative Perspectives.* Cambridge, U.K.: Cambridge University Press.

Pardey, P. G., R. K. Lindner, E. Abdurachman, S. Wood, S. Fan, W. M. Eveleens, B. Zhang, and J. M. Alston. 1992. *The Economic Returns to Indonesian Rice and Soybean Research.* ISNAR Report. The Hague, Netherlands: ISNAR.

Picciotto, R. 1995. *Putting Institutional Economics to Work: From Participation to Governance.* Discussion Paper No. 304. Washington, D.C.: World Bank.

Pray, D. E., and R. G. Echeverría. 1991. "Private Sector Agricultural Research in Less-Developed Countries." In P. G. Pardey, J. Roseboom, and J. R. Anderson, eds., *Agricultural Research Policy: International Quantitative Perspectives.* Cambridge, U.K.: Cambridge University Press.

Pritchard, A. J. 1990. *Lending by the World Bank for Agricultural Research: A Review of the Years 1981 through 1987.* Technical Paper No. 118. Washington, D.C.: World Bank.

———. 1994. "World Bank Investment in Agricultural Research Policy and Strategy: Past and Future." In J. R. Anderson, ed., *Agricultural Technology: Policy Issues for the International Community.* Wallingford, U.K.: CAB International.

Purcell, D. L. 1994. "The World Bank Experience with NARS-Building." In J. R. Anderson, ed., *Agricultural Technology: Policy Issues for the International Community.* Wallingford, U.K.: CAB International.

Rajasekaran, B., R. A. Martin, and D. M. Warren. 1993. "A Framework for Incorporating Indigenous Knowledge Systems into Agricultural Extension." *Indigenous Knowledge and Development Monitor* 1(3).

Roe, T. L., and P. G. Pardey. 1991. "Agricultural Research in a Policy Context." In P. G. Pardey, J. Roseboom, and J. R. Anderson, eds., *Agricultural Research Policy: International Quantitative Perspectives.* Cambridge, U.K.: Cambridge University Press.

Schwartz, L. A., J. A. Sterns, J. F. Oehmke, and R. D. Freed. 1989. "Impact Study of the Bean/Cowpea Collaborative Research Support Program (CRSP) for Senegal." Draft. East Lansing, Michigan: Michigan State University, Department of Agricultural Economics.

———., J. Kampen. 1992. *Agricultural Extension in East Africa.* World Bank Technical Paper No. 164. Washington, D.C.: World Bank.

Sims, H., and D. Leonard. 1990. "The Political Economy of the Development and Transfer of Agricultural Technologies." In David Kamowitz, ed., *Making the Link: Agricultural Research and Technology Transfer in Developing Countries.* Boulder, Colorado: Westview Press.

Sims Feldstein, H., and A. Slack. 1995. "Inventory of Gender-Related Research and Training in the International Agricultural Research Centers: 1990-1995."

CGIAR Gender Program Working Paper No. 8. Washington, D.C.: CGIAR Secretariat.

Spencer, D., P. Kleene, and J. Davies. 1995. "SPAAR. Lessons Learnt from Implementation of the Frameworks for Action (FFAs)." SPAAR Working Paper No. 15070. Washington, D.C.: SPAAR Secretariat.

Sperling, L., M. E. Loevinsohn, and B. Ntabomvura. 1993. "Rethinking Farmers' Role in Plant Breeding: Local Bean Experts and On-Station Selection in Rwanda." *Experimental Agriculture* 29:509-519.

Spurling, A., Y. Pee, G. Mkamanga, and C. Nkwanyana. 1992. *Agricultural Research in Southern Africa: A Framework for Action.* Discussion Paper No. 184, Africa Technical Department Series. Washington, D.C.: World Bank.

Thirtle, C., and P. Bottomley. 1989. "The Rate of Return to Public Sector Agricultural R&D in the U.K., 1965-80." *Applied Economics* 21(8):1063-86.

Thirtle, C., D. Hadley, and R. Townsend 1995. "Policy-Induced Innovation in Sub-Saharan African Agriculture: A Multilateral Malmquist Productivity Index Approach." *Development Policy Review* 13(4):323-48.

Thirtle, C., V. E. Ball, J.-C. Bureau, and R. Townsend. 1995. "Accounting for Productivity Differences in European Agriculture: Cointegration, Multilateral TFPs and R&D Spillovers." In G. H. Peters and D. D. Hedley, eds., *Agricultural Competitiveness, Market Forces, and Policy Choice.* Zimbabwe Conference Proceedings. Aldershot, England: International Association of Agricultural Economists.

Thirtle, C., J. Atkins, P. Bottomley, N. Gonese, J. Govereh, Y. and Khatri. 1993. "Agricultural Productivity in Zimbabwe, 1970-90." *Economic Journal* 103(417):474-80.

Tinker, P. B., and J. R. Anderson. 1996. *A Strategic Review of Natural Resources Management Research on Soil and Water.* SDR/TAC: IAR/96/9. Washington, D.C.: CGIAR Secretariat.

Tolley, G., V. Thomas, J. Nash, and J. Snyder. 1996. "What We Know about Agricultural Prices: Policies, Politics, and Supply." In J. M. Antle and D. A. Sumner, eds., *The Economics of Agriculture,* vol. 2, *Papers in Honor of D. Gale Johnson.* Chicago: University of Chicago Press.

Umali, D. L. 1992. *Public and Private Sector Roles in Agricultural Research: Theory and Experience.* Discussion Paper No. 176. Washington, D.C.: World Bank.

U.S. Department of Agriculture. 1993. *World Agricultural Trends and Indicators 1970-1991.* Economic Research Service Statistical Bulletin No. 861. Washington, D.C.: Government Printing Office.

Venezian, L. E. 1995. "El Financiamento de las Actividades de I&D en el Ambito de la Universidad." Paper presented at the workshop "Enfoques Innovativos para el Financiamiento de la Investigación Agropecuario en America Latina." Buenos Aires: Fundación Argentina.

Venkatesan, V., and L. Swartz. 1992. "Agricultural Services Initiative: Report Based on the World Bank Workshop Held in Lilongwe in February 1991." Working Paper No. 11310. Washington, D.C.: World Bank.

Vernon, R. 1995. *INFORM: An Information System for Agricultural Research Management.* Briefing Paper No. 21. The Hague, Netherlands: ISNAR.

Weijenberg, J., J. Doiné, M. Fuchs-Carsch, A. Kéré, and J. Lefort. 1993. *Revitalizing Agricultural Research in the Sahel: A Proposed Framework for Action.* Discussion Paper No. 211, Africa Technical Department Series. Washington, D.C.: World Bank.

Weijenberg, J., J. M. Dagg, J. Kampen, M. Kalunda, M. Mailu, S, Ketema, L. Navarro, and M. Abdi Noor. 1995. *Strengthening National Agricultural Research Systems in Eastern and Central Africa: A Framework for Action.* Technical Paper No. 290. Washington, D.C.: World Bank.

Wood, S., and U. Wood-Sichra. 1995. *Dream: A Program for the Ex Ante Assessment of the Likely Magnitude and Development of the Economic Benefits of Agricultural Research.* Version 1 (October). The Hague, Netherlands: ISNAR.

World Bank. 1981. "Agricultural Research Systems." Policy Paper No. 2966. Agricultural and Rural Development Department. Washington, D.C.

———. 1990. "Agricultural Extension: The Next Step." Policy and Research Series No. 13. Agriculture and Rural Development Department. Washington, D.C.

———. 1993. *Dynamics of Rural Development in Northeast Brazil: New Lessons from Old Projects.* Operations Evaluation Department. Washington, D.C.

———. 1995. *Performance Indicators in Bank-Financed Agricultural Projects: A First Edition Note.* Agriculture and Natural Resources Department. Washington, D.C.

———. 1996a. *Handbook on Economic Analysis of Investment Operations, A Living Document to Assist in Responding to OP/BP 10.04.* Operations Policy Department and Learning and Leadership Center. Washington, D.C.

———. 1996b. *Renewal of the CGIAR: The Final Milestone.* CGIAR Secretariat. Washington, D.C.

———. Various years. *World Development Report.* Washington, D.C.

Zijp, W. 1991. *From Extension to Agricultural Information: Issues and Recommendations from World Bank Experience in the Middle East and North Africa.* Technical Department Paper No. 1.2. Europe, Middle East and North Africa Region. Washington, D.C.: World Bank.

Supplement

Introductory note

Feedback of evaluation results within the World Bank

Each study by the Bank's independent Operations Evaluation Department is reviewed by the Bank's management before being discussed by a committee of the board of executive directors. Management provides a detailed response to the recommendations outlined in the study. This response is discussed by the committee and, together with a record of actions promised and taken, is recorded in a "policy ledger" accessible to all Bank staff. The Bank's executive directors have requested that all published studies by the Operations Evaluation Department include a synopsis of the management response and the committee's findings.

Management response: agricultural extension

We have read the OED report and consider it a comprehensive, useful piece of work, which is the result of sound analysis. The report contains important and useful lessons learned from completed projects that need to be taken into account in the implementation of ongoing projects and in the design of new projects. Many of these lessons have already been incorporated in various ongoing operations. The matrix indicates where we intend to make further improvements. Farmers need timely information and relevant technology, as much as they need land, labor, and capital. Public and private extension are important sources of that information. For some—particularly the poorer farmers—public extension is among the few sources of information, in addition to local, informal networks.

The specific extent of extension investment in a country depends on local needs and circumstances, as well as on economic justification. Extension makes important contributions to poverty reduction, increased participation by the poor, improved natural resource management, improved governance, and enhancement of the role of women. Therefore, we agree with the evaluation's conclusion that continued Bank support for extension is justified. Whether this is done in free-standing extension projects or as components of wider agricultural development projects will depend on local circumstances.

Our approach to extension has evolved from viewing extension as a separate activity to considering it as a component within the whole system of technology generation, transfer, and utilization. Such a wider perspective allows for a more results-oriented focus, particularly in terms of farmer income and welfare. This perspective shows, for instance, that some research is being carried out by farmers and some extension by researchers. Synergies between the elements of the agricultural technology and information system are considerable, but can only be realized by approaching the elements in a comprehensive, systemic manner. As a consequence, we no longer view extension within the confines of transfer of technology. We feel that extension can be seen in a wider context, including farmer education as opposed to farmer instruction and farmer organization. Seen in such a wider context, extension can play an important role in organizing and educating farmers.

The OED report states that "many of the organizational principles included in the training and visit model are internalized in the majority of 'good' extension services and are unquestionably sound." Further, it also states that "unfortunately, many of these principles were not adequately developed in projects." The latter statement could be true, but in the case of the Africa region, where the vigorous pursuit of the T&V extension approach is more recent, OED findings are based on the review of the limited set of completed projects (5 free-standing extension operations and 11 agricultural projects that include extension components). In that region, the extension programs are evolving and should be viewed within a long-term perspective. The new generation of extension projects in the Africa region that were not reviewed

by the OED report incorporate many of the principles outlined in the report. In particular there has been an increased emphasis on research and extension linkages, farmers' participation, staff training, decentralized organization and management, programming of activities, technology emphasis, monitoring and evaluation, development of performance indicators, gender issues, and sustainability. Increasingly, interventions at the country level in the region focus on national extension programs, but these are tailored to take into account local circumstances, farmers' needs, and local capacity and resources. These programs are one element in overall national strategies for agricultural development.

Generally, we accept the thrust of the OED report's recommendations and, as indicated, many are already part of the best practices being disseminated among staff. The enclosed matrix describes our response to the recommendations in some detail, and outlines specific activities planned to further strengthen the design and implementation of extension activities through Bank lending. In preparing this matrix, we refer to OED's recommendations.

AGRICULTURAL EXTENSION: LESSONS FROM COMPLETED PROJECTS
LEDGER OF OED RECOMMENDATIONS
MANAGEMENT RESPONSES AND ACTIONS

OED recommendations	*Management response*	*Actions promised*	*Actions taken*
1. Public sector extension projects should be designed to fit particular fiscal, institutional, human resource and farming system constraints, and take into account the availability and prospects of appropriate and sustainable technologies. The objective should be to develop a service that is cost-effective in addressing priority agricultural development objectives. This will require more resources than have been traditionally expended in designing such projects and relating them more specifically to particular environments. Specifically: (a) In the context of extension strategy and investment program formulation, analysis of existing circumstances should be undertaken in the areas of production conditions and farming systems; stock of technology; government commitment; and existing and anticipated fiscal and human resources. (b) In light of the above considerations, preparation of the extension strategy would involve identifying types of farming systems/rural groups; potential for technology to meet the needs of particular clientele; relating extension assistance to the priority objectives, infrastructure, complementary services, human resources and fiscal capacity; defining the appropriate role of the private sector and nongovernmental organizations; assessing the role of responsive mass media; defining the extent to which farmers should pay for technical services, and defining the role of specific types	We agree with the need to do more preproject analysis that would focus specifically on constraints, solutions, and opportunities. The Agricultural Strategy Paper, approved by the Board in 1993, identifies the same need. Many of OED's recommendations are already part of our best practices, as indicated below: • Technological itinerary studies (Mozambique, Benin, Kenya, Ghana, and Nigeria, and—as part of the preparation of the second phase project—in Zaire, Chad, and Côte d'Ivoire, for instance). These studies covered agro-ecological, technical, and economic constraints and potential. • Before embarking upon large-scale investment in extension, a number of pilot projects—rather than formal studies—have been carried out to guide the design of national projects (Zaire, Madagascar, Côte d'Ivoire, Niger, Guinea); • To increase understanding of the role of extension in a market economy and to create ownership of extension and research mandates and priorities, a comprehensive policy and concurrent investment plan for the generation, transfer and utilization of agricultural technology is being prepared and coordinated by a working group, representing farmers, and the public and private sectors (Romania). • Distribution of extension responsibilities among farmers and the public and private sectors, on the basis of participa-	An assessment in each staff appraisal report on the availability and relevance of technology and information to different categories of farmers. Such a diagnostic discussion would incorporate inputs from farmers, research, education, and extension staff, and from the private sector. Public sector investment in extension, based on this assessment, will be appraised in view of existing and anticipated fiscal and human resources. The findings of the initial assessment will be updated regularly in a continuous dialogue between farmers, extension, research, and education, as farming and technology develop, to ensure extension's responsiveness to the needs of different categories of farmers. • Project preparation will include—on the basis of participatory diagnoses of constraints, resources and opportunities for different categories of farmers—an articulation of training needs for extension staff to better respond to farmers' problems and opportunities. This needs assessment will address not only the technological aspects of staff training, but also participatory approaches, practical skills, economic understanding and communication skills, for instance. • Dissemination of best practices in preproject analysis. • Preparation of a best practice note for staff on private and public sector roles in	Action has been taken in the following areas: a participatory assessment note has been published; a summary of participatory extension has been included in the World Bank Sourcebook on Participation; performance indictors have been finalized for extension (but this will likely need follow-up with staff to ensure their implementation); study tours in extension have been organized to France and the Netherlands; and staff training is ongoing. Action reported to be underway by AGR includes an analysis of quality of entry of new projects, taking into account the recommendations in Annex 4 in the extension study; and a technical paper on extension funding.

OED recommendations	*Management response*	*Actions promised*	*Actions taken*
of face-to-public services. (c) Within the strategy, extension investment programs/projects would be identified in accordance with available resources. (d) A needs-based training program should be designed to develop practical technical skills, economic orientation, sociological awareness, communication skills and an appreciation of the premium on relevant advice in a responsive service.	tory interaction (Morocco). • Participatory project preparation, including beneficiaries, borrower staff and Bank staff (Egypt). • Farm diagnostic and project preparatory work by local stakeholders (Iran). • Publication of a technical note, "Designing and Implementing Agricultural Extension for women farmers" (1993, in collaboration with PHR). • Needs-based training programs, based on skill-gap analyses (Turkey, Jordan) that provide four outputs: (1) agreement on the duties, and so forth, for all levels of staff; (2) a master plan for in-service training of current staff, where desired and actual levels show a difference; (3) a transparent plan for hiring staff and for separation of redundant staff; and (4) a transparent system of incentives for extension staff. Further dissemination of best practices, and their incorporation in Bank extension activities are discussed in the "Actions Promised" column.	extension (FY95), based on an already completed comprehensive study on privatization of extension services (Discussion Paper 236) and a Bank-sponsored conference on privatization of agricultural services (May 1993). • Preparation of a best practice note to staff on participatory extension, including mechanisms, examples and recommendations (FY95). • Circulation of a best practice document on "Improving the transfer and use of agricultural information, a guide to information technologies" (by June 1994).	Tasks still to be undertaken include: a best practice note on public and private sector roles in extension; dissemination of best practices in preproject analysis; a note on different extension systems; and recruitment of extension practitioners with experience in a variety of extension systems (an analysis of the impact of the recent/current staff reductions on this factor would also appear worthwhile).
2. The Bank should place much greater emphasis during implementation on assessing the effectiveness of the extension process in meeting the program objectives in the targeted farming systems—accelerating the rate of adoption of relevant technology in a cost-effective manner. (a) The Bank should encourage and assist in the development of monitoring systems in the	• Management agrees that the Bank should put more emphasis on the assessment of extension effectiveness. Extension monitoring should be enhanced and oriented to focus on its effects, in addition to its efforts. However, it should be recognized that many factors affect farmers' performance. Monitoring extension is easier, where a sound pre-project analysis has been carried out as a basis	• Organization of training sessions for staff in the use of performance indicators, and the adjustment of those indicators, using staff feedback. AGR has prepared three sets of practical, simple performance indicators for extension. These three sets—(1) farmers' opinions on extension; (2) extension's promotion and reaction to change, including farmers' rationale for adoption and non-	

OED recommendations	*Management response*	*Actions promised*	*Actions taken*
public extension service that use periodic sample surveys to (i) measure the change in adoption of promoted practices; (ii) understand the reasons for any significant non-adoption in particular farming systems or classes of clientele; and (iii) obtain farmer perceptions of the usefulness of the services being provided by public extension and by other public or private institutions relating to the farming enterprise. These surveys should be complemented by collation of other primary and secondary data that provide (i) indications of how the program is being implemented; (ii) input and output indicators of changes in use of technology and in production to which the extension program has likely contributed; (iii) analysis of factors involved in effectiveness (funding, linkages, training); and (iv) sustainability indicators (progressive annual budgets and expenditures, staffing, involvement of the private sector). (b) In supervising extension projects, Bank staff should pay particular attention to the implementation of the monitoring system, to the quick analysis of monitoring data, and to the responsiveness of management to this information and analysis. This will assist both program management and the Bank's ability to undertake its supervision function. (c) Bank supervision missions should have staff capable of interacting with farmers and understanding the reasons for adoption or non-adoption of particular technologies. Field visits should be made to have first-hand exposure to farmer reactions in the different types	for formulating objectives, in terms of expected changes in farmers' activities. • We agree with the need to have staff capable of effectively interacting with farmers. The Wapenhans report clearly indicated the need for staff capable of fruitful dialogue with the borrower and beneficiaries. • We agree with the need to expand the midterm review to include examination of design issues so as to provide for remedial action to more effectively address the needs and changing opportunities of different categories of farmers.	adoption; and (3) the sustainability of extension—would be monitored by the extension department, by independent subcontractors, by the Ministry of Finance and by Bank supervision missions. These indicators will be annexed to each form 590. • Preparation of a brochure on"how to use extension performance indicators." • Recruitment of extension practitioners who are experienced with a variety of extension approaches. • Inclusion—in relevant project midterm reviews—of a formal update, and assessment and adjustment of the preproject analysis, in addition to the regular dialogue mentioned above.	

OED recommendations	*Management response*	*Actions promised*	*Actions taken*
of targeted farming systems. (d) Midterm Reviews should be used not only to examine project implementation and its effectiveness but also to closely analyze design issues. Depending on the quality of the monitoring system, it may be necessary to undertake rapid rural surveys.			
3. In view of the emphasis that the Bank has given in the last 15 years to the T&V extension management system, and the findings of this study, which indicate important roles for approaches other than those traditionally associated with the T&V system (and the potential for improvement in the typical T&V services), it would be appropriate for the Bank to organize training/information transfer for staff across regions through seminars, case study reviews, and so on to enhance staff capability in designing, appraising, and supervising extension projects. Items for particular attention could include (a) practical methods to undertake the pre-project situation analysis and strategy/program formulation at acceptable costs, with full borrower participation to ensure program ownership and to develop a capability for responsive management of the extension system; and (b) techniques by which public sector extension can overcome the common "top-down" attitude in formulation of technical recommendations and demonstrate responsiveness to the needs of farmer clientele in both mass media and face-to-face services.	• We concur that there is a need to organize training and information transfer to Bank staff. We also recognize the need to learn from and transfer technology to extension managers in borrowing countries and consultants in Bank-supported extension projects. Such activities have been ongoing as part of our extension effort. In addition, AGR carried out a needs assessment survey in 1993 among extension staff, and now delivers on the identified needs, including papers on privatization of extension, communication technology for agricultural development, participatory rural assessment, and short, topical newsletters. • As stated above, we agree with the need for practical methods for pre-project analysis and techniques for enhancing responsiveness.	• Disseminate best practice papers, networking, and staff training (see above). • Organize study tours to countries with various successful extension services, in both industrialized and developing nations. • Prepare a short note for task managers on different extension systems (FY95). • Continue and further expand the current electronic network on extension, coordinated by AGR. • Continue staff seminars on technology generation, transfer, and utilization, with particular attention to the potential for information technology for rural development.	

Summary of Joint Audit Committee findings: agricultural extension

The Joint Audit Committee (now Committee on Development Effectiveness), in its discussion of the OED study, welcomed the progress toward mutual understanding between OED and management on the issue of extension and research projects. It also noted OED's identification of some areas that required more attention, particularly regarding the implementation of extension projects in the Africa region. The committee endorsed a suggestion that the Bank adopt a more flexible, case-by-case approach to extension. The committee said that the evolution of extension projects in Africa was an area that needed intensive follow-up by OED. In addition, for its part, the region should mention the implementation of lessons learned whenever extension projects are presented for approval, so that the Board can make a more informed decision.

Management response: agricultural research

We have read the OED report and provided significant comments on a number of occasions during its development. We consider it a comprehensive, useful piece of work, which is the result of sound analysis. The report contains important lessons learned from completed projects that need to be taken into account in the implementation of ongoing projects and in the design of new projects. The OED report was completed during the development of the Action Plan for Agricultural and Rural Development, and most of the lessons in the report have already been extensively discussed among task managers and incorporated into ongoing operations. The matrix indicates where we intend to make further improvements.

The specific extent of research investment in a country depends on local needs and circumstances, as well as on economic justification. Investment in agricultural research is central to efforts to promote agricultural and economic growth, as well as contribute to poverty reduction, increased participation by the poor, and improved natural resource management. Therefore, we agree with the evaluation's conclusion that continued Bank support for research is a high priority in future Bank operations. Whether this is done in free-standing research projects or components of wider agricultural development projects will depend on local circumstances.

While we are in substantial agreement with the report, we do not completely concur with all of the recommendations. Agricultural research, like any scientific endeavour, is an inherently uncertain process, often with unexpected outcomes. Therefore, ex ante economic analysis of agricultural research programs and projects, as strongly urged by the report, must be approached with caution. While we know from numerous ex post studies that investment in agricultural research provides high payoffs over the long term, it is very difficult to anticipate a priori those payoffs for designing specific research programs and projects. Therefore, rather than investing substantial resources in ex ante economic analysis of research programs and projects, we feel there are more urgent tasks in hand—to build capacity in agricultural research management and provide a productive environment for agricultural scientists.

The Bank's approach to agricultural research has been evolving rapidly in recent years. Our future agenda will include not only the specific issues addressed in the OED recommendations but a number of new initiatives that are already well underway and that go well beyond support to public sector research institutes emphasized in the OED report. These include a greater focus on institutional pluralism in research execution, by ensuring that universities, the private sector, and nongovernmental organizations are considered an integral part of the national agricultural research systems. Such pluralism combined with the serious budget situation in many public research systems also implies greater rigor in defining the types of research that are clearly public goods (and therefore appropriate for public sector financing), as well as attention to tapping new and more diverse funding sources for other

types of research, including various combinations of joint ventures, cost recovery, farmer contributions, and private enterprise. As part of this effort, nearly all Bank research projects now include competitive funding mechanisms that allow broad participation in the execution of research. Beyond these essential institutional issues, Bank research projects are also emphasizing access by developing country research systems to global scientific advances through strengthening in some of the basic sciences, as well as by improved communication and exchange with scientists in international research centers and advanced research institutes.

ACHIEVEMENTS AND PROBLEMS IN THE DEVELOPMENT OF NATIONAL AGRICULTURAL RESEARCH SYSTEMS
LEDGER OF OED RECOMMENDATIONS
MANAGEMENT RESPONSES AND ACTIONS

OED recommendations	*Management response*	*Actions promised*
1. *Bank country assistance strategies and programs should explicitly address the role of the agricultural sector and, as appropriate, agricultural research.* In most borrowing countries, agricultural growth can make a major contribution to economic development and poverty reduction. An effective agricultural research system is a critical element in enhancing agricultural production and productivity. This fact has not been adequately recognized in the Bank's dialogue with borrowers and in the formulation of country assistance strategies (CASs).	As part of the Bank's Action Plan for agricultural and rural development, the Bank is committed to ensuring that agriculture and rural development are explicitly considered in the CAS. In FY97, as part of implementing the Action Plan, AGR (the Bank's Agriculture and Natural Resources Department) is closely interacting with the regions in the preparation of the CAS's for six pilot countries in order to strengthen the methodology and analytical underpinnings for CAS preparation. Management agrees that in most countries, agricultural research is a key element of support to the agricultural and rural development sector and should be explicitly addressed in the CAS.	Where agricultural growth is deemed a priority, the regions, in cooperation with AGR, will enlarge the scope of their contribution to the CAS to address the role of technical change in accelerating agricultural growth, the constraints on the national agricultural system (including the private sector) in promoting technical change, and needed changes in agricultural research policy to overcome these constraints. The role of agricultural research in productivity growth, maintenance of productivity gains, and conservation of the natural resource base, will be central to all agricultural and rural sector work.
2. *The Bank should continue its strong support for international and regional research and the development of national agricultural research systems (NARSs). Comprehensive assistance to a NARS, however, should only be provided when there is a clear commitment from the borrower to adequately fund the system and to adopt sound research management principles.* The high returns to publicly financed agricultural research warrant continuing substantial support by the Bank for international and regional research initiatives and for development of NARSs. Agricultural research represents a long-term undertaking requiring sustained and adequate recurrent funding. Unless there is a firm commitment by a borrower to fully support the research system, investment by the Bank to improve the productivity and efficiency of a national research system is not a good use of Bank resources. The Bank should lend only when commitments to adopt policies and procedures that enable cost-effective and relevant research are provided by the borrower. To justify	Management agrees that adoption of sound research management principles to enhance research efficiency is a priority. In recent years, emphasis has switched from expansion of the physical infrastructure and size of the research system to enhancing the efficient utilization of the physical and human resources already available. It also agrees that commitment to adequately fund the system is critical. Projects in the pipeline are emphasizing cost recovery mechanisms as well as downsizing to provide operating funds for a smaller number of scientists in the public sector research institutes. In addition, current research projects seek to diversify funding support and emphasize the role of nongovernmental organizations and the private sector in funding and execution of some types of research. However, the ability to adequately fund research is a relative concept and Bank support must be based on country-specific situations and needs. In most countries, there is no alternative but to assign the highest priority to public support to research for the medium to long term.	Future agricultural research projects will address financial sustainability to ensure that (a) the share of government budgets allocated to agricultural research demonstrates financial commitment; (b) feasible avenues of cost recovery have been implemented; and (c) national support to agricultural research increases in real terms over the period of the project. Future research projects will continue to emphasize borrower commitments to measures to improve the efficiency of the research system. During the upcoming portfolio review of agricultural research and extension projects, AGR will assess the extent that lack of commitment to funding of agricultural research and implementing appropriate policy reforms are affecting performance of research projects.

OED recommendations	*Management response*	*Actions promised*
comprehensive support by the Bank for a NARS, this commitment should be substantiated by documentation from the borrower showing a willingness to adopt (a) key research-system efficiency measures; (b) all feasible measures to reduce the budgetary cost of research without sacrificing its quality (rationalization before expansion, introduction of cost recovery from end-users of research wherever feasible, regional research cooperation to avoid duplicative wastage of resources, and encouragement of private-sector research); and (c) a willingness to allocate a sufficient recurrent budget to enable the research system to operate effectively.		
3. *Targeted research program assistance by the Bank (in the absence of generally favorable sectoral or research policies) should be highly selective and address a clearly defined research problem or gap. It should normally be combined with nonlending services designed to strengthen borrower commitment to research policy reform.* Where conditions are unsuitable for comprehensive support for a NARS, there will be circumstances where support is justified for selected programs as an interim measure while more favorable overall sectoral and research policies are pursued. These interventions may pertain to key programs such as plant breeding on staple crops, where interruptions would be very costly, or research programs targeted at solving specific technological constraints in commodities or systems that have substantial potential benefits (e.g., an important export crop or for an identified problem affecting large numbers of smallholder farmers).	Management agrees that comprehenisve support to agricultural research should only be made in an environment of appropriate sectoral and research policies. In the absence of such policies, management strongly supports targeted lending to ensure that (a) technologies are available to underpin growth strategies when and if the policy regime becomes more favorable; and (b) critical research programs that require long-term continuity and that may provide payoffs even in the absence of appropriate sectoral policies, are maintained.	The appropriateness of the sectoral and research policy environment for support to agricultural research will be addressed in the CAS and in agricultural sector work. The Bank will continue to emphasize the implementation of appropriate research policies as conditions for Bank assistance in this sector. These will include policies that promote efficient management of public sector research institutes, emphasis on promoting broader participation in the national research system, and institutional mechanisms to diversify funding support to research.

OED recommendations	*Management response*	*Actions promised*
4. *The Bank, through its lending and nonlending work, should foster the development of external linkages by NARSs and build strategic alliances with appropriate development partners to enhance the effectiveness of national and international research programs.* Individual NARSs should not be considered isolated entities. They are part of a global agricultural research system, as yet imperfectly linked. The ESDAR (Agricultural Research and Extension Group) mission represents a step toward more effective linkages. The Bank should advance this objective on two fronts: (a) by using its projects to facilitate strategic partnerships among the NARSs, the international research centers, other leading research institutions, and entities that can provide relevant support to the programs and institutional development of the NARSs; and (b) by forming strategic alliances and partnerships with components of the international research and research-support community to deliver coordinated and efficient external support to NARSs.	Most projects in the pipeline already foster external linkages of NARSs, especially the international research centers under the Consultative Group for International Agricultural Research (CGIAR). ESDAR is actively seeking ways to promote increasing linkages between NARSs, IARCs, and developed country research institutions. It is also seeking to improve coordination in donor support to agricultural research. In addition, the Special Program for African Agricultural Research (SPAAR) is coordinating donor efforts in Africa and is fostering regional research associations.	Future projects will continue to emphasize linkages with and through regional agricultural research associations, IARCs, and advanced research institutions. The Bank will proactively promote support by other donors to research programs.
5. *Economic analysis (normally using an economic surplus model or a simplified derivative) should be fostered in borrowers' processes for prioritizing research. By the same logic, economic analysis should be used by the Bank in ex ante and ex post evaluation of supported research programs.* Substantial economic benefits can be expected from well-conceived investment in agricultural research in the aggregate. However, every effort must be made to effect efficient use of scarce fiscal resources. This implies that programs, subprograms, and projects within the NARSs must be prioritized. There is no substitute for economic analysis to inform this process. As part of a process	Management agrees only partially with this recommendation. While conceptually appealing, there are several practical difficulties in implementing the recommendation on ex ante analysis of research programs and projects. First, it is difficult to quantify the outputs of research ex ante, given the inherently uncertain nature of the research process. Second, some types of research outputs are difficult to value (e.g., research in natural resource management). Third, there are more urgent needs for increasing research effectiveness, such as improving the quality of science and enhancing the relevance of the research program to its clients. More rigorous ex ante	The Bank will: apply and evaluate the use of exante economic analyses methodologies (at the research program level only) in several upcoming projects in order to assess the contribution of economic analysis to improved research efficiency arrange for training for task managers in economic analysis and its limitations for research programs/projects; include in future projects, the development of institutional capacity in NARSs to undertake exante analysis of the research portfolio, including research activities to be supported by the Bank.

OED recommendations	*Management response*	*Actions promised*
of building this capability in NARSs, *ex ante economic assessment of programs within a borrower's research agenda should be completed* during the project preparation/appraisal process. To be consistent with ownership and capacity-building objectives, the scale and comprehensiveness of ex ante analysis will depend upon the availability of economic expertise within a NARS. Ex ante analysis should also provide a basis for *ex post economic evaluation* of research programs, which has been lacking to date and has impeded the Bank's efforts to assess the impact of its support for agricultural research.	economic analysis should not be at the expense of these other activities. Finally, economic expertise is weak in nearly all NARSs and their expertise is especially important in other activities such as assessment and evaluation of technologies at the farm level. AGR, together with ESDAR, is developing a training program for Bank staff in agricultural research as part of the Core Training Program, which is an integral part of the Action Plan for the Agricultural and Rural Sectors. This training will include a component on the use and limitations of ex ante economic analysis in priority setting at the program and project level. Management encourages ex post economic evaluation of research but recognizes the long time lag required to provide useful feedback from these studies.	
6. *A core of Bank staff with specialized skills in agricultural research systems should be used to enhance the effectiveness of Bank assistance in NARS development. Particular research projects and programs within NARSs should be identified/developed to serve as functional models of good practice under different resource circumstances.* Bank staff dealing with agricultural research projects do not always have expertise in research organization or implementation. The Bank should create (through identification and/or change in its staff skill mix) a core of staff specialized in agricultural research systems. In addition to regular operational duties, such staff would (a) maintain *linkages* with the international agricultural research community and facilitate the *alliances* referred to above; (b) inform and *train* less-specialized staff with task manager responsibility for research projects; and (c) directly *assist task*	The Bank already has considerable staff with specialized skills in developing agricultural research systems. However, these are distributed in AGR, ESDAR, and the regions, with limited interaction among them. An exception is in the Africa region, where regular meetings with staff and representatives from ESDAR and AGR are organized by the SPAAR Secretariat. Currently AGR and ESDAR play a key role in best practice, training, and cross-support in research and extension, and four staff are allocated part time to agricultural research issues. These staff maintain good contact with the international agricultural research community. Complementing this, some staff from bilateral agencies and universities are seconded to ESDAR to cross-fertilize and strengthen the Bank's technical resources.	Given its fundamental role in supporting agricultural intensification for achieving world food security needs, the Bank will give continued and strong support for agricultural research as a central element of the Action Plan for the agricultural and rural sectors. AGR and ESDAR will help foster an association of staff in the Bank with like interests in agricultural research, through regular seminars, meetings, and so forth. AGR and ESDAR will organize regular training courses in agricultural research. AGR will carry out a portfolio review of ongoing research and extension projects; in this process, to be completed by January 1997, functional models of good practice will be identified.

OED recommendations	*Management response*	*Actions promised*
managers, especially in the design and implementation of projects in selected NARSs that can serve as functional models of sound research organization principles. Substantial training would be needed in the use of economic surplus models for research prioritization and ex ante program assessment.		
7. *The Bank should treat the efficient dissemination of research findings as an integral part of the technology development process.* Research that is not applied is not effective. Thus, an effective technology transfer system (public, private, or a combination of both) is needed to increase the rate of adoption of new or modified technology and so reduce the adoption lag normally associated with research investment.	Management agrees, except for some types of basic research. Most projects now are joint research-extension projects or include a technology transfer component.	Future projects will continue to emphasize technology transfer as an integral part of agricultural research project implementation. Under the Action Plan for the agriculture and rural sectors, in-country Bank support to research and extension will be strengthened, including greater use of local expertise to enhance strategy and program formulation, as well as to strengthen project implementation.
8. *Bank-supported research projects should foster procedures in NARS that enhance the relevance of research.* Relevance of technology is a primary consideration within a sound research process. The use of ex ante economic assessment is conducive to this approach, but procedures that include farming system diagnosis, technology adoption surveys, and active stakeholder involvement in research design and evaluation also need strong encouragement.	Most projects now have some or all of these components in their design. However, lack of social science capacity in NARS (economists and other social scientists) hampers the wider use of these methods. The most effective mechanism over the longer-term will come through active stakeholder (i.e., farmer) participation in the setting of the research agenda and in resource allocation.	Future projects will give more emphasis to strengthening social science capacity in agricultural research systems, and to processes and institutional mechanisms for involving stakeholders (farmers) in developing research priorities and assessing technologies.
9. *Monitoring and evaluation to facilitate planning and to underpin ex post research evaluation should become a mandatory element of Bank-supported research projects.* Monitoring and evaluation procedures are necessary—not only to provide information for financial and program planning, but also for assessing the adoption of developed technology by the intended clientele (and for understanding the reasons for any non-adoption).	Most projects now have some monitoring and evaluation system, including technology adoption assessment, in their design. Management agrees that more needs to be done, but lack of social science capacity in NARSs inhibits the wider use of these methods. Suggested performance indicators for agricultural research projects have been prepared and widely distributed in the Bank.	Future projects will give more emphasis to strengthening social science capacity in agricultural research systems, including in monitoring and evaluation. AGR will work with others to ensure that performance indicators are included in project design.

OED recommendations	*Management response*	*Actions promised*
10. *The Bank should require research projects to include all feasible steps to raise the scientific rigor of borrowers' research systems.* More emphasis is needed on improving the scientific rigor and quality of research, through needs-based training programs, technical assistance, external reviews of research programs, enhancement of the internal peer review process, competitive grant funding of research subprojects, effective internal and external scientific networking, and linkages and alliances with research entities of excellence that can contribute to NARS development in long-term guidance and training (as mentioned above under *Policies*).	Recent projects have included at least some of these elements. Management agrees that more emphasis should be given to scientific rigor, especially by encouraging the wider use of the external and internal review process in agricultural research programs, collaborative research with external research programs, and upgrading of human resources.	Scientific rigor will receive more emphasis in future projects, by including internal and external review process in project design, ensuring that the required technical expertise is included in supervision missions, and fostering technical associations among Bank staff, strengthening of in-country Bank expertise.
11. *In view of the above recommended changes in strategy, policy, and project design intended to improve the performance of the Bank's agricultural research portfolio, a restatement of its agricultural research policy in the form of a strategic issues paper is warranted.*	AGR and ESDAR are preparing such a strategic issues paper.	The strategic issues paper, together with a best practice note on research management practices, will be completed by December 31, 1996.

Summary of Committee on Development Effectiveness findings: agricultural research

The Committee on Development Effectiveness, in its comments on the study, noted that because the Bank is the largest single source of external financing to agricultural research in developing countries, it has a key role to play—both in enhancing the prospects for sustainability of NARS investments and in ensuring that effective and sustainable arrangements are in place to introduce appropriate technologies to targeted farming communities. The committee stressed that the importance of the agricultural sector and the technological advancement for improved agricultural productivity should be integral elements in the Bank's dialogue with borrowers. The committee cautioned against providing high levels of funding without first carefully analyzing the government's fiscal support for agriculture and agricultural research. Borrower commitment to adequately fund research systems and to adopt sound research management principles must be ensured. The committee emphasized the need for more relevant research that addresses the needs of smallholder farmers. The Bank should continue to insist on research being client driven and responsive to defined client needs, and it should take more initiative in promoting the formal involvement of beneficiaries in the design and evaluation of research projects. While acknowledging management's view that it is difficult to quantify the outputs of research beforehand, it generally agreed with OED's recommendation of using ex ante economic analysis for strategic planning and prioritizing of research for efficient use of scarce resources. The committee stressed the importance of monitoring and evaluation procedures that provide information not only for financial and program planning, but also for assessing the adoption of developed technology by the intended clientele (and for understanding the reasons for non-adoption). It suggested that such procedures should become a mandatory element of Bank-supported research projects.

The World Bank

1818 H Street, N.W.
Washington, D.C. 20433, U.S.A.
Telephone: (202) 477-1234
Facsimile: (202) 477-6391
Telex: MCI 64145 WORLDBANK
MCI 248423 WORLDBANK
Cable Address: INTBAFRAD
WASHINGTONDC
World Wide Web: http://www.worldbank.org/
E-mail: books@worldbank.org

ISBN 0-8213-3878-1

Cover design by Joyce C. Petruzzelli