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Transforming Agricultural Research Systems in Transition Economies

The Case of Russia

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Robert W. Jolly
Jitendra P. Srivastava

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FOREWORD

Agriculture is an important sector in Russia and other transition economies of Eastern Europe and the former Soviet Union. A well functioning agricultural research, education, training, and technology transfer — the components of the national agricultural knowledge system — are necessary in creating a competitive and efficient agricultural sector. Agricultural research is essential for reducing production costs, improving product quality, creating unique product characteristics, reducing environmental damage, adding value to primary commodities, and developing utilization technologies that add value or enhance demand for agricultural products.

Economic analysis shows high rates of return to investment in agricultural research around the world. Thus, investment in agricultural research should be viewed as a key component of a rural development strategy designed to accelerate growth, alleviate poverty, and increase the competitiveness of agriculture. However, to achieve these goals, Russia and other transition economies must transform their agricultural knowledge system to make it financially sustainable, effective in producing high-quality research with a positive impact on the agricultural sector, and appropriate for producing scientists with the skills needed to serve the emerging private agriculture in a market economy.

This report stems from a strong belief that the long-term productivity, profitability, and sustainability of Russian agriculture will depend on the ability and capacity of the Russian agricultural research system to respond to emerging problems and opportunities. The ability to sustain gains from economic reforms will depend on Russia's capacity to solve agricultural problems in ways that are appropriate for private agriculture. However, unless the agricultural research system is transformed, its stores of knowledge, germplasm, data, and know-how will continue to deteriorate.

Russia's agricultural research system is important not only to Russia but also to the world community because of its implications for food security. Thus the international scientific and donor community should provide carefully targeted assistance to Russia in order to facilitate the transformation of its agricultural research system, stabilize and protect targeted agricultural research assets, and develop and refine models of institutional change and human capital development that are appropriate for Russia. The strategy proposed here, also relevant for other transition economies, will make a positive contribution by improving the efficiency, effectiveness, and sustainability of agricultural research.

This report served as a basis for the World Bank workshop on Reforming Agricultural Research Systems in Central Asia and the Caucasus, March 5-11, 1998. The workshop provided an opportunity for participants from several transition economies to discuss the conclusions and recommendations of this report and to provide useful comments. I hope that this case study on Russia will contribute to the formulation of national strategies to transform the agricultural knowledge system to serve the emerging private agriculture in Russia and other transition economies.

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ABSTRACT

This report examines the current state of Russian agriculture and agricultural research system. It develops a conceptual framework for managing the transformation and rehabilitation of agricultural research systems in transition economies, with a particular focus on Russia. This model is used to specify an agenda for capacity development and institutional reform that would stabilize and preserve critical agricultural research assets in Russia and begin the difficult process of increasing the efficiency, effectiveness, and sustainability of its agricultural research system. The report is intended for agricultural scientists, research administrators, public officials, and agricultural leaders interested in the transformation of agricultural research systems in the transition economies.

ACKNOWLEDGMENTS

This report, although it reflects our own experience and judgment, has benefited from discussions with our colleagues in Russia, the World Bank, and Iowa State University. We gratefully acknowledge the openness and candor of friends and colleagues in Russia's agricultural research and education community, both in Moscow and in the regions.

In particular, the authors would like to thank Gary Alex, Jock Anderson, Derek Byerlee, Doug Forno, Alexander McCalla, Michael Petit, and T. V. Sampath for sharing their experience, and for providing very useful comments on an earlier draft. The authors also benefited from the extensive knowledge of Bob Evenson (Yale University) and Wally Huffman (Iowa State University), who provided helpful suggestions to improve the quality of this report.

The authors have benefited a great deal from discussions with Russian colleagues in the Ministry of Agriculture and Food, the Russian Academy of Agricultural Sciences (RAAS), Timiryazev Moscow Agricultural Academy, and several regional agricultural research institutes. The authors would like to acknowledge the support, information, and advice provided by Messrs. V. Khlystun (former Minister of Agriculture), A. Romanenko (President of RAAS), and A. Zhuchenko (Vice President of RAAS).

The main conclusions and recommendations of this report were presented at the World Bank workshop on Reforming Agricultural Research Systems in Central Asia and the Caucasus, March 5-11, 1998. We are indeed grateful for the valuable perspectives and many useful comments received from the workshop participants. We are also grateful to Kevin Cleaver, Laura Tuck, Joseph Goldberg, John Hayward, and Csaba Csaki for their comments and advice and for their support for the publication of this report. Evgeny Polyakov provided statistical assistance, Sharifa Kalala and Rathna Chiniah processed the report, and Meta de Coquereaumont edited it. We gratefully acknowledge their contributions.

ACRONYMS AND ABBREVIATIONS

AIC:	Agro-Industrial Complex
AKKOR:	Association of Peasant Farms and Cooperatives of Russia
AKS:	Agricultural Knowledge System
ARSRIIMA:	All Russian Scientific and Research Institute of Innovation and Marketing in Agriculture
CGIAR:	Consultative Group on International Agricultural Research
CIAT:	Centro Internacional de Agricultura Tropical (International Center for Tropical Agriculture)
CIFOR:	Center for International Forestry Research
CIMMYT:	Centro Internacional de Mejoramiento de Maiz y Trigo (International Center for Improvement of Maize and Wheat)
CIP:	Centro Internacional de la Papa (International Potato Center)
CIS:	Commonwealth of Independent States
EC:	European Commission
EDI:	Economic Development Institute of the World Bank
ERS:	Economic Research Service of USDA
EU:	European Union
FIAS:	Farmer Information and Advisory Services
FIST:	Federation of International Seed Trade
FSU:	Former Soviet Union
GKI:	State Committee for the Management of State Property (Russia)
IC:	Institute of Cybernetics (Russia)
ICARDA:	International Center for Agricultural Research in the Dry Areas
ICLARM:	International Center for Living Aquatic Resources Management
ICRAF:	International Center for Research in Agroforestry
ICRISAT:	International Crops Research Institute for the Semi-Arid Tropics
IFPRI:	International Food Policy Research Institute
IIMI:	International Irrigation Management Institute
IITA:	International Institute of Tropical Agriculture
ILRI:	International Livestock Research Institute
IPGRI:	International Plant Genetics Resources Institute
IPM	Integrated Pest Management
IRRI:	International Rice Research Institute
ISNAR:	International Service for National Agricultural Research
ISTA:	International Seed Testing Association
MIS:	Market Information System
MOAF:	Russian Ministry of Agriculture and Food
MOAFCC:	Russian Ministry of Agriculture and Food Computer Center
NARS:	National Agricultural Research System
NSA:	National Seed Association
NSAC:	National Seed Advisory Committee
OECD:	Organization of Economic Cooperation and Development
R & D:	Research and Development

RAS:	Russian Academy of Sciences
RAAS:	Russian Academy of Agricultural Sciences
RSFSR:	Russian Soviet Federated Socialist Republic
SRI:	Scientific Research Institutes (Russia)
SRIA:	Siberian Research Institute for Agriculture (Russia)
SRIASE:	Scientific Research Institute of Agriculture for Southeast Region (Russia)
TACIS:	Technical Assistance to the Commonwealth of Independent States
TMAA:	Timiryazev Moscow Agricultural Academy (Russia)
UPOV:	Union for Protection of Plant Varieties
USAID:	US Agency for International Development
USDA:	US Department of Agriculture
USSR:	Union of Soviet Socialist Republics
VIR:	N.I. Vavilov Institute of Plant Industry (Russia)
WARDA:	West African Rice Development Association

GLOSSARY

Fermer	Private Farmer Support Program
Goskomstat	State Statistical Committee
Gosseminspektsia	Russian Seed Inspection Agency
Gossortkomissia	Russian Seed Registration Agency
Kolkhoz	Collective Farm
Kray	Administrative Region; A constituent part of the Russian Federation
Oblast	Administrative Region; A constituent part of the Russian Federation
Rayon	Administrative District; A constituent part of a kray, oblast or republic
Sovkhoz	State Farm
SPTU	Agricultural Vocational Training Schools
VASKhNIL	All-Union Academy of Agricultural Sciences
VUZ	Agricultural Higher Educational Institutions

EXECUTIVE SUMMARY

Reforming Russian agriculture is vital for the successful transition to a market economy. The ability to sustain the gains from economic reforms will rest on Russia's capacity to solve agricultural problems in the future, in ways that are appropriate for private agriculture based on market principles. Furthermore, the long-term productivity of Russian agriculture will be determined, to a large extent, by the capacity of the Russian agricultural research system, public and private, to respond to emerging problems and opportunities. Despite the urgency of problems related to policy reform and the need to develop managerial and technical capacity throughout the agro-industrial complex, it has proved difficult to build a case for strengthening agricultural research in Russia — an admittedly long-term issue.

Russia's agricultural research system is at risk. Unless this system is quickly transformed and rehabilitated, its capacity, along with its stores of knowledge, germplasm, data, and know-how, will be lost to future generations. Russia's agricultural research system is vitally important to Russia and to the world community. Thus Russia should eschew a policy of benign neglect toward its deteriorating agricultural knowledge system in favor of active engagement in reorienting and restructuring its institutions to meet the new demands of a market economy. And the international scientific and donor community, for their part, should take steps to provide targeted assistance to Russian scientists, public officials, and agricultural leaders to restructure and refocus Russia's agricultural research system.

Numerous proposals to transform the agricultural research system have been discussed with Russian administrators and scientists in the past five years. But after all the studies, needs assessments, vision statements, and memoranda of understanding, little of significance has occurred. Russia's agricultural research system continues to face serious problems. This is the consequence of collective failure — by the Russian central government, by oblast and municipal governments, by the Russian scientific establishment, and by the international community. The reform agenda proposed here begins with the acknowledgment that there are no proven models of reform in transition economies and that critical elements of Russia's agricultural research system are at immediate risk of being lost. Consequently, reform must focus on stabilizing and protecting targeted agricultural research assets and developing and refining models of institutional change and human capital development that are appropriate for Russian circumstances. The priority activities proposed in this report make a positive contribution toward redefining roles and responsibilities for agricultural research in Russia. And more important, they would help ensure that the human, biological, and physical capital invested in Russia's agricultural research system is not lost to future generations.

AGRICULTURAL KNOWLEDGE SYSTEM

The agricultural knowledge system consists of agricultural research, education, training, and technology transfer. The agricultural knowledge system needs to be fully integrated if it is to be responsive, efficient, and cost effective. While the agricultural knowledge system in Russia is gradually adjusting to policy reforms, serious problems remain. These problems need to be addressed with a sense of urgency before the whole system collapses. However, this must be done in the context of reforming the agricultural sector, promoting efficient economic policies, and building much- needed institutional infrastructure to support private agriculture based on market principles. See Box 1 for a comparison of the attributes of the agricultural knowledge system prior to reform and the needed attributes of the new agricultural knowledge system, as well as an outline of emerging trends and critical problems.

Box 1: Agricultural Knowledge System with a Particular Focus on Agricultural Research in Transition Economies: The Case of Russia

Attributes of the Old System

- public sector dominance;
- centralized and quota-driven system;
- unsustainable size;
- primary production focus;
- isolated from global network;
- excessive overlap;
- skewed priorities;
- lack of training in economics;
- high quality but narrowly focused;
- crisis management during transition.

Emerging Trends

- reform initiatives in higher education;
- shifting focus of research priorities;
- client problem-oriented research;
- decentralization of activities;
- consolidation of institutes and programs;
- cost consciousness and revenue generation;
- private sector involvement.

Critical Problems

- remains highly centralized;
- departure of high quality staff;
- inadequate financial support;
- large and unsustainable size;
- lack of overall direction;
- limited research capability in economics;
- serious information and knowledge gaps.

Needed Attributes of the New System

- provides performance incentives;
- integrated (research, education and extension);
- demand driven and responsive to clients;
- efficient and cost effective;
- decentralized, pluralistic and participatory;
- globally linked;
- private sector involvement;
- accountable to key stakeholders;
- promotes cost recovery;
- sustainable.

AGRICULTURAL RESEARCH

Issues

The national agricultural research system in Russia faces the five major challenges: (i) to restructure, rehabilitate, decentralize, and consolidate the system to make it sustainable and efficient; (ii) to re-orient the system to make it serve private agriculture based on market principles; (iii) to adopt socio-economic, ecological, and business criteria in planning, priority-setting, monitoring, and evaluating agricultural research; (iv) to develop and strengthen linkages between researchers and users, and among research, teaching, and knowledge transfer activities; and (v) to facilitate increased investment in agricultural research and development, both public and private.

Status and Achievements

Russia has an extensive network of more than 300 national and regional agricultural research institutes and academies. Some 235 of these institutes are managed by the Russian Academy of Agricultural Sciences (RAAS), and 71 by the Ministry of Agriculture and Food (MOAF). The RAAS became a part of MOAF in early 1996. The national agricultural research system in Russia was designed to meet pre-determined production targets for individual crop and livestock commodities. However, this system is not suitable for the emerging private agriculture based on market principles.

Russia's agricultural research system is too large, inefficient, and unsustainable under current or projected funding levels. In order to serve private agriculture in a market economy, the agricultural research system must be made sustainable, efficient, demand driven, decentralized, accountable to key stakeholders, and integrated with higher education, knowledge transfer, and the world scientific community. Current budgetary support is so low that it is not adequate even to finance and sustain the most critical research programs designed to improve agricultural productivity.

The long-term nature of agricultural research should not be used as justification for inaction or for assigning it a low priority in public investment. An appropriate and dynamic agricultural research system is critical for a successful transition to a market economy. Most, but not all, agricultural research can be viewed as a public good and thus merits public funding. Evidence from around the world indicates very high rates of return (40 to 80 percent) to investment in agricultural research. However, these high rates of return to investment in agricultural research will not be realized in the absence of good agricultural and economic policies. Russia has enormous potential for expanding agricultural production and exports. But, this potential will not be realized unless Russian agriculture becomes efficient and competitive. Agricultural technology generation and its application at the farm level are essential to improve the productivity of Russian agriculture and its competitiveness in world markets.

With the introduction of economic reforms to reduce the budget deficit and achieve macroeconomic stability, funding for agricultural research was substantially reduced. As a result, research has literally stopped since the budget is not adequate to pay even staff salaries. Scientists are leaving to find better paying jobs elsewhere. The research farms are being used primarily for agricultural production, to meet the needs of the staff rather than for research purposes. Capital budgets to replace research equipment and operating budgets to carry out research have declined. While budgetary pressures are forcing the research institutes to make much-needed adjustments, budget shortages over a longer period are doing irreparable damage to Russia's capacity to generate, adapt, and transfer appropriate agricultural technology to meet the needs of agriculture in transition. In addition, the public sector's capacity to undertake agricultural research needs to be supplemented by the private sector, and efforts must also be made by the public sector to recover part of the cost.

Policy Recommendations

Russia needs a complete overhaul of its national agricultural research system. This will require fundamental changes in decision-making, priority-setting, incentive systems, cost effectiveness, revenue generation through cost recovery, and accountability to stakeholders. These changes are long term and would require a long time to achieve. As a first step, however, there is a need to develop a national agricultural research strategy to rationalize the structure, organization, management, and financing of the scientific research system in agriculture at the federal and regional levels; to make it responsive to market conditions and the needs of new stakeholders; and to make it sustainable.

KNOWLEDGE TRANSFER

Issues

The current system of agricultural knowledge transfer is not adequate, and the knowledge (particularly information on prices, markets, technology, and reforms) itself is not appropriate to the needs of the emerging private agriculture and market economy. This is true at all levels of decision-making, including producers, traders, advisors, administrators, and policymakers.

Status and Achievements

In the past, information services for agricultural producers were centralized. This system resulted in the development of a large number of narrowly focused specialists who provided advice to the managers of state and collective farms. This knowledge was supplemented by research and field applications. Most of the research results were introduced through directives. There were few incentives to promote new innovations. While this system worked reasonably well with a limited number of clients (about 25,000 state and collective farms), it is not adequate to meet the needs of the more than 280,000 private farmers, 50,000 restructured farm enterprises and 40 million household plot holders that have already been established in Russia — and their number continue to increase.

A World Bank-financed Agricultural Reform Implementation Support (ARIS) project is supporting the establishment of Farm Information and Advisory Service (FIAS) centers in the main agricultural regions of the country. The centers are designed to provide timely, reliable, user-friendly, easily accessible, and practical information (agronomic, technical, management, business, legal, and environmental) to newly emerging private farmers, restructured farm enterprises, and agro-business enterprises to help them make informed decisions in a market environment. This approach is based on use of the information already available in an extensive network of agricultural research institutes, agro-chemical testing stations, land data banks, academies, and universities, and it capitalizes on Russia's highly skilled and literate work force. The FIAS centers, which will be located at the rayon and oblast levels, will be supported by a network of regional and federal training centers and the agricultural research system.

In addition, the ARIS project is also supporting the establishment of a national network of Market Information System (MIS) centers. These centers are designed to collect, process, and disseminate relevant, timely, and reliable market and price information for the benefit of farmers, traders, and policymakers. Access to such market information is crucial for the successful functioning of the emerging market economy since it increases market transparency, transmits incentives and opportunities for agricultural producers, improves producers bargaining position, stimulates competition among traders, expands producers' and consumers' choices in product selection, and facilitates rational decision-making by producers, traders, and policymakers.

Policy Recommendations

Clearly, there is a need to accelerate the establishment of FIAS and MIS centers and to make the information available to producers, traders, and policymakers. These centers need to be supplemented by the establishment of a national center for monitoring progress in agricultural reforms and conducting analysis on critical agricultural policy issues. The federal training center (being established under the ARIS project) should also be used to train personnel of federal ministries, regional departments, and other agencies involved in the agricultural adjustment and in efforts to improve productivity, profitability, and sustainability of the agricultural sector.

INSTITUTIONAL REFORM

Issues

The agricultural research institutions under the Ministry of Agriculture and Food, including institutions under RAAS, need to be restructured to make them more responsive and relevant to the needs of an emerging agriculture dominated by the private sector and driven by market forces.

Status and Achievements

The agricultural institutional structure in Russia is complex, with many layers of decision-making, policy formulation, and program implementation authority. The new Constitution has decentralized much power from the federal to the oblast authorities. However, the division of responsibilities and roles is not yet clearly defined. And in addition to the MOAF at the federal level and agricultural departments at the oblast level, a large number of other agencies also deal with different aspects of the agricultural sector. All these agencies are gradually being reorganized to meet the needs of a private sector-dominated market economy. However, the slow pace of this institutional change remains a major barrier to adjustment.

Policy Recommendations

This process of institutional change needs to be accelerated by abolishing old departments and agencies that were designed to meet the needs of centralized agriculture and creating a few well-equipped departments and agencies to meet the needs of private agriculture based on market principles. A first step is to develop an action plan to reorganize the institutions that serve agriculture, with a focus on the agricultural knowledge system. Implementation of such an action plan would improve the public sector's capacity to provide appropriate new services to agriculture in a timely and cost-effective manner.

CHAPTER I

STRATEGIC IMPORTANCE OF AGRICULTURAL RESEARCH

The strategic role of agricultural research in Russia derives from the critical importance of agriculture in the overall economy and Russia's large natural resource base. The agro-industrial complex is large and accounts for about 20 percent of GDP and employment in Russia. Agriculture also has a large export potential and considerable scope for import substitution. At present, Russias' agriculture resources are not being used efficiently. Because agriculture continues to absorb a large share of budgetary resources, any improvement in its performance could have a large impact on budget deficits and thus on macroeconomic stability.

Despite the sector's potential for higher efficiency and growth, overall agricultural production remains inefficient. Production has declined, yields are low, physical losses are high, prices remain distorted, profitability is low (particularly for the livestock sector), and subsidies remain high. Unfavorable terms of trade, inefficient farm structures and lack of adequate incentives, competitive markets, technical and market information, and a well-functioning credit system have— combined with the prevailing macroeconomic imbalances— offset the expected benefits of reform. These problems are gradually being addressed through reform and development of institutional infrastructure, but implementation of reform has been slow.

Russian agriculture has embarked on a difficult and protracted transition. The short-term problems in agriculture — political, social, and economic — seem almost overwhelming. Why, then, worry now about agricultural research in Russia which, to paraphrase T. W. Schultz (1964) is admittedly "long-term business." It would seem reasonable to place these activities on the back burner and focus on the complexities of privatization, price liberalization, the development of managerial skills, or even the improvement of mechanisms to transfer existing research knowledge or technology. It is difficult to argue with the need for Russia to aggressively address this complex set of immediate transition issues. However, the ability to sustain the gains achieved from short-term reform will rest on Russia's capacity to solve agricultural problems in the future in ways that are appropriate for private agriculture based on market principles. Thus agricultural research is vital in ensuring Russia's successful transition to a market economy. Its long-term nature should not be used as a justification for inaction or low priority. Agricultural research capacity is a strategic resource that can be justified from a number of perspectives.

RESEARCH AS A SOCIETAL INVESTMENT

No matter which measure of return is selected or which analytical method is applied, an extensive literature in agricultural economics convincingly demonstrates that investment in agricultural research yields high payoffs.[1] Evenson and Westphal (1995) recently summarized 156 studies of estimated real rates of return to agricultural research and development (Table 1.1). For public sector agricultural research, average returns were 48 percent for developed countries and 80 percent for developing countries. For the United States, Huffman and Evenson (1993) show that returns differ

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1 Returns to investment in agricultural research can be measured by following an economic surplus approach or an aggregate production function approach. Economic surplus approach is relatively more popular. Examples for the latter approach are Griliches (1964), Binswanger et.al. (1987), Pardey (1989), and Mundlak (1996).

significantly between applied and more basic or pretechnology research, between research and extension, and between the public and private sector (Table 1.2).

Table 1.1: Summary of Empirical Studies with Estimated Rates of Return to R & D

Activity/Regions	*Number of Studies*	*Studies with Range of Estimates for Rates of Return (%)*				
		1-24	*25-49*	*50-75*	*75+*	*Mean*
Public Sector Agricultural Research						
Africa	10	2	3	3	1	41
Latin America	36	14	22	13	13	46
Asia	35	7	20	23	25	56
All developing countries	85	23	45	40	44	80
All developed countries	71	21	54	26	29	48
Private Sector Industrial Research						
Developing countries	5	0	3	3	2	58
Developed countries	35	10	20	10	5	44
Public Sector Agricultural Extension						
Developing countries	17	4	2	4	6	50
Developed countries	6	1	0	3	2	63

a Includes international agricultural research centers

Source: Evenson and Westphal (1995).

Table 1.2: Internal Rates of Return to Research, Extension, and Education in the U. S.

Type of Activity (Sector Specific)	*Internal Rates of Return (%)*[a]
Public research	41
Pretechnology	74
Private R & D	46
Public extension	20
Farmers' schooling	40

a Refers to both crop and livestock sector aggregates, 1950-82.

Source: Adapted from Huffman and Evenson (1993).

The rates of return to investment in agricultural research are generally very high. However, the magnitude of the rate of return varies from one crop to another, from one livestock product to another, from crop sector to livestock sector or aggregate agricultural production, from one country to another, and from developed to developing countries (Table 1.3 and 1.4). The rate of return to investment in research varies from 22 to 42 percent for potatoes in Peru, to 45 percent for agriculture (crops and livestock) in the United States, to 97 percent for dairy in Canada and 191 percent for maize in South America. The nature of agricultural technology, the level of agricultural productivity and appropriateness of agricultural policies greatly influence payoffs to investment in agricultural research. Careful and informed research management and public investment are essential and must take place within a set of constraints defined by a country's resources and policies.

Much of agricultural research can be viewed as a public good (Box 1.1). Missing markets, particularly when private research and needed institutions such as intellectual property rights are relatively underdeveloped, can result in systematic underinvestment in agricultural research. The fact that the estimated social payoff to research is high suggests that systematic underinvestment is still occurring, even in developed countries with well-established private sector research.

Positive and high rates of return mean that the stream of societal benefits from research outweigh the costs over a planning horizon of several years. The costs of these investments are repaid because the economy grows as a consequence of the reduced food and fiber costs that benefit both consumers and producers, the reallocation of physical and human capital into higher and better uses, and increased economic activity, including trade. But as with any investment, there is frequently a lag between expenditure and return. For agriculture, the lag may be 10-20 years. Even allowing for the long lag, however, the expected return on investment in agricultural research and extension is positive and high.[2]

RESEARCH AS A STRATEGY TO INCREASE COMPETITIVENESS

Public support for agricultural research can also be an important part of a nation's strategy to increase the competitiveness of its agricultural sector, whether through directed public investment or public action to foster private research. Operationally, increased competitiveness means that the agricultural sector is better able to sell products abroad or to produce substitutes for products being imported. Increased competitiveness is desirable because it results in improved standards of living for the given nation or region.

Our understanding of the role of research and technological change has been influenced by concepts of comparative advantage that underlie trade theory. In this framework, a nation's factor endowment — stock of land, labor, natural resources, or capital — will influence its production and consumption decisions. Nations will choose, for example, to export products that make more intensive use of factors of production that are relatively plentiful. In this context, research will be directed toward developing technologies capable of augmenting scarce factors of production or reducing costs. Research

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2 There is vast amount of published literature dealing with different aspects of agricultural research and development or, more broadly, with the generation and dissemination of agricultural technology. Few selected examples are Alston and Pardey (1996); Alston, Norton and Pardey (1995); Anderson(1994); Binswanger and Ruttan (1978); Byerlee and Alex (1998); Evenson and Pray (1991); Hayami and Ruttan (1995); Pardey, Roseboom and Anderson (1991); Pinstrup-Andersen (1982); Purcell and Anderson (1997); Ruttan (1981); Ruttan and Pray (1987); Tabor (1995), and the World Bank (1981, 1983, 1996b).

Table 1.3: Rate of Return to Agricultural Research in OECD Countries

Country	*Study*	*Commodity*	*Period*	*Rate of Return (%)*
Australia	Duncan (1972)	Pasture Improvement	1948-69	58-68
Canada	Fox, et al. (1989)	Dairy	1968-84	97
Canada	Widmer, et al. (1988)	Beef	1968-84	63
Canada	Zachariah, et al. (1988)	Broilers	1968-84	48
Finland	Sumelius (1987)	Aggregate	1950-84	21-62
Germany	Burian (1992)	Aggregate	1950-87	21-56
Ireland	Boyle (1986)	Aggregate	1963-83	26
Japan	Hayami and Akino (1977)	Rice	1932-61	73-75
New Zealand	Scobie and Eveleens (1987)	Aggregate	1926-84	15-66
United Kingdom	Thirtle and Bottomley (1988)	Aggregate	1950-81	70
United States	Huffman and Evenson (1992)	Crop and Livestock	1949-85	45
United States	Lyu, White and Lu (1984)	Aggregate	1949-81	66-83

Source: Alston, Chalfant and Pardey (1995).

Table 1.4: Rate of Return to Agricultural Research in Developing Countries

Country	*Study*	*Commodity*	*Rate of Return (%)*
Mexico	Ruvalcaba (1986)	Maize	78-91
South America	Evenson (1989)	Maize	191
Indonesia	Pardey (1993)	Rice	60-65
India	Evenson (1990)	Rice	65
Pakistan	Nagy (1983)	Wheat	58
Brazil	Ayers (1985)	Soybeans	46-69
Philippines	Librero (1987)	Sugarcane	51-71
Peru	Norton (1987)	Potatoes	22-42
Senegal	Schwartz (1989)	Cowpeas	60-80

Source: Bonte-Friedheim, Tabor and Roseboom (1994).

Box 1.1: Public Goods and Public Finance

Agricultural research is often described as a public good and as a consequence merits public funding. The discussion of this topic is frequently carried out using the rather arcane language of public economics. But the underlying issues are fairly straightforward. As the evidence shows, investments in agricultural research yield high rates of returns. Would these investments be made if the task were left to private firms? Furthermore, would sufficient funds be invested to meet society's needs? And would the correct mix of projects be undertaken? The answer to all three questions is probably not.

A private firm -- a seed company, chemical company or a farmer for that matter, will only invest in research if the benefits from doing so exceed the costs. In many cases, this means that the firm conducting the research must be able to earn returns from research to the exclusion of competitors. Access to the earnings from research might be obtained from a patent, as a trade secret or through physical control of the invention. If a firm cannot be reasonably assured that it can capture a sufficient portion of the income stream from a research project, it won't make the investment. Alternatively, the firm might not carry out a research project in hopes that a competitor would make the investment. When either of these two situations exist, when firms cannot directly and sufficiently benefit from research investments, public action can be justified. Economists describe this action as one of correcting a market failure. Here are a few simple examples of research areas that might not be adequately undertaken by the private sector.

- Basic research is often funded by the public sector. For example, in order to breed soybean varieties with altered fatty acid composition, it might be necessary to understand the synthesis pathways. A private firm might be unwilling to invest in this basic research because it cannot directly capture the benefits, or because the expected return cannot compete with returns from other short-term investment alternatives. In this case, it makes more sense for society to fund the research and make the results widely available to support commercial application.

- Research that increases knowledge or managerial skills might not be adequately funded by the private sector. A pesticide company with products to sell, would probably not invest in developing integrated pest management (IPM) systems that reduce application rates of its product. But these low input technologies clearly benefit the society and the environment. If the research is to be carried out, the public sector might have to pay for it or find ways for cost recovery from the beneficiaries.

- Some applied research is difficult to protect. Patents create a partial monopoly and protect a firm's return on research investment -- at least for a period of time. This works fairly well for pesticides or machinery. Corn hybrids can be protected because access to the inbred parents can be physically controlled as a trade secret. Self-pollinated crops such as wheat or soybeans are more difficult to control since farmers can save their own seed. Consequently it can be difficult for a private firm to capture the return on its research investment. In this case, public funding or intervention may be needed if these beneficial investments are to be made.

These examples illustrate a few of the reasons why private firms might not invest or underinvest in research that society would find desirable. To resolve this dilemma, public action is often justified. However, public action can take many forms. The public can fund and conduct research directly. The public might fund the research but have it conducted by the private sector under contract. Or the public might pass legislation to create commodity or export tax programs to fund research that firms would find in their best interest to pursue. In many developed countries, funding of research has evolved from largely a public responsibility to a shared responsibility with the private sector. For Russia, agricultural research will likely remain a public function until the private sector and the needed institutions are well-developed to permit a shared role. This will likely take a decade or more.

attempts to ease constraints that are largely the consequence of resource endowments (Thirtle and Ruttan 1987).

One of the most important insights from this line of inquiry is that research productivity and hence agricultural productivity can be enhanced by "getting prices right" in transition economies. Market signals that are relatively free of distortions caused by domestic taxes or trade intervention will result in efficient production and thereby drive research in the proper direction. This means that research managers can make their investment decisions largely on the basis of welfare measures that reflect the net gain to producers and consumers (Alston, Norton, and Pardey 1995). Competitiveness and research strategy in this framework are the consequences of well-functioning commodity markets and economically literate research managers.

Porter (1985, 1990) has synthesized and extended an alternative to the resource-based notion of comparative advantage that he calls competitive advantage. It is the consequence of a deliberate strategy — by firms, industries, or nations — to achieve cost leadership or product differentiation. Cost leadership, or consistently achieving low unit production costs, includes the entire sequence or value chain required to produce goods and services from basic manufacturing to transportation, distribution, marketing, and customer service. Differentiation refers to the ability to produce and market goods or services with unique characteristics. Through differentiation, a firm is able to exact price premiums and earn higher than normal profits.

In Porter's model, national competitive advantage follows the firm or industry and is the result of conditions in factor and product markets, firm strategy and rivalry, and the characteristics of supporting industries. Agriculture would seem at first glance less suited for Porter's model, which he argues is most appropriate for high technology industries rather than resource-based industries. However, in industrial countries and in more advanced transition economies, agriculture is an increasingly high-technology industry, where competitive strategy can offer some valuable insights on industry location, productivity growth, and research. The cut flower industry in the Netherlands, the dairy industry in Denmark, and recent developments in the pork industry in North Carolina (in the United States), Singapore, or Chile are cases in point. The major building blocks in Porter's model of national competitive advantage as it applies to the role of research and development are factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry.

Factor conditions. Porter's model includes factor endowments as one of the key determinants of national competitive advantage. Factor endowments consist of human, physical, natural, knowledge, and capital resources as well as infrastructure — transportation, communication, and health care, for example. Relatively few of these endowments are really fixed or given; technology and research can alter many of them over time. Competitive advantage is created and sustained when factor augmentation provides benefits to specialized industries — benefits that are not easily transferred to rivals. Research clearly is one of the driving forces behind this factor-augmenting technology change.

Demand conditions. Domestic demand conditions are the second major determinant of national competitive advantage. The larger and more visible the domestic demand for a product, the greater the incentives to increase an industry's competitiveness. Domestic demand for products that reflect unique physical or cultural characteristics is also important. In the United States., for example, the increasing household incomes of two-career families have significantly altered the demand for services embodied in retail food products. In another example, the scale of the U.S. corn industry has resulted in a large domestic demand for hybrid seed adapted to many climatic or maturity zones. This has, in turn, fostered an internationally competitive seed industry in the United States.

Related and supporting industries. Porter identifies the importance of industry "clusters" in determining national competitive advantage. Clusters are groups of individual firms that provide materials, services, or expertise to a given industry. Supporting firms may form part of an integrated or coordinated industry -- for example, linking feed processing, nutrition, livestock production and meat processing. Or they may simply be related or relevant to a particular situation. The strong, ubiquitous computer software industry in the United States has certainly fostered the development of improved farm machinery instruments and control devices. The common practice of outsourcing materials or services builds capacity in supporting industries and can lead to cost reductions and quality improvement through scale economies and joint R & D. Japan's success in automobiles and electronics has, in part, been achieved through strengthening its supporting industrial base.

Firm strategy, structure and rivalry. Porter's "diamond" of firm strategy, structure, and rivalry refers to the characteristics of management and competition within the relevant industry. It includes such diverse aspects as corporate culture, societal values and tradition, and the degree of rivalry among firms within an industry.

Porter's work incorporates many of the earlier notions of comparative advantage and induced innovation. His primary new insight is that national competitive advantage is the consequence of four inter-related forces linked to factors of production, demand conditions, the existence and performance of allied industries, and the characteristics of management and firm behavior within an industry. Further, in Porter's model, research and development plays a critical role in all four areas as part of deliberate strategies to reduce costs, increase product differentiation and quality, or reduce adverse environmental consequences. Agricultural research and technological development create competitive advantage by improving the ability of the agricultural sector to create value for domestic and international customers. The consequences of technological and managerial innovation fostered by agricultural research are sustained high rates of return and increasing market share.

Evenson (1986) offers an additional perspective on agricultural research and competitive advantage within a framework that includes producers and consumers as interest groups. Evenson introduces a simple typology that distinguishes between agricultural products that are traded or nontraded and technological change that affects agricultural production or utilization (processing). Finally, Evenson distinguishes between technologies that can or cannot be transferred into competing nations (spillovers). The typology is summarized in Table 1.5.

Most agricultural commodities are traded or are potentially tradable. Grains, protein, meat, cheese, farm machinery, bull semen, and prepared foods are cases in point. However, some commodities such as fresh meat, forages, or milk more closely resemble nontraded goods. The key issue is how sensitive commodity prices are to changes in output. Production research is focused on increasing output or improving input quality or efficiency. Utilization research improves the efficiency of storage, transportation, and processing of agricultural commodities, leading to improved production quality or differentiation. Transferability of research can be influenced by a number of factors. Production technologies that are suitable for specific soil or climatic conditions or require special management skills are not particularly transferable. Others such as dairy genetics or wet-milling technologies can be easily transferred to competitors. Institutional restrictions such as patents or health regulations limit transferability. And local economic conditions or price distortions can also be important limiting factors. Table 1.6 lists a few examples applicable to Russia that are consistent with this typology.

Table 1.5: Perceived Short-Term Benefits to Domestic Producers and Consumers from Agricultural Research

Research Focus	*Commodity*[a]			
	Traded Goods		*Nontraded Goods*	
Production Research				
Transferable	C +	P -	C ++	P -
Nontransferable	C +	P ++	C ++	P -
Utilization Research				
Transferable	C -	P +	C +	P +
Nontransferable	C +	P +	C +	P +

a The definition of these symbols is as follows:
C + = consumer benefits
C - = consumer loses
P + = producer benefits
P - = producer loses

Source: Derived from Evenson (1986).

Table 1.6: Benefits from Agricultural Research: Some Examples Applicable to Russia

Research Focus	*Commodity*	
	Traded Goods	*Nontraded Goods*
Production Research		
Transferable	New wheat varieties	High protein forage cultivars
Nontransferable	Sustainable wheat production systems for the Volga Hills	Improved beef grazing systems
Utilization Research		
Transferable	Improved flour milling technologies	Improved fresh milk handling systems
Nontransferable	Improved flour milling technologies protected by patent or trade secrets	Processing technologies for ethnic foods or foods for local tastes

Source: Authors' compilation, based on Evenson (1986).

The benefits of research to domestic producers and consumers highlighted in Tables 1.5 and 1.6 are conjectural. But the typology does illustrate some key points as well as some controversies. Consumers appear to benefit from almost all types of technological change in agriculture, while producers benefit as well, but more selectively. Farmers would likely support nontransferable production research in traded commodities. For Russia, given its range and variability of agroclimatic regions and its highly educated agricultural labor force, site-specific technologies with high managerial requirements would seem to offer clear advantages. If these production technologies can be developed around agroecological principles to reduce environmental degradation and other social costs, Russia's long-term competitive advantage could be significantly enhanced. Farmers also benefit from, and would probably support, investments in utilization research. But whether utilization research should be funded publicly or privately is certainly subject to debate (Alston and Pardey 1996). Finally, even in situations where there seems to be a mixture of winners and losers, as with production research on nontraded goods, the net benefits to society are still likely to be positive. The gains to consumers simply outweigh the losses to producers and result in positive rates of return on these research investments.

RESEARCH AS A TOOL FOR FOOD SECURITY

The first two perspectives on agricultural research are admittedly inwardly focused on the gains to a nation or region. However, there is a global perspective to agricultural research that is particularly important. In a recent study, McCalla (1994a) juxtaposes plausible growth rates in world population and income against historical growth rates in agricultural productivity. What emerges is a simple disquieting fact: agricultural productivity must continue to increase worldwide at or above historical rates if future food demands are to be met without potentially dire human consequences. McCalla makes a second and equally ominous observation: in most countries throughout the world, developing and industrial, national priorities are shifting away from agriculture and from agricultural research. This myopic perspective further diminishes the world's collective ability to achieve the needed increases in agricultural productivity in a manner that can be sustained into the future.

Food security is relevant to Russia in two important ways. First, Russia (and the other transition economies) can go a long way toward realizing its vast potential in agricultural production and in meeting future food needs by increasing the intensity and productivity of a sustainable agricultural production system, improving efficiency and quality in agricultural processing and distribution, and easing production constraints in difficult agroclimatic regions. By actively contributing to the resolution of global food problems, Russia can also improve earnings from its agricultural sector and contribute to rural well-being. Second, there is an important domestic dimension to food security. Russia is not, by world standards, a poor country. Nor does the specter of hunger threaten its population. But national food security is an important issue for Russia in that it effects Russians' standards of living. The transition to a democratic and civil society is significantly influenced by the price of sausages and bread. Agricultural research plays an important role in improving productivity, increasing standards of living for rural as well as urban people, and concomitantly supporting democratization.

AGRICULTURAL RESEARCH AS A PRIORITY INVESTMENT

The logic for supporting agricultural research as a priority investment is straightforward and compelling. Agricultural research has been shown to be a sound societal investment. Few public goods can show a better rate of return.

- Agricultural research can create and sustain national competitive advantage and, thereby, increase earnings from agricultural assets and the incomes of rural people.

- Agricultural research is needed if Russia is to contribute with its vast potential to the resolution of global food and environmental problems.

- Agricultural research is needed if Russia is to properly meet its national food security objectives, which support democratic reform.

Russia faces this challenge with an extensive agricultural knowledge system and a long history of investment in research and education. This situation is characteristic of most transition economies in Eastern Europe and the former Soviet Union. Agricultural research, education, training, and technology transfer were given some priority under central planning. However, the agricultural knowledge system that emerged was not designed to meet the needs of private agriculture in a market economy. For the World Bank and other international financial institutions and donors, this fact creates new challenges. Most of their experience is in developing national agricultural research systems from the ground up. The problems of transition — of transforming an extensive and complex knowledge system appropriate to a command economy to one suitable for a market economy — are unprecedented, and the task of transforming the agricultural research system will not be easy.[3]

In mature market economies, agricultural knowledge systems are also in transition — in the division of labor between the private and public sectors, in the training and expertise of scientists and educators, among other ways. Thus the future configuration of agricultural knowledge systems in North America, Europe, or Australia may, in general, be appropriate for transition economies while the current structure found in industrial market economies may not be. The transition of Russia's agricultural knowledge system may thus follow a path toward which industrial market economies are also moving. So the vision for Russia's agricultural research and education system must be oriented toward the future.

The problems Russia's agricultural research system faces are especially urgent. Agricultural research is properly viewed as a long-term investment — an investment in a country's ability to meet future food needs, exploit commercial opportunities, or protect environments and people. But as with any other high-return investment, the loss resulting from a dollar not spent today is magnified many times in the future. With agricultural research systems, passive neglect not only reduces returns from current investments, it also erodes capacity. For Russia, the loss of research capacity in both physical and human terms poses one of the greatest threats to future returns. What is needed is action now -- human-scale, concrete, doable steps to limit the losses in capacity, to develop workable strategies for reform during transition, and to make needed investments to secure Russia's agricultural future.

Agricultural policymakers must be aware that potentially high rates of return to investment in agricultural research will not be realized in the absence of reforms in the agricultural research system and agricultural sector. This report assesses the current situation of Russia's agricultural knowledge system, with an explicit emphasis on agricultural research, and outlines a simple conceptual model to address the strategic management of agricultural research during the transition. A specific set of recommendations is made that can be implemented quickly and can contribute to a better understanding of how Russia's agricultural knowledge system can be rehabilitated and transformed to improve the efficiency and productivity of the agricultural sector.

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3 Russia has made major progress in stabilizing and reforming the economy and to a lesser degree in reforming the agricultural sector. An overview of the current status of agricultural reforms and performance of the agricultural sector is provided in Brooks, Krylatykh, Lerman, Petrikov and Uzun (1996), Mudahar (1996a, 1996b), Mudahar and Polyakov (1996), Mudahar and Schaeffer (1996), Mudahar and Sahota (1996), and the World Bank (1992a, 1994a, 1994b).

CHAPTER II

STATUS AND PERFORMANCE OF THE AGRICULTURAL SECTOR

Despite a rich natural resource base, Russia's agricultural production performance has been far below its potential. In many ways, Russian agriculture is a study in contrasts:

- Russia occupies nearly a seventh of the earth's land area — over 1.7 billion hectares. Yet only 220 million hectares are devoted to agricultural purposes (about 13 percent) and of that, about 60 percent is considered arable. And most of the arable land is subject to some significant limitation — inadequate rainfall, excessive salinity or moisture, limited growing season, or difficult terrain. Only 2 million hectares of Russia's vast belt of black soils has adequate rainfall and growing conditions.

- Russia's farms, the re-registered state and collective farms, are huge by North American or European standards. Yet they vie with tiny privately owned household plots for market share.

- Most of Russia's food processing system is spatially dispersed, relatively small scale, and antiquated. Yet processing firms continue to maintain their monopsony power in regional commodity markets, exacting rents from producers, delaying payments, and impeding incentives for reform.

- Russia has made as significant a commitment to agricultural research and education as her European neighbors or North America. Yet Russia's agricultural productivity and technology lag significantly behind the West's.

- Since the early 1990s, Russia has enacted a steady stream of economic reforms intended to facilitate private sector participation and to transform the economy and the agricultural sector. Yet agricultural output remains low and continues to fluctuate, particularly livestock production.

The paradoxes that characterize Russian agriculture also establish the context within which reform of the agricultural knowledge system must occur. The following overview of the status and performance of Russian agriculture focuses on agricultural organization, production, productivity, technology, and research.

RESTRUCTURING PRODUCTION AGRICULTURE

For nearly 70 years, large state and collective farms have been emblematic of Russian agriculture. Since the collapse of central planning, however, several decrees and laws have established a new legal framework for privatizing production agriculture. The impact has been striking— at least on paper. By January 1996, state ownership had fallen to approximately 34 percent of all land, and only 8 percent of arable land was controlled by state agricultural production enterprises. Transformed collectives operating as joint stock companies, limited liability partnerships, or with revised charters have become the dominant form of ownership or control (Table 2.1).

Table 2.1: Agriculture Land by Type of Enterprise, January 1, 1996

Item	Total Land (million ha)	Agricultural Land (million ha)			
		Total	Arable	Meadows	Pastures
Total land (territory)	1708.2	221.0	129.8	23.9	63.7
Land used by owners and users for agricultural production	694.6	209.6	127.6	20.1	58.6
Reserve land and forestry	843.4	9.0	1.6	3.3	4.0
Land for other uses	70.7	3.6	0.2	1.8	1.7
Land of agricultural enterprises and organizations	544.7	171.2	113.2	13.6	42.8
Collective farms	63.1	31.3	21.0	2.1	8.0
Joint stock societies, agricultural cooperatives and other organizations	181.4	93.6	64.4	8.0	20.3
State farm enterprises	236.5	20.9	10.6	1.5	8.6
Private farms	36.2[a]	10.4	7.5	0.7	2.1
Personal household plots	5.8	5.4	3.4	1.7[b]	---
Collective orchards	1.2	1.2	1.2	---	---
Collective vegetable gardens	0.6	0.6	0.6	---	---

a Including 17.1 million ha of caribou pastures and forests.
b Including pastures.

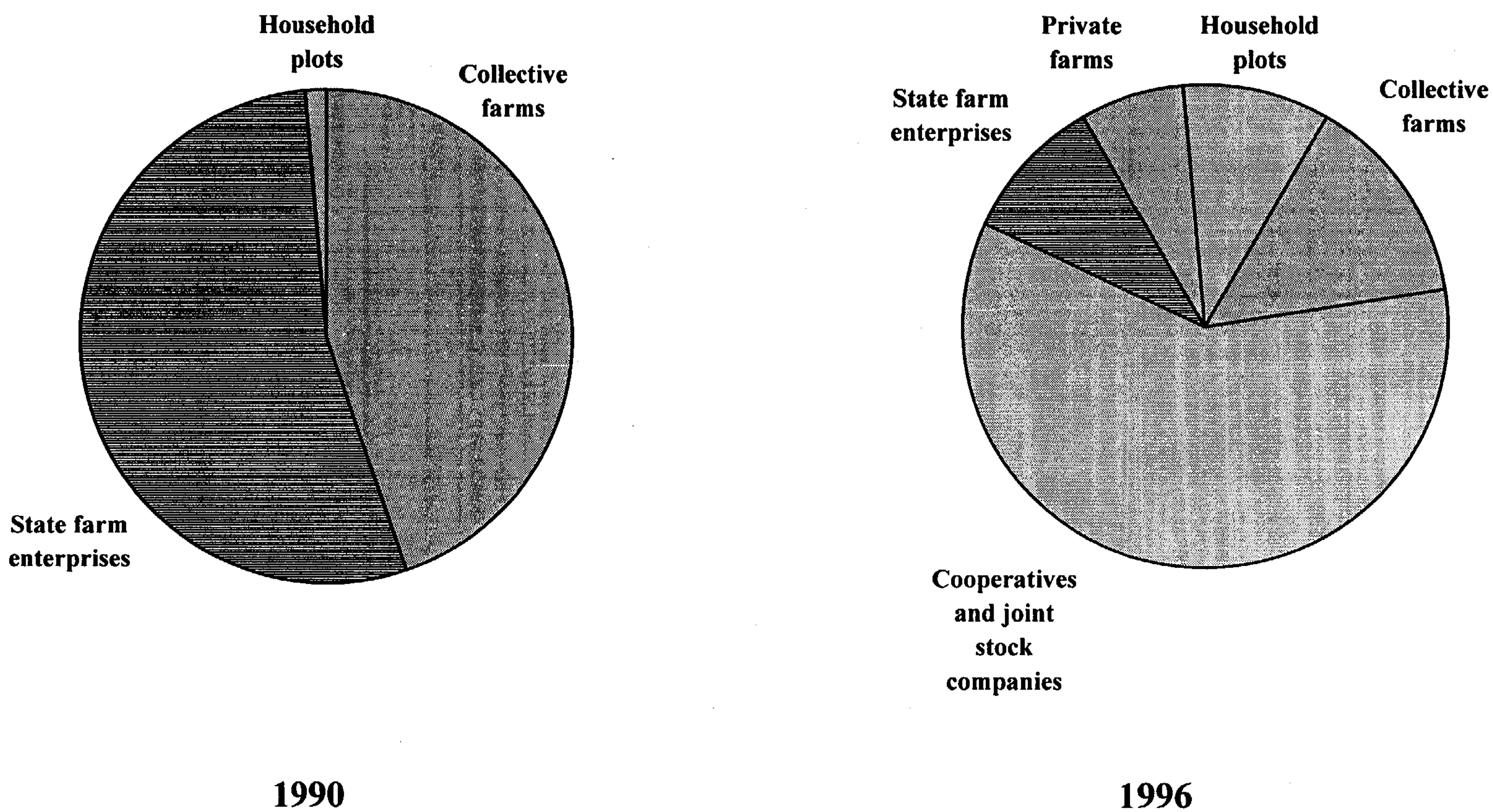
Sources: Goskomstat of Russia.

Agricultural production enterprises are gradually restructuring (Figure 2.1). In 1990, almost 99 percent of arable land was under state and collective farms, with the remainder (about 1.3 percent) operated as household plots. By 1996 state and collective farms accounted for just 29 percent of the arable land. The remaining arable land is owned and operated by cooperatives and joint stock companies (59 percent), private farms (7 percent), and household plots, including collective orchards and vegetable gardens (5 percent). The number of private farms increased very rapidly from about 4,400 in January 1991 to 270,000 in January 1994, but the process has slowed down since then. However, newly emerging private farmers are finding it very difficult to survive due to economic hardships and lack of farm machinery, inputs, credit, markets, and knowledge.

These dramatic changes in legal structure and organization have not been accompanied by meaningful changes in operation or management.[1] Output shares of agricultural enterprises have been declining relative to those of household plots and private farms (Figure 2.2). This suggests that

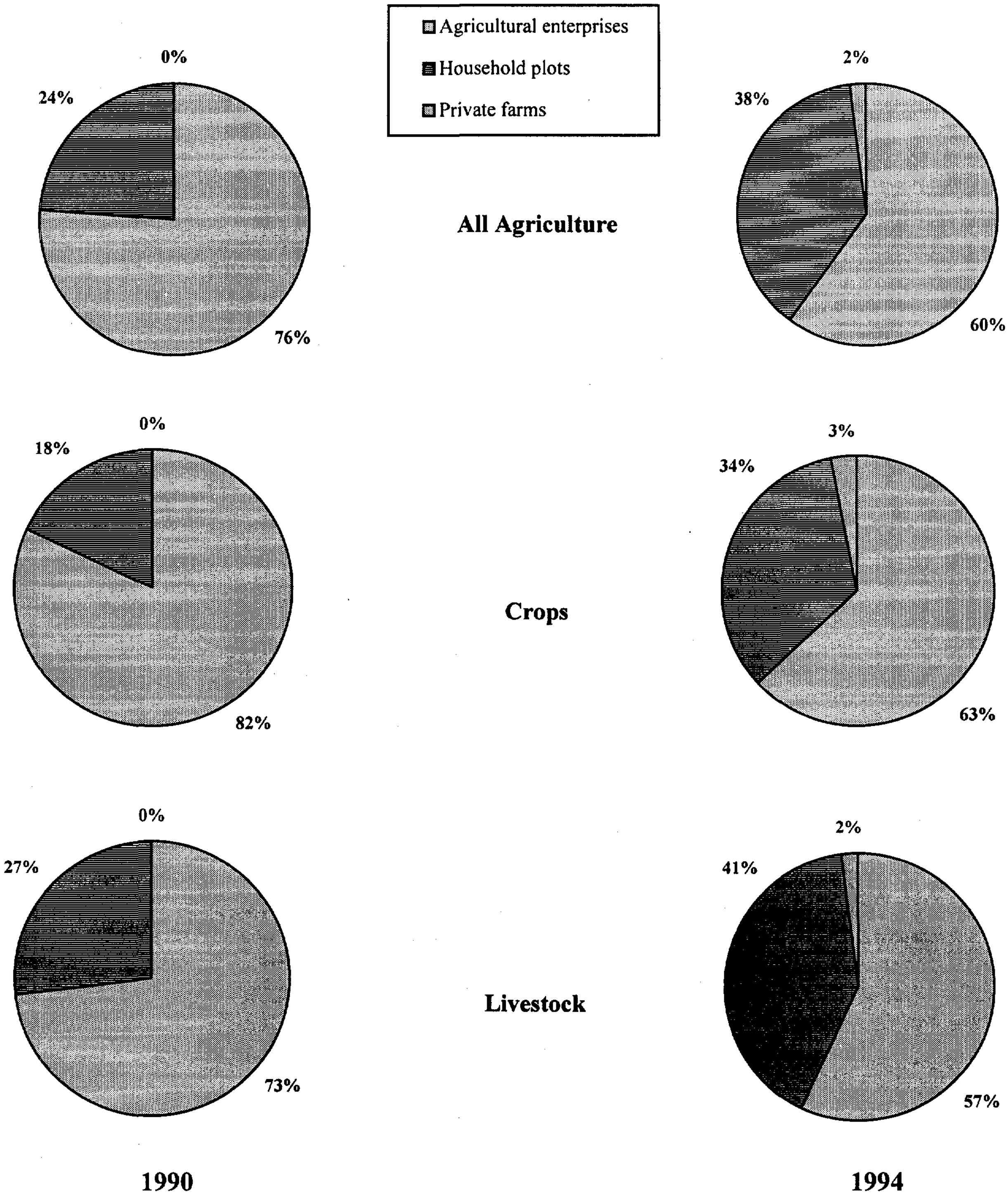
1 Additional information on restructuring of state and collective farms in Russia and its impact on their operations, management and productivity is available in Brooks, Krylatykh, Lerman, Petrikov and Uzun (1996), and Brooks and Lerman (1995). According to them, most restructured farms are still manged like collective farms of the past, but with more administrative autonomy and less financial security. Furthermore, the results based on farm-level survey in 1994/95 indicate that shareholders are aware of their rights but perceive little tangible gain to share ownership. This, of course, is likely to change as agriculture proceeds with transition and becomes relatively more profitable over time.

Figure 2.1: Changes in Farm Organizations in Russia from 1990 to 1996



Source: Goskomstat.

Figure 2.2: Change in Output Shares for Different Farm Organizations in Russia from 1990 to 1994



Source: Goskomstat.

privatization and reorganization of the state and collective farms have not created the incentives necessary to increase production or improve efficiency.

The analysis shows two clear trends. First, about 40 percent of agricultural production (slightly less for crops and slightly more for livestock) originates primarily with the household plots (38 percent) and private farms (2 percent), which account for only about 12 percent of the arable land. Agricultural productivity is much higher on household plots than on the former state and collective farms. However, the household plots produce primarily fruits, vegetables, potatoes and, to a lesser extent, livestock products. The former state and collective farms account for most of grain, sunflower seed, sugarbeet, meat, milk, and eggs, the main staples in Russia and the main source of raw material for agro-industry. Second, the former state and collective farms account for 78 percent of arable land; of this, unrestructured farms account for 29 percent and restructured farms, including cooperatives and joint stock companies for 59 percent. Clearly, the long-term future of agriculture in Russia lies not as much with the household plots but with improving the efficiency and productivity of large farms. As the adjustment takes place over time, the role of household plots in agricultural production is likely to decline.

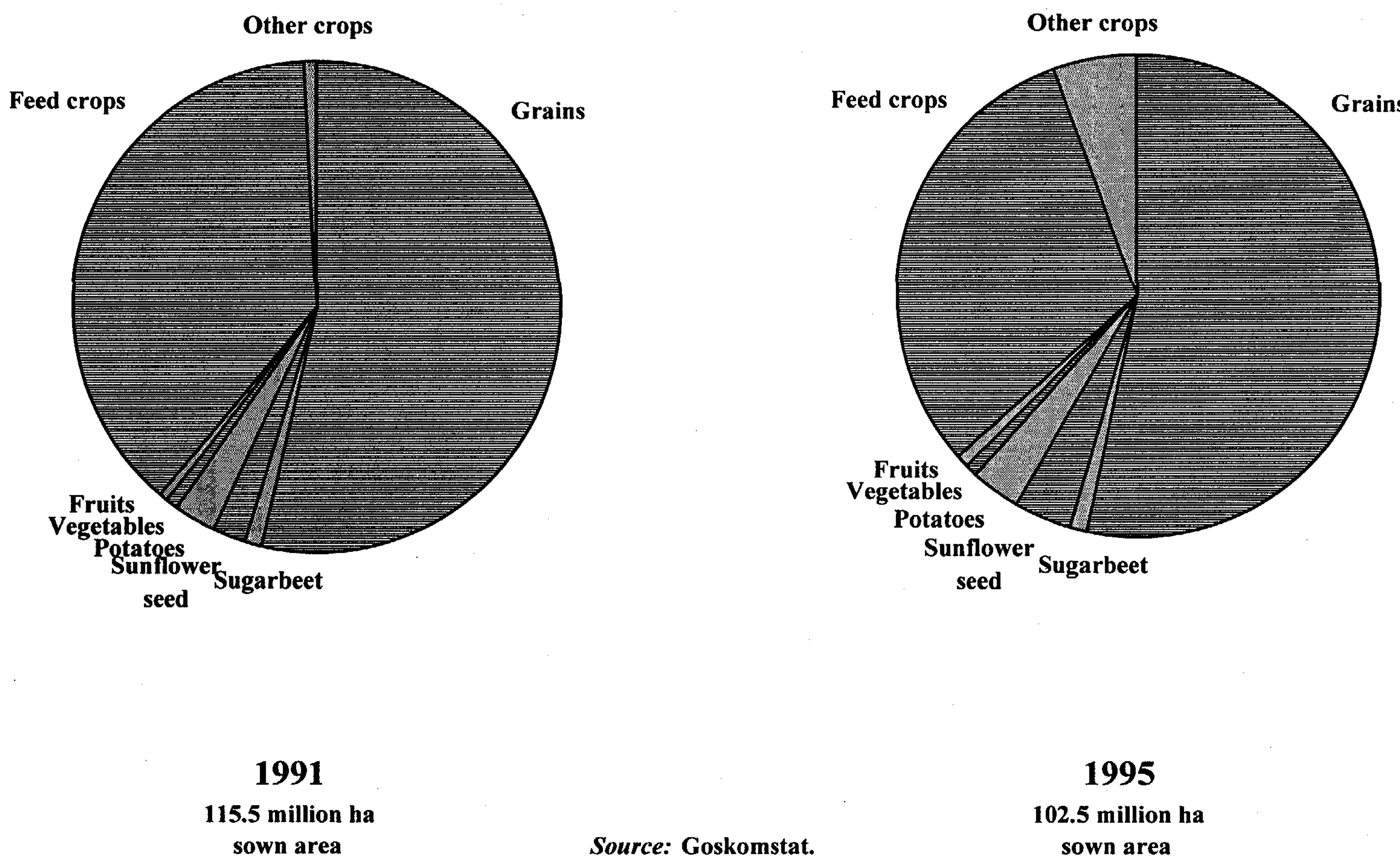
CHANGING CROP SECTOR

Shifting Cropping Pattern. The area sown under crops has declined from 115.5 million hectares in 1991 to 102.5 million hectares in 1995, an 11 percent decline (Figure 2.3). In addition, the cropping pattern is changing in favor of fruits, vegetables, potatoes, and high-value industrial crops, such as sunflower seed. The area under feedcrops has declined significantly, from 44 million hectares in 1991 to 32 million hectares in 1995. This decline is due primarily to the rapid decline in livestock inventories. As part of the economic transition to a market economy, the demand for fruits and vegetables is increasing while demand for livestock products is declining.

Declining Crop Yields. Crop production is determined by sown area and yields. Both aggregate sown area and sown area under major crops have declined, as have yields for most crops except potatoes, which are grown primarily on household plots (Figure 2.4). Average crop yields in Russia are much lower than average yields in the United States and Canada, which have some similarities in the agro-climatic conditions. Even though potato yields in Russia increased slightly in the mid-1990s, they are still only about 29 percent of average yields in the United States and 40 percent of yields in Canada. Clearly, there is a large potential to improve crop yields.

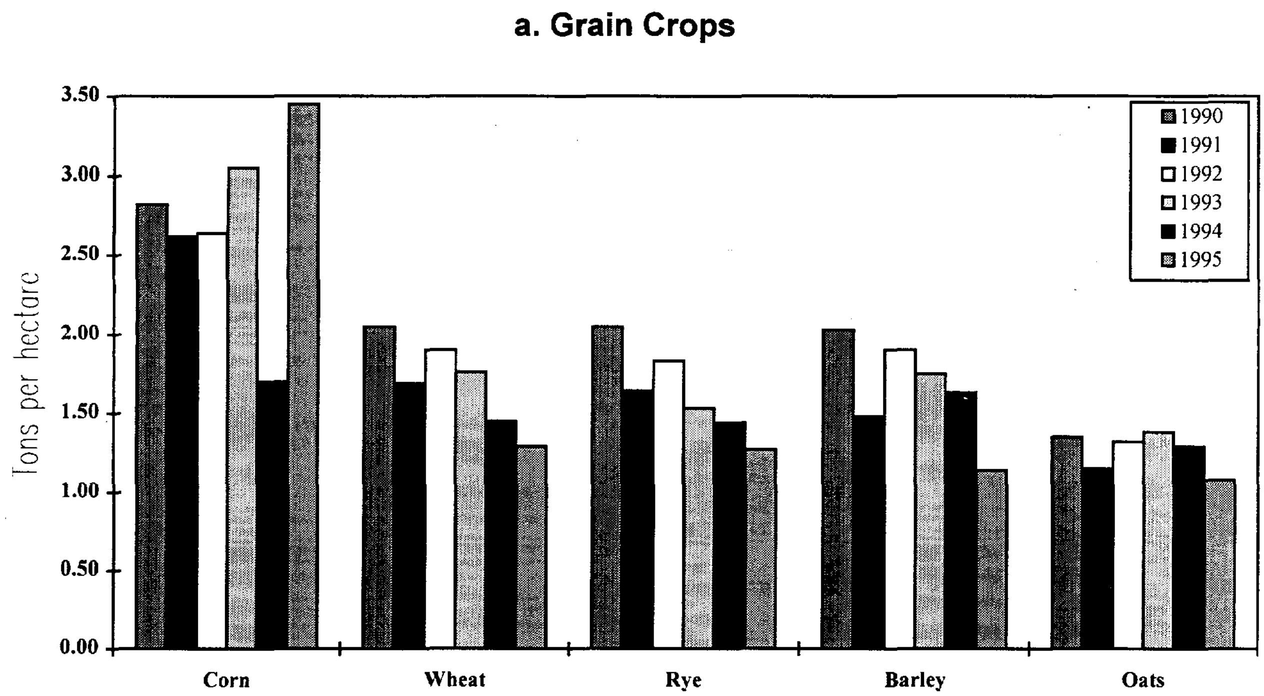
Falling Input Use. One of the main reasons for the rapid decline in crop yields has been a reduction in the use of critical farm inputs. Most farm machinery is in poor condition. There has been a shortage of spare parts. Fuel supply has also been a serious problem, interfering with timely sowing and harvesting operations. Fertilizer use has dropped from about 11 million tons of nutrients in 1990 to about 1.4 million tons in 1994. The use of pesticides, fungicides, and herbicides has also declined significantly. The main reasons for this decline in input use have been lack of availability following the collapse of the old input distribution system and lack of credit and high prices when inputs are available. Although input use in the old system was too high to be sustained (from both economic efficiency and environmental protection points of view) it has now dropped to levels that are not adequate to meet minimum crop nutrient needs and efficient crop production.

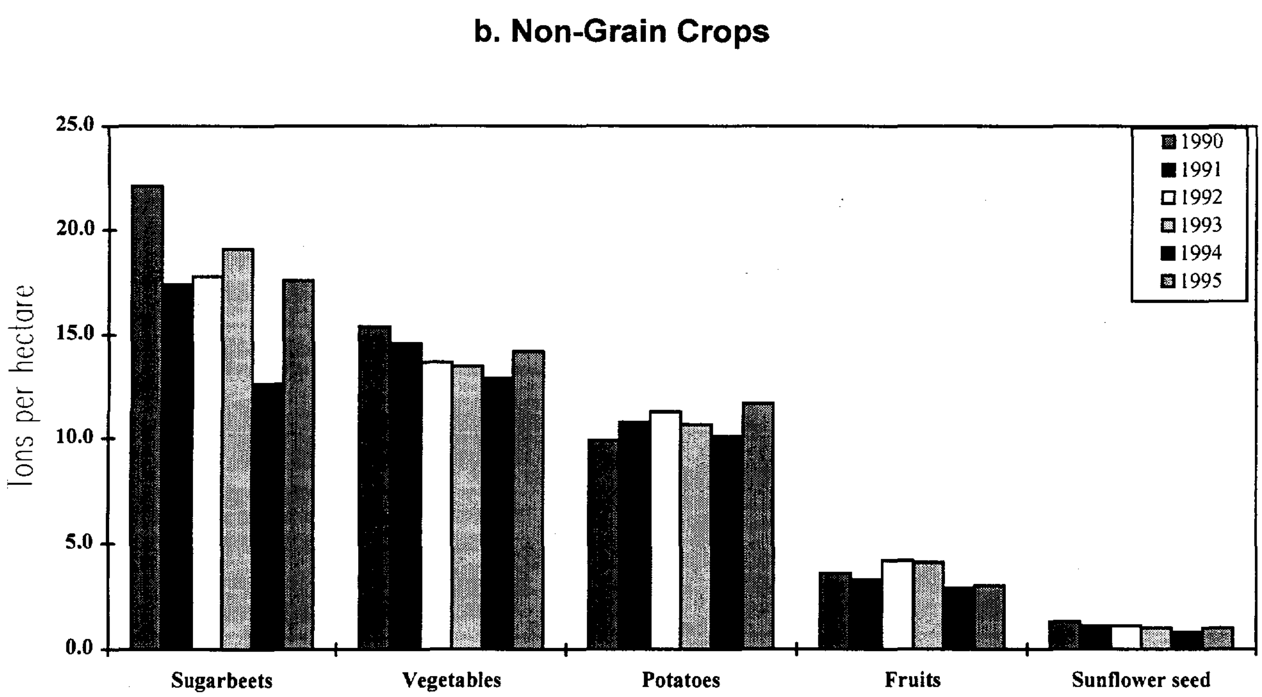
Figure 2.3: Changes in Cropping Pattern in Russia from 1990 to 1995



Source: Goskomstat.

Figure 2.4: Changes in Crop Yields over Time in Russia





Source: Goskomstat.

Inefficient Seed Sector. The foundation of an efficient crop production system is the supply and use of high quality seed. The seed sector in Russia is not very efficient (Table 2.2). Average seed rates are much higher in Russia than in the United States, mainly because of poor seed quality (low germination rates) and poor crop management practices. The bulk of the seed requirements is met by producers from their own production. Because of the high seed rate and low crop yields, the amount of seed is a much higher share of individual crop yields than, for example, in the United States. Clearly, improvements in seed quality, as well as crop and land management practices, have the potential for achieving substantial gains in the form of reduced seed requirements, higher crop yields, lower production costs and improved agricultural efficiency.

Table 2.2: Performance Indicators for the Seed Sector in Russia, mid-1990s

Crop	*Seed Rate in Russia as % of USA*	*Seed use as % of Production*	
		Russia	*USA*
Wheat (winter)	298	11	4
Wheat (spring)	237	21	4
Barley (spring)	256	16	3
Oats	247	18	8
Corn (grain)	111	1	0.2
Sunflower	160	1	0.4
Potatoes	145	30	6

Source: Mudahar, Sampath, and Pray (1997).

SHRINKING LIVESTOCK SECTOR

Prior to the introduction of reform in the early 1990s, the livestock sector was too large and was sustained primarily by large subsidies to producers and consumers. With the introduction of reforms, the livestock sector began to shrink as livestock inventories and livestock productivity declined. Output of livestock products declined 41 percent for meat, 30 percent for milk and 29 percent for eggs from 1990 to 1995 (Table 2.3).

Table 2.3: Production of Livestock Products in Russia

(million tons)

Livestock Products	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*% Change over 1990*
Meat[a]	10.11	9.38	8.26	7.51	6.86	5.93	-41
Milk	55.72	51.89	47.24	46.90	42.80	39.31	-30
Eggs	47.47	46.88	42.90	40.35	37.48	33.71	-29

[a] Carcass weight for beef, pork, poultry etc., including fat.

Source: Goskomstat of Russia, Mudahar (1996a) and USDA (1995a).

Livestock inventories declined 16 percent for dairy cows and 54 percent for sheep and goats from 1990 to 1996 (Table 2.4). Livestock productivity also declined significantly over the same period, as indicated by yields per animal, weight gain, feed conversion efficiency, and mortality rate (Table 2.5). Most of the changes reflect the combined impact of price liberalization, subsidy reduction, poor management, and inefficiencies in input and output production.

Table 2.4: Livestock Inventories in Russia

(million head on January 1)

Livestock	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*% Change over 1990*
Cattle (include cows)	58.8	57.0	54.8	52.2	48.9	43.3	39.7	-33
Cows	20.8	20.6	20.6	20.2	19.8	18.4	17.4	-16
Hogs	40.0	38.3	35.8	31.5	28.6	24.9	22.7	-43
Sheep & goats	61.3	58.2	55.3	51.4	43.7	34.5	28.3	-54
Poultry	654.0	660.0	652.2	568.2	565.0	507.8	439.0	-33

Source: Goskomstat of Russia, Mudahar (1996a) and USDA (1995a).

Table 2.5: Livestock Productivity and Feed Conversion Indicators in Russia

Indicator	*Unit*	*1990*	*1994*	*% Change over 1990*
Eggs per layer	Number	236	214	-9
Milk per cow	kg	2731	2195	-20
Annual weight gain per cattle[a]	kg	121	98	-19
Annual weight gain per swine[a]	kg	118	101	-14
Feed use per center of weight gain				
Cattle[a]	kg	13500	18.9	40
Swine[a]	kg	8300	12.5	51
Feed use per 100 kg of milk produced	kg	1400	1.7	21
Mortality rate (% of herd)				
Cattle[a]	%	3.0	6.1	103
Swine[a]	%	6.9	15.1	119
Sheep/goat[a]	%	7.9	13.7	73

a State sector only.

Source: Adapted from Goskomstat of Russia and USDA (1995a).

FALLING AGRICULTURAL INVESTMENT

As part of the macroeconomic stabilization program, budget allocations to the agricultural sector declined substantially after 1991 falling from 37.4 billion rubles in 1991 to 3.9 billion rubles in 1994 (Table 2.6). The budget allocations were used primarily to finance large subsidies, current expenditure (such as salaries, benefits, supplies, and other operations and maintenance expenditures), and capital investments. While the previous levels of budget allocation would be difficult to justify, agricultural expenditure since 1991 has declined so drastically that it is likely to hurt prospects for improving agricultural efficiency and productivity and the long-term potential for agricultural production in general.

Table 2.6: Public Sector Agricultural Expenditure in Russia

(billion 1991 rubles)

Type of Expenditure	*1985*	*1990*	*1991*	*1992*	*1993*	*1994*
Total agricultural expenditure	28.9	39.5	37.4	13.0	8.1	3.9
Livestock buildings	4.2	3.1	3.0	0.8	0.5	0.3
Land amelioration	3.9	2.6	1.5	0.6	0.4	0.2
Electrification	0.7	0.9	0.7	0.7	0.5	0.2
Plantations	0.3	0.2	0.2	0.07	0.05	0.06
Tractors, machinery, and equipment	11.6	15.3	14.3	2.8	2.2	0.9

Source: Goskomstat of Russia. Sel'skoeKhoziaistvo Rossii 1995.

PERSISTENT SECTORAL INEFFICIENCY

By any standard of efficiency, Russian agriculture falls short. The main reasons for low productivity are the following:

- limited entrepreneurial and economic skills of agricultural workers and managers suitable to a market economy
- collective ownership and poorly defined property rights that provide weak incentives to managers and workers
- lack of competition in the input and processing industries
- outdated agricultural production and processing technology
- price distortions caused by government intervention — particularly subsidies on key inputs — or incomplete price liberalization
- inadequate rural infrastructure for storage and transport of commodities from farm to market
- lack of economic, market, and legal information.

2.14. The cumulative effect of these and other shortcomings has been persistent inefficiency in Russian agriculture. Figure 2.5 illustrates some of the problems for wheat, the dominant grain in Russia, using wheat yields for the former Soviet Union for 1960-95 as a proxy. Russian wheat yields have shown significant variability, with a slow upward trend of 0.02 tons per hectare per year. By comparison, Canada has shown approximately the same rate of yield increase, but the gap between them

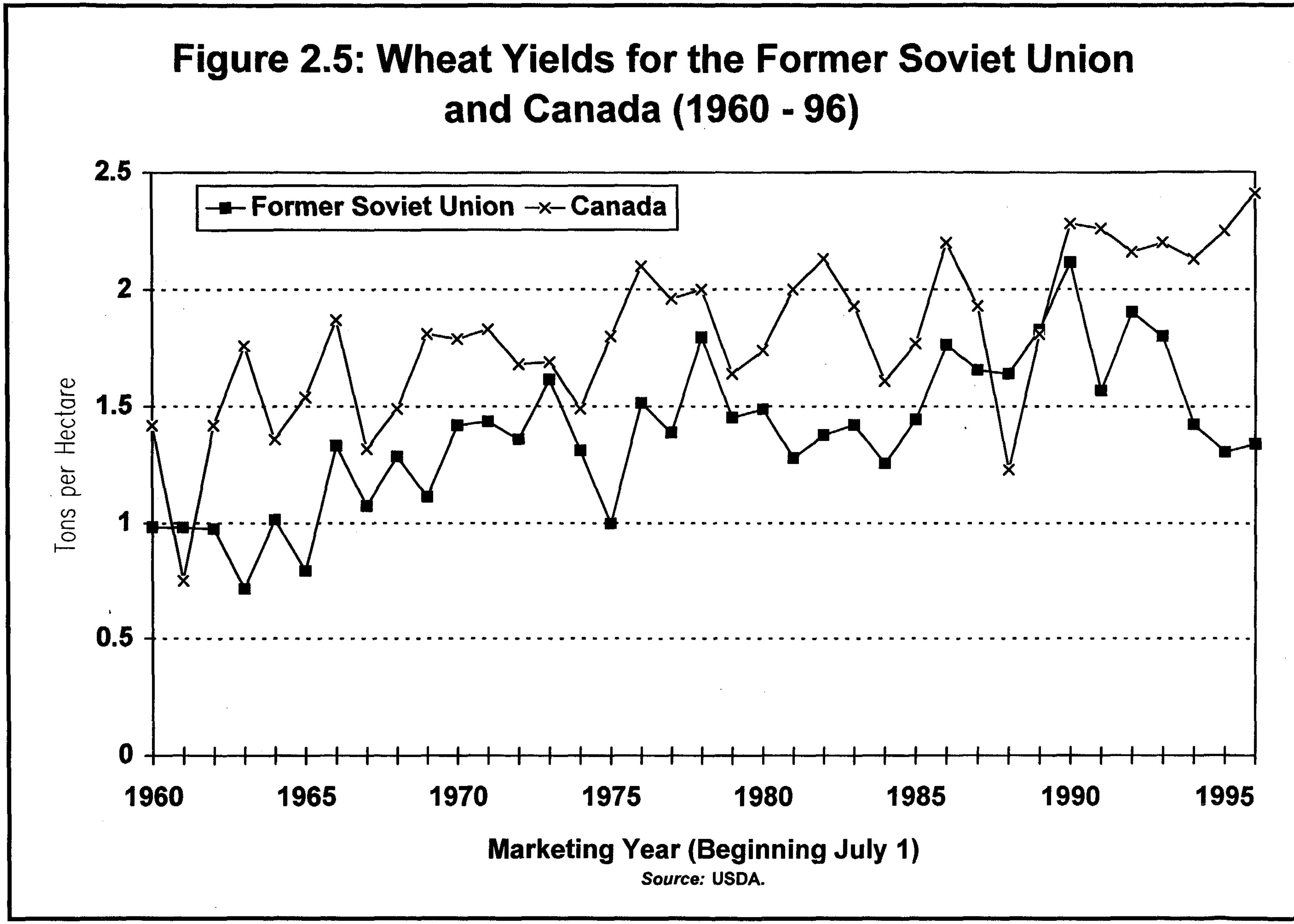


Figure 2.5: Wheat Yields for the Former Soviet Union and Canada (1960 - 96)
Former Soviet Union
Canada
Tons per Hectare
2.5
2
1.5
1
0.5
0
1960
1965
1970
1975
1980
1985
1990
1995
Marketing Year (Beginning July 1)
Source: USDA.

has been around 0.4 metric tons per hectare for much of the period, though it has been widening since the break-up of the Soviet Union. The gap partially reflects differences in climate and soils, but mostly it is due to differences in technology and economic incentives.

Russian livestock productivity also lags behind that in Europe and North America. Output levels in milk and swine enterprises are 60 percent those in the West. Feed efficiency in cattle and swine production is just half that in Europe. Given the historical importance of meat in the Russian diet and the declining output levels in feed grains and oilseeds, low feed efficiencies in livestock production are particularly worrisome.

These productivity gaps in Russian agriculture have persisted for a long time. But the productive potential of Russian agriculture should not be overlooked simply because of the sector's past performance. With improved technology and stronger economic incentives, agricultural output in Russia can be significantly increased. However, this will require not only improved agricultural incentives and policies but also improved access to more efficient agricultural technology. Thus the need for the generation and dissemination of appropriate agricultural technology is great.

IMPLICATIONS FOR AGRICULTURAL RESEARCH

Reform of Russia's agricultural knowledge system must be planned and implemented against this backdrop of massive structural change, declining output, and lagging productivity. The urgency of the sectoral reform and efficiency problems will likely swamp attempts to fund or reform agricultural research and education. Russian agriculture's reputation of low productivity and inefficiency is not likely to attract investors (local or foreign) in research -- public or private -- at this stage. However, these are the conditions under which the case for reform and improved agricultural research must be made to private investors, international financial institutions, bilateral donors, and national policymakers.

CHAPTER III

STATUS OF THE AGRICULTURAL KNOWLEDGE SYSTEM

STRUCTURE AND ORGANIZATION

Although this report focuses primarily on agricultural research, it is important to place this activity within the overall structure of Russia's agricultural knowledge system. The agricultural knowledge system is defined broadly to include agricultural education, training, retraining, extension, and technology transfer as well as agricultural research. Both public and private sector institutions play a role in strengthening the agricultural knowledge system.

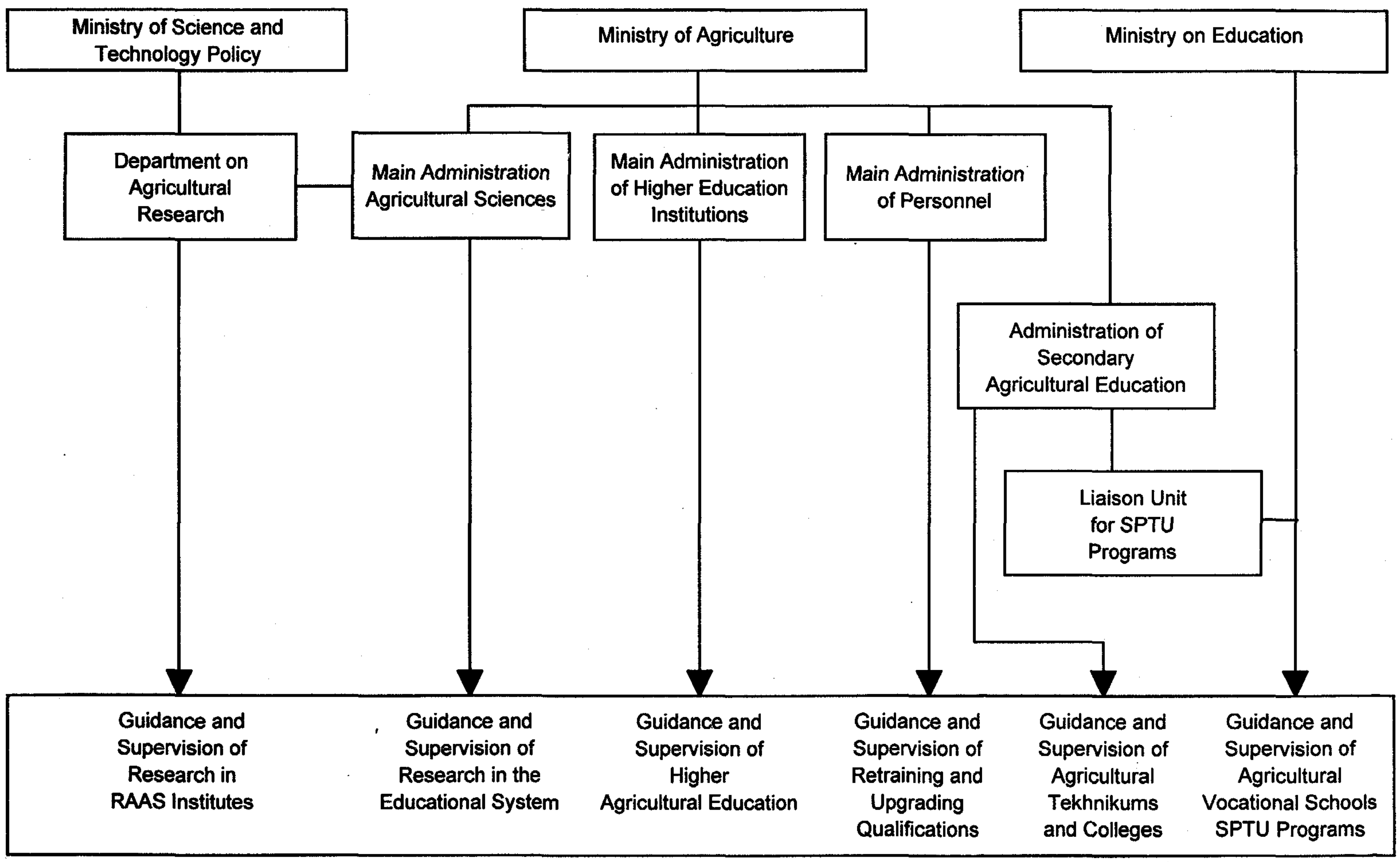
Russia's agricultural knowledge system was designed specifically to serve agriculture under the system of central planning (OECD 1994). It still retains most of its original characteristics and objectives:

- generate an adequate supply of semi-skilled and skilled agricultural workers for specific industries or enterprises
- generate an adequate supply of agricultural technicians and managers for agricultural enterprises
- provide the institutional capacity to retrain and improve the professional skills of workers, technicians, and managers
- develop and adapt agricultural production and utilization technologies through research
- transfer these technologies directly to production or processing enterprises
- provide policy analysis and information to central planners and government officials
- produce an adequate supply of agricultural scientists and educators.

Management and operational responsibility for the Russian agricultural knowledge system is shared by at least three federal agencies-- the Ministries of Education, Agriculture and Food, and Science and Technology Policy (Figure 3.1). The primary institutional building blocks for Russia's agricultural knowledge system are agricultural vocational training schools, technikums or agricultural colleges, agricultural higher educations institutions, scientific research institutes, and retraining institutes. However, the considerable research activities of the Russian Academy of Agricultural Sciences institutes fall outside the jurisdiction of higher education. The educational pathways that can be followed by qualified students are summarized in Figure 3.2.

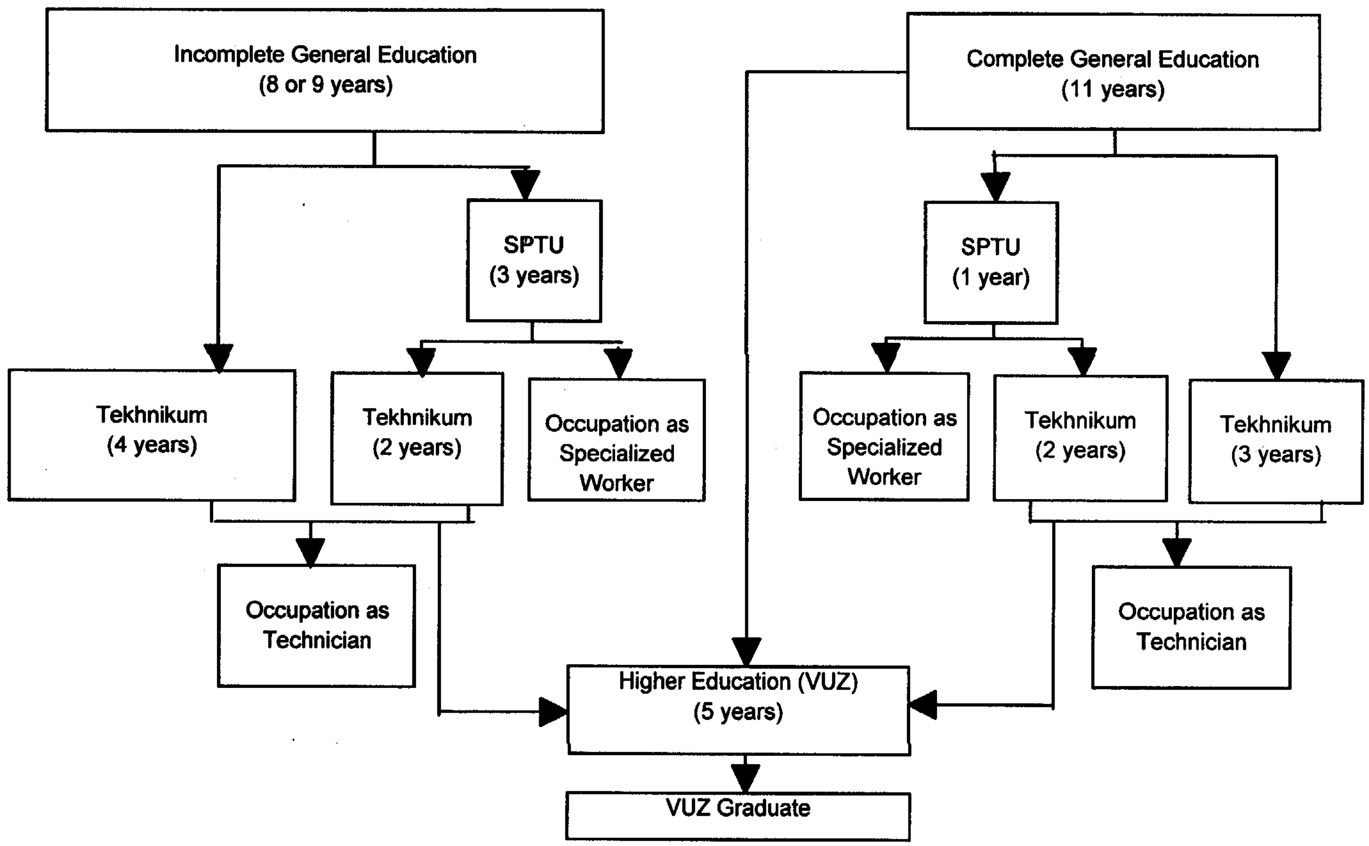
Agricultural vocational training schools. Students typically enter the agricultural vocational training schools in grade 8 or 9 and complete the training program with a certificate as a skilled agricultural worker in one of the 200 to 300 professions. The schools are financed at the oblast and rayon level. In 1992, there were nearly 2200 agricultural vocational schools in Russia. However, enrollment, as well as the number of offered professions, have fallen sharply since 1992.

Figure 3.1: Agricultural Knowledge System in Russia



Source: Based on OECD (1994.)

Figure 3.2. Agricultural Education System in Russia



Source: OECD (1994).

Tekhnikums or agricultural colleges. There are approximately 300 tekhnikums or agricultural colleges providing secondary vocational education. Graduates of these programs may enter a career as an agricultural technician or pursue further education. Since 1992, the tekhnikums have introduced new curricula that focus on retraining recent graduates in management and economics. Curriculum and funding for the tekhnikums are controlled largely at the federal level.

Agricultural higher educational institutions. The agricultural higher education institutions resemble agricultural colleges or universities in Europe and the United States. Students enter after completing general education or after graduating from a tekhnikum or agricultural college. Students traditionally received advanced, but very narrowly focused training related to a specific occupation, such as a crop production manager or food processing specialist. There are approximately 60 agricultural higher education institutions in Russia, consisting of 8 universities, 2 national academies, and 53 institutes. A complete list of agricultural institutes of higher education in Russia is provided in Annex A. Although the institutions tend to emphasize undergraduate education, they may also offer postgraduate degrees. Many of their faculty members conduct agricultural research as well.

Scientific research institutes. Agricultural research is conducted in over 300 research institutes across the country. Most of the research institutes fall under the direction of the Russian Academy of Agricultural Sciences (RAAS). However, approximately 80 are supervised by the Ministry of Agriculture and Food. This group of research institutes tends to be more narrowly focused than those under direction of the RAAS. In addition, there are a few scientific research institutes under the Russian Academy of Sciences (RAS) that address rural or agricultural problems. Several of the scientific research institutes also confer advanced degrees. Most scientific research institutes have rudimentary technology transfer and advisory capabilities. A list of the main agricultural research institutes in Russia is provided in Annex B.

Retraining institutes. Retraining or upgrading professional skills has been an important element of Russia's agricultural knowledge system. In 1992 several regional retraining institutes were established by the Ministry of Agriculture and Food by merging the continuing education programs of several agricultural academies. The retraining institutes offer short courses in upgrading technical agricultural skills and knowledge. However, they have also introduced training programs in farm management, accounting, agricultural law, and other emerging fields. The retraining institutes typically have only a small resident staff. They function, to a large extent as educational brokers -- organizing short courses, recruiting students, and hiring instructors from academies, tekhnikums, or the private sector.

MEETING DEMAND FOR HIGHER EDUCATION

Under central planning, educational, training, and professional improvement needs, were fairly predictable and under complete control of the state. The education system was designed to train people to function under very narrow job descriptions, and employment was guaranteed for life. This orientation differed markedly from that of European and North American institutions, which are oriented toward job mobility and multiple career paths.

The MOAF has initiated a series of studies under the auspices of the Scientific Research Institute of Social Problems in the Agro-Industrial Complex on demand for agricultural managers and specialists with a higher education. The preliminary results indicate that demand will slowly decline from 37,000 specialists in 1995 to 34,000 by 2005. The expected supply is 25,000-30,000 graduates each year. This estimated supply reflects a dropout rate of 25-30 percent and the fact that only 30 percent of the students graduating with an agricultural degree actually enter an agricultural profession. Preliminary reports by the Ministry indicate that in early 1996 over 130,000 agricultural graduates under age 30 were unemployed. However, the Ministry concluded that higher education for agriculture would still need to operate near current levels.

AGRICULTURAL RESEARCH MANAGEMENT

In the former Soviet Union, agricultural research management was the responsibility of the V. I. Lenin All-Union Academy of Agricultural Sciences (VASKhNIL). This huge scientific complex, established in 1929, played the role of research institute, funding agency, professional society, and extension service. The Russian Academy of Agricultural Sciences (RAAS) originated from VASKhNIL and was formally established in 1992.

RAAS manages some 235 crop and livestock research institutes and experiment stations. Of its 28,000 researchers, 700 hold the Doctor of science degrees and 8,700 candidates of science degrees. More than 400 state-run experimental farms and nearly 100 design offices, seed plants, and agro-processing factories are under the RAAS umbrella. Approximately 250,000 people are employed in laboratories, fields, farms, and shops that RAAS controls. About 1.7 million hectares of arable land (and total land holdings of 7.6 million hectares) are part of its experimental farm network. RAAS land holdings annually produce large quantities of seeds for cereals, vegetables, and potatoes; fruit cuttings; and pedigree young stock.

The main task of the RAAS researchers is to provide scientific support for Russia's agroindustrial complex. However, some of its institutes are also responsible for staff training and doctoral thesis preparation, supported by research work. This involves some 600 researchers each year. Fifty specialized boards are responsible for conferring doctoral and candidate degrees. Some RAAS researchers are involved as teachers in the higher educational, training, and qualification improvement system, and the leading researchers deliver lectures at universities, academies, and other institutes. An estimate of RAAS institutes, staffing and funding allocations for 1991/92 is presented in Table 3.1.

Table 3.1: RAAS Research Institutes, Staffing, and Budgets in 1991/92

Type of Research Institutes	*Number of Research Institutes*	*Research Staff*[a]	*Budget Proportions*[b]
Livestock	54	10,800	30
Crops	181	19,200	70
Total	235	30,000[c]	100

a Most of the research staff are well trained and hold Ph.D., doctor of science, candidate of science, or M.Sc. degrees.
b Budgets may not have been received in full by institutions.
c Estimated to have been reduced by 40 percent in 1993.

Sources: OECD (1994), MOAF, and World Bank estimates.

A comparison of agricultural research personnel in Russia, United States, and the Federal Republic of Germany shows that in 1991, there were 0.46 researchers for every $1 million in agricultural GDP in Russia (almost three times), 0.14 researchers in the United States and 0.16 researchers in the Federal Republic of Germany (Table 3.2). Russia had a much lower share of researchers working in the university system, however, and the university faculty devoted relatively less time to research institutes. Research in the private sector was almost nonexistent in Russia but it is beginning to emerge.

Table 3.2: Full-time Equivalent Agricultural Research Personnel, 1991

Category	*Russia (1991)*	*USA (1991)*	*Federal Republic of Germany (1989)*
Research institutes	23144	3687	13000
Universities	?	7525	2410
Private industry	0	14188	404
Total	23144	25400	4114
Researchers/100,000 ha of arable land	175	136	57
Researchers/million US$Ag GDP	0.46	0.14	0.16

Source: Pray and Anderson (1997).

Research management under RAAS has changed relatively little since the days of VASKhNIL. In theory, researchers identify potential projects and submit them to RAAS for approval and funding, along with an economic justification for the research -- how the project is expected to improve Russian agriculture. In practice, however, research management tends to be driven from the center, since research priorities and funding are controlled there.

Research management under RAAS is chaotic. The original structure for research management has remained in place, but the funding has not. A typical research institute under VASKhNIL would have received 80-95 percent of its budget directly from Moscow. The remainder would have come from product sales, fees, or research contracts with production or processing industries. These research contracts served both as a mechanism for technology transfer and as a source of graduate student research projects. Over the past 2-3 years, funding support from RAAS has fallen significantly -- often to 50-70 percent of original levels. The reduced funding levels have not been sufficient to cover even staff salaries. Operating budgets to perform research are almost nonexistent. The Russian agricultural research community is fighting for its survival.

The funding crisis has triggered a wide range of responses. Some researchers have quit for better paying jobs in the private sector, frequently outside their field of expertise, and some have taken on part-time jobs outside their own institutes. Others have begun to teach part-time at agricultural academies or retraining institutes. Some research institutes have merged with other institutes or teaching academies (Box 3.1), and some have refocused their research programs on topics of local interest, with an accompanying shift in funding from federal to oblast sources (Box 3.2). Some research institutes are aggressively seeking research grants from the MOAF or other sources, including the private sector.

Research institutes in urban centers frequently rent building and laboratory space to the private sector, while research institutes with experimental farms are increasing agricultural production on these plots and selling it to help support research and staff remuneration.

Box 3.1: Institutional Reform of the Agricultural Knowledge System in Omsk Oblast

Agriculture was expanded in Omsk Oblast in western Siberia during the new land programs of the 1950s and 1960s. Agriculture is an important industry and has always been given emphasis by the oblast administration. The agricultural knowledge system in Omsk was typical of that in many other oblasts -- a research institute, two agricultural academies of higher education reporting to MOAF, and a retraining institute.

In April 1994, three of the educational institutes took an unusual step -- they merged. Omsk State Agrarian University was formed by combining Omsk Agricultural Institute of Higher Education, Omsk Institute of Veterinary Medicine, and Omsk Institute for Retraining Agriculture Specialists. The merger was undertaken, in part, to address the financial problems experienced by all three institutions. But it was not a new idea. Institute administrators and oblast officials had been discussing a merger for the past 10 years. The merger has led to increased efficiencies in teaching common subjects. And the merged institutions have been able to introduce new subjects, such as market economics. The merger has not been effortless, however, and the three institutions still tend to refer to themselves as separate entities -- much like colleges within a university. But the merger was facilitated because all three institutions had, historically, reported to MOAF. This has been a step in the right direction since it has reduced overlap of functions, led to better utilization of resources, and improved cost consciousness.

The Siberian Research Institute for Agriculture (SRIA) is the major research institution in Omsk Oblast. It reports to MOAF and has not yet formally merged with the higher educational institution. However, over 50 percent of SRIA's researchers now teach at Omsk State Agrarian University. SRIA is also having to face fundamental choices about its research program. In the past, some research focused on designing irrigation systems for Kazakhstan. This need no longer exits. The institute is attempting to turn its attention to issues of local interest -- horticulture, for example. Omsk State Agrarian University appears to be well on its way to combining the research, teaching, and extension functions found at land grant universities in the United States.

This process of accommodation to reduced funding levels has not resulted in strong research programs designed to meet future agricultural needs. Rather, agricultural research and research management in Russia are in disarray and at risk. The old system of priority setting, funding, and oversight is not appropriate for Russia's transformation to a market economy. The morale of the agricultural science community is extremely low. The current state of crisis may change individual attitudes toward agricultural research, but it will not necessarily lead to a desirable outcome, in terms of both research priorities and research productivity.

Box 3.2: Shifting Funding and Shifting Priorities

The Scientific Research Institute of Agriculture for the Southeast Region (SRIASE) is the Volga region's premier wheat breeding institute. Established in 1909, SRIASE has a very good reputation for developing high-quality cultivars of durum, hard spring, and hard winter wheats. These cultivars are seeded on millions of hectares throughout this region.

In 1989, 81 percent of SRIASE's budget came from the federal government through VASKhNIL. The remaining 19 percent came from its own funds earned through the sale of seed and farm production. In 1993, SRIASE began receiving support from the oblast government -- about 16 percent of its budget. A year later, the oblast was providing nearly 40 percent of the budget, almost equal to the federal component. By 1995, the oblast contribution was approximately 50 percent of the total budget. As a consequence of the oblast's commitment to research, SRIASE has been spared some of the severe financial difficulties experienced by other agricultural research institutes.

How did this change occur? It was the result of an effective working relationship between SRIASE's administration and the oblast government. However, SRIASE has also redirected its research program to focus more on the needs of Saratov Oblast. It has become more applied and problem-oriented. Research on tillage systems and erosion control has increased. And linkages with extension and higher education institutions have been significantly strengthened. In addition, SRIASE has divested itself of experimental farms in neighboring oblasts. The changes initiated by SRIASE are very consistent with changes occurring in national agricultural research systems throughout the world -- increasing local funding and accountability and solving real problems faced by commercial agriculture.

CHAPTER IV

CHALLENGES FACING THE AGRICULTURAL RESEARCH SYSTEM

ATTRIBUTES OF A MODERN AGRICULTURAL RESEARCH SYSTEM

The fundamental challenge facing Russia's agricultural research system is to transform itself from a system designed to work under central planning to one that would work under market conditions— an extremely difficult process. But it would be imprudent for Russia to choose any other path. Russia's investment in its entire agricultural knowledge system is significant. There is great potential for institutional reform if human and financial obstacles can be overcome. However, merely preserving and strengthening the existing system is not an option.

It would also not be prudent to select, for example, a national agricultural research system in North America or Europe and simply pattern Russia's system after it. Russia's agricultural research system must reflect its unique history, resource base, and needs. In addition, the national agricultural research systems in most countries are themselves undergoing scrutiny and reform, making them a moving target rather than a static model to be replicated. It is extremely important for Russians to understand the directions of change as well as the likely characteristics of transformed agricultural research systems in other developed countries. Based on international experience, Byerlee and Alex (1998) provide a summary of "good practices" for research policy and research management in efforts for strengthening national agricultural research systems.

Some of the major changes occurring in national agricultural research systems around the world include the following:

- increased emphasis on cost effectiveness of agricultural research, often requiring reductions in staff and streamlining of bureaucracies;
- resource commitments based on anticipated applied research outcomes;
- increased involvement by users of research in decision-making, including resource allocation, private sector participation, and reduction of government's role;
- more access to research resources by those likely to benefit from its outcomes, including farmers, processing firms, and seed producers;
- consolidation of agricultural research activities in selected, well-equipped regional centers with appropriate financial support, physical equipment, and human resources to link researchers with major stakeholders, educators, producers, processors, marketers, and consumers;
- responsibility and substantial autonomy for management of research in main centers, with policy and funding bodies providing only overall guidelines on programs and outcomes;

- funding of special research institutes for national-interest projects and major national industries, with funds increasingly supplied from industry and, in many cases, managed competitively;

- shift from basic to applied research while ensuring public-good linkage between basic and applied research, with such research activities supported by government.

Porter (1990) makes some helpful observations about the characteristics of effective science and technology and the development of national competitive advantage, based on industrial country experience:

- Research is consistent with the nation's competitive advantage — it advances clusters of industries. To some degree, research seeks to retain and expand high-performing industries already operating in the country.

- Research is located primarily in research universities rather than government laboratories or research institutes. University research, because of institutional openness and industry contact, generally outperforms specialized government research institutes.

- Research emphasis is given to technologies that have commercial relevance.

- Strong links exist between industry and the research community. These links may take the form of specialized research institutions devoted to specific industries or clusters, research contracts, or formal technology transfer mechanisms.

- Private R & D is encouraged through direct incentives or intellectual property institutions.

- Science policy encourages innovation rather than providing extensive protection of property rights. This suggests a balance between protection and innovation incentives.

These common directions of change also imply a set of common characteristics for Russia's agricultural research system. In the future, Russia's agricultural research system will likely be more:

- decentralized, with increased local autonomy;
- accountable to key stakeholders;
- demand driven and responsive to clients;
- efficient (right sized, flexible, entrepreneurial, and coordinated with other institutions);
- linked with the global research community;
- sustainable, in its ability to produce new scientists, maintain an appropriate foundation in basic sciences, generate acceptable rates of return, and acquire adequate funding levels;
- coordinated and complementary with private research entities; and
- integrated with multiple technology transfer and educational interfaces, both public and private.

This description highlights the expected characteristics of Russia's agricultural research system. Nothing, however, has been said about how the Russian agricultural research system achieves these goals. The process of transformation is fraught with uncertainty. The macroeconomic and political environment, which is well outside the control of Russia's agricultural research managers, will significantly influence the success of many reforms. More important, few models of institutional reform that are relevant to Russia's conditions exist. Transformation strategies must, therefore, be undertaken in such a way that institutional learning can occur. This will take time and money to achieve.

HOW DOES RUSSIA'S RESEARCH SYSTEM MEASURE UP ?

In many countries, public agricultural research systems are becoming more demand-driven, efficient, and closely coordinated with the private sector. If these characteristics can serve as a benchmark, it is clear that Russia has a long way to go. Transformation strategies need to be based on a clear analysis of the current system's strengths and weaknesses and the opportunities and threats it faces now and in the future.

Strengths and Opportunities

The difficult challenges faced by Russia's agricultural research system should not obscure its many strengths, assets, and opportunities:

- Russia's agricultural research system is extensive and has comparatively high level of investment in human and physical capital.

- Russia's agricultural research system is distributed throughout its major agroclimatic zones. It was designed to be decentralized and close to stakeholders.

- The basic training of its technical agricultural scientists is good. Fundamental skills such as mathematics, statistics, chemistry, and physics are well developed.

- Agricultural researchers in regional institutions have a long tradition of entering into joint projects or consultancies with agricultural enterprises. This can form a foundation for more effective problem recognition and technology transfer.

- Despite low salaries, dwindling operating funds, and isolation from the world scientific community, many dedicated Russian agricultural scientists continue to work their trade as best they can.

- Russia's stock of agricultural research products has not been widely shared with the rest of the world. The potential for collaboration and mutual benefit in research with other scientists, public or private, around the world has scarcely been explored. This stock includes knowledge, expertise, new technologies as well as data.

- There are many reform-minded institutions and individuals in Russia's agricultural research system, and many positive examples of institutional innovation and reform. Many of the reforms, such as increasing contract research, are driven by financial necessity. Others, such as redirecting research away from minor crops and irrigation to work on improved tillage systems and erosion control practices, are being driven by scientists' response to client demands.

- Many agricultural researchers and institutions are seeking collaborative arrangements with foreign universities, government agencies, and private firms. These are new activities for many Russian scientists. Despite the novelty of these relationships, however, the entrepreneurial drive to create opportunities in research is clearly evident.

- Many Russian agricultural research institutes control extensive landholdings. These assets may form the basis for real "land grant" institutions. Well-managed farms can provide needed cash flows to support research activities. Furthermore, it may be possible to sell excess land and reinvest the proceeds in needed research facilities or as an endowment for financing research.

- Since the early 1990s, the federal government has devolved many financial decisions to regional governments. The oblasts now have authority to tax and spend, an important step for moving agricultural research closer to stakeholders.

Weaknesses and Threats

The fundamental weakness of the Russia's agricultural research system is that it cannot be financially or politically supported and sustained as it is currently configured. Many of its weaknesses are legacies of central planning that weaken the vitality of the agricultural research system:

- Centralized management is still the norm. Research managers and scientists are largely accountable and responsive to the center -- to MOAF and RAAS -- rather than to end users. Only to the extent that top administrators correctly anticipate end user needs can the current system be viewed as demand driven.

- The organization of Russia's agricultural research system is extremely complex. Scientific councils, boards, and committees abound. The effectiveness of this system in establishing appropriate priorities, incentives, and oversight is questionable.

- The system appears to have a great deal of overlap and duplication of responsibilities and a lack of coordination among research institutes as well as institutions of higher education with research programs. Duplication is difficult to pinpoint in any national agricultural research system, but the sheer size, isolation, and lack of local accountability in Russia would suggest that duplicated effort is likely.

- Research has focused on increasing primary agricultural production. Research objectives tended to be quota-driven, with little regard for economic efficiency, product quality, environmental consequences, or the safety of agricultural workers. This orientation is still evident throughout the system.

- Little, if any, research capability exists in agricultural economics, agribusiness management, or related social sciences. This fact remains despite the large number of economists working in separate research institutes in many oblasts. For ideological reasons, there had been little contact between Russian and western agricultural economists in the past. The two groups probably share a knowledge of constrained optimization. Beyond that, however, there appears little in the training or orientation of Russian economists to allow them to tackle the problems of market-based agriculture or the necessary transition (Box 4.1).

Box 4.1: Closing the Skill Gap in Economics

Economists employed in Russia's agricultural economics research institutes have had limited exposure to modern microeconomic theory, the foundation of agricultural economics. Without modern microeconomic theory and econometrics, as well as a healthy dose of economic intuition, Russian economists cannot function at the same level of their Western colleagues because they lack the scientific skills to examine problems in commodity marketing, technology assessment, industry performance and competition, finance, risk management, trade, and agricultural policy. Russian economists were trained in accounting, labor management, mathematical programming, statistics, law, and Marxist economic theory, valuable components of an economist's tool kit but not sufficient.

Russian economists also have limited knowledge of macroeconomics, its link with the agricultural sector, intersectoral economic linkages, and the impact of macroeconomic stability on decision-making and profitability at the farm and enterprise level. Knowledge of modern theory of economic growth and international trade is essential for designing strategies for agricultural development, especially in the context of transition to market economy. These skill gaps can only be closed with in-depth training, ample access to Western economic literature, and upgrading of computers and appropriate software.

- Agricultural scientists have had almost no exposure to concepts in agricultural economics or farm management. Limited economic literacy makes it difficult for them to understand incentives for farmers to adopt new technologies. Consequently, the design attributes of new production technologies do not reflect the realities of decentralized, profit-oriented farm management.

- Research capacity in utilization, food science, storage, transportation, logistics, and marketing is rudimentary at best. It is found mainly in specialized institutes, with little contact with agricultural scientists or end users.

- The integration of production research with environmental disciplines is extremely limited. To some degree, this reflects the limited scientific development of agroecology in Russia. However, some environmentally relevant research capacity does exist -- in soil conservation and land reclamation, for example. Again the vertical, discipline-based structure of Russia's agricultural research system limits opportunities for multidisciplinary research. This working environment is essential if integrated production systems are to be developed and successfully transferred.

- Laws governing intellectual property rights are being developed in Russia, but even with established law enforcement capacity, these laws will be extremely difficult to enforce. As a consequence, publicly funded intellectual property — often in the form of crop varieties or animal biotics — can wind up in private concerns without payment of royalties to the institutions that developed it. Along similar lines, the lack of strong enforceable intellectual property laws inhibits the growth of privately funded research and technology transfer.

- Central planning has determined the location and structure of Russian agricultural enterprises. These decisions have in turn influenced the structure and orientation of agricultural research in Russia. Price liberalization and other economic reforms will change the scope, scale, and location of Russian agriculture to some largely unknown extent. The current configuration of Russia's agricultural research system does not necessarily reflect the emerging changes in agriculture.

Why Has the System Been So Unproductive?

The productivity of a public agricultural research system is determined by several interrelated factors. Among the more important are:

- the management of the research enterprise itself, including priority setting, problem focus, scientist training, and motivation;
- the levels of support and investment for scientists;
- the efficacy of public education and technology transfer systems;
- the capacity of and incentives for the private sector to commercialize research findings; and
- the efficiency and profitability of the agricultural sector.

Russia's agricultural research system appears unproductive because many of these conditions are not met. Some of the major factors that influence Russian research productivity are evident in a comparison of yields for continuous or stubble-cropped hard spring wheat in northwestern North Dakota in the United States and Saratov Oblast in Russia. The two regions are roughly comparable in terms of agroclimatic characteristics (Table 4.1) but quite different in terms of wheat yields (Table 4.2). Though it is not possible to apportion yield differences specifically among technology, management, and the regional environment, it is possible to draw some inferences after making a few assumptions.

Table 4.1: Meteorological Comparisons in North Dakota, US, and Saratov, Russia

Agroclimatic Indicator	*Williston, North Dakota*	*Saratov, Russia*
Latitude (° N)	48.11	51.34
Precipitation (mm)		
May-August	215	177
Total	365	465
Mean Temperature		
May-August	17.7	19.4
December-February	-11.2	-8.9
Whole Year	4.8	6.1
Days Above 0° C	177.2	206

Sources: Murganov, 1992 and High Plains Climate Center, University of Nebraska.

Table 4.2: Spring Wheat Yield Comparisons between Saratov, Russia and North Dakota, US

Yields	Yields (100kg/ha)		
	Saratov[a]	North Dakota	Yield Gap
A. Farmers' average	7.5	22.6[b]	15.1 (201%)
B. Experimental farms	11.8	-	-
C. Experimental plots	15.0	34.1[c]	19.1 (127%)
Yield Gaps			
(B-A)	4.3 (57%)	-	-
(C-B)	3.2 (27%)	-	-
(C-A)	7.5 (100%)	11.5 (51%)	-

Note: Yields in Saratov are reported at the farm or oblast level for large-scale experimental farms operated by the Russian wheat breeding institute and at the varietal test plot level. Yields in North Dakota are reported at the farm or regional level and from replicated varietal trials in the same region.

a 1981-1993 average.
b 1991-1994 average, continuous crop.
c 1991-1994 average, area semi-dwarf, varietal trials.

Sources: Scientific Research Institute of Agriculture for Southeast Region, Saratov, Russia and L.A. Spilde, Department of Plant Sciences, North Dakota State University, Fargo.

For Saratov, the yield gap between farmers' fields and the experimental farms is due largely to technology. Farm organization, management, and economic incentives are similar on the research institute's farms and on large-scale collectives farms. Regional production differences are also likely to be small. The yield gap between the experimental farms and the experimental plots reflects differences in management and environment -- due to small plot size and location. If the plot or environmental effects increase yields by, say, 10 percent, then management differences account for a yield gap of roughly 1.7 quintal/ha (= 13.5 - 11.8; one quintal = 100 kg = one centner). This suggests that most of the observed gap of about 6 quintal/ha (= 13.5 - 7.5) between maximum feasible yields and yields obtained on farmers' fields is due to technology transfer rather than ineffective management of existing technologies.

The yield gaps between farmers' fields in Saratov and North Dakota are quite large, much larger than the aggregate yield estimates presented earlier in Figure 2.5. The yield gap between plots is also large but smaller proportionally than the gap between farmers' fields. Part of the plot gap is likely attributable to inherent productivity and weather differences between the two regions. But given the size of the gap, it seems likely that the best Russian technology lags U.S. technology by a significant amount.

Finally, the yield gap between farmers' fields and experimental plots is larger in absolute terms in North Dakota than in Saratov, though proportionally it is only half that observed in Saratov.

The yield gap analysis is based on averages and therefore masks the productivity trends experienced in Russia. A time series plotting of spring wheat yields in Saratov at three levels of aggregation shows a precipitous decline in productivity (Figure 4.1). The decline stems largely from a lack of inputs. Inadequate machinery capacity due to mechanical failure and a lack of spare parts have reduced the timeliness of planting and harvesting. Fertilizer and pesticide inputs have been cut sharply, while the use of low-quality seed has reduced stands significantly. As a consequence, the historical yield gaps between farmers' fields, experimental farms, and experimental plots in Saratov have been closing, but for the wrong reasons.

Though incomplete and admittedly somewhat conjectural, the foregoing analysis suggests that the Russian research establishment has not been able to effectively transfer existing technologies to farmers or to keep pace with research advances in similar agroclimatic regions in North America.

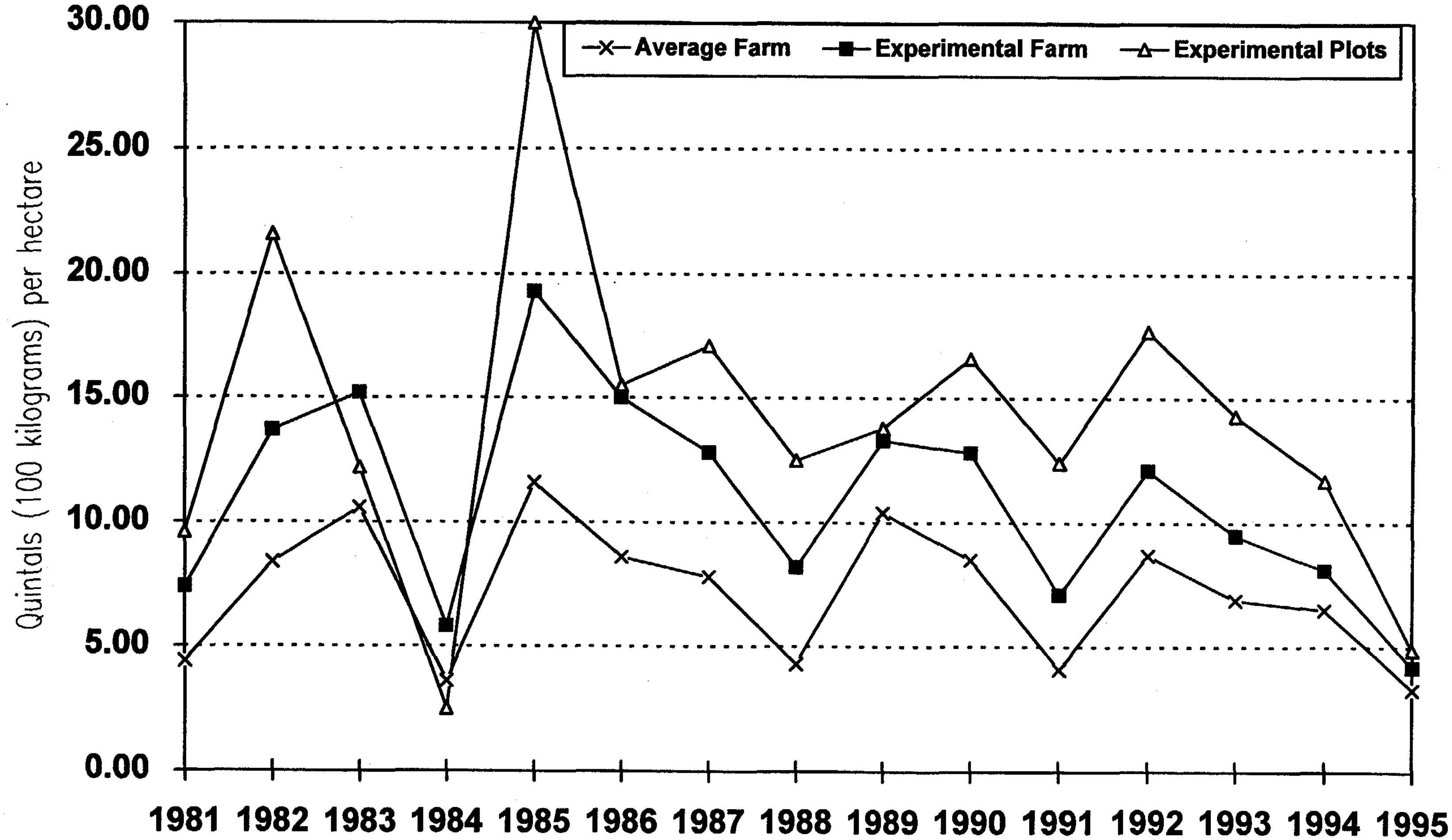
The agricultural technologies being adopted today are the result of investments made years earlier. Lags in research and technology adoption can distribute the impact of these investments over a significant length of time — up to 30 years in some cases (Pardey and Craig 1989). Even allowing for differences in levels of scientific support, private research, and scientist training, Russia appears over the past 35 years or so to have invested in agricultural research at levels comparable to those in West. Lack of research productivity does not appear to be simply a matter of inadequate research inputs. This would suggest that inadequate motivation and coordination of researchers and extension personnel have contributed to low research productivity.

Finally, the agricultural research establishment cannot be productive if the agricultural industry is inefficient. There is an extensive literature documenting the negative relationship between agricultural productivity and price distortions (Fulginiti and Perrin 1993, 1996; Alston and Pardey 1996). For Russia, the lesson to be learned from this literature is that agricultural productivity will be depressed if price signals or state orders fail to provide correct incentives to motivate and coordinate managers and workers. This, in turn, reduces incentives to adopt new technology and manage it appropriately. Clearly, research incentives and directions will be adversely affected by distorted economic signals as well. The lack of productivity of Russia's agricultural research establishment may be attributable largely to the inefficiencies inherent in central planning (Wong and Ruttan 1990).

FUNDING AND STAFFING OF AGRICULTURAL RESEARCH SYSTEM

It is difficult to accurately estimate total expenditure on the agricultural research system in Russia, for several reasons. The system is large and complex, with varied responsibilities that often extend beyond the agricultural research function and many different sources of financing (though the primary source has been the federal government). Incomplete estimates of actual expenditure related to agricultural research and problems of the transition to market economy further complicate the process. The best and relatively complete estimates on actual agricultural research expenditure are available for 1994, and the following analysis is based on these estimates. This information clearly demonstrates the precipitous decline in Russian agricultural research funding.

Figure 4.1: Spring Wheat Yields in the Saratov Oblast, Russia (1981 - 95)



Source: Scientific Research Institute of Agriculture for Southeast Region, Saratov, Russia

Funding for Agricultural Research

By international standards, total R & D expenditure on agricultural research was very small in 1994. It has declined even further since then. In 1995, total budgetary funding for agricultural research was about 15 percent (in real terms) of 1991 levels. Clearly, funding for agricultural research in Russia is well below global trends. In 1994, total nominal funding for agricultural R and D was 94.6 billion rubles for institutes under the direction of the Russian Academy of Agricultural Sciences (RAAS)and 31.0 billion rubles for those under the Ministry of Agriculture and Food (MOAF), for a total of 126 billion rubles, or about 0.25% of agricultural GDP.

Funding the Russian Academy of Agricultural Sciences. Federal funding for RAAS was 123 billion rubles ($55.6 million) in 1994 (Table 4.3). Planned allocations dropped to $33 million in 1995, bringing the RAAS budget expenditure as a share of Russian Academy of Sciences' expenditure from 26 percent in 1994 to 21 percent. Of the total budgetary financing for RAAS, $42.8 million (about 75 percent) was used for agricultural R & D (Table 4.4). The required payments by the RAAS to the budget (such as taxes and social security payments) were estimated to be 1.7 times more than the funding for RAAS from the budget during 1994. It is not clear whether these payments were in fact made, however.

Table 4.3: Federal Budget Expenditures on the Russian Academy of Sciences and the Russian Academy of Agricultural Sciences, 1994 and 1995

Federal Funding for	*1994*		*1995 (est.)*	
	Billion rubles	***Million US$***	***Billion rubles***	***Million US$***
Russian Academy of Sciences (RAS)				
Basic funding	438.9	198.4	687.0	150.5
Additional financing[a]	28.0	12.7	22.0	4.8
Total	466.9	211.1	709.0	155.3
Russian Academy of Agricultural Sciences (RAAS)	122.9	55.6	150.3	32.9
A share of RAS funding (%)	26		21	

[a] Funds earmarked for its Urals, Siberia and Far Eastern divisions.

Source: The Russian Academy of Agricultural Sciences.

Funding research under the Ministry of Agriculture. Selected indictors for agricultural research institutes under the Ministry of Agriculture and Food are reported for 1994/95 in Table 4.5. Total expenditure on agricultural R & D was 51 billion rubles (about $23 million). The bulk of the budgetary allocations was used to meet current expenditures, such as payroll, social security taxes, supplies, and equipment.

Table 4.4: Financing of the Russian Academy of Agricultural Sciences, 1994 and 1995

(Billions of rubles; U.S. dollars in parentheses)

Financing	*1994 (Actual)*	*1995 (est.)*
Total financing from the budget	126.2 (57.1)	n.a.
R & D financing	94.6 (42.8)	150.3 (32.9)
Experimental production	29.6 (13.4)	n.a.
Industry	2.0 (0.9)	n.a.
Total payments to the budget and social security[a]	341.7 (154.5)	255.4 (115.7)

a. It is not clear whether reported payments to the budget and social security were infact made in full.

Source: The Russian Academy of Agricultural Sciences.

Funding of Research Programs

Three programs received all of the agricultural R & D expenditure for institutions under the Ministry of Agriculture and Food: agricultural sciences (86 percent), natural sciences (10 percent), and engineering sciences (4 percent; Table 4.6). From the total resources allocated to "internal" R & D, 53 percent was allocated to applied research, 35 percent to developmental research, and 12 percent to fundamental or basic research. Though similar information was not available for research programs supported by RAAS, the broad allocations are likely to be of similar magnitude.

Although agricultural research has been financed primarily by the public sector, there are indications of limited participation by the private sector. There is also some evidence that most research institutes are now involved in some commercial activities (production and sale of seeds or agricultural output) to meet some of the costs of research activities and staff salaries. Clearly, agricultural research is not receiving the priority it deserves during this period of transition due to serious budget problems.

Qualifications of Agricultural Research Personnel

Overall, the training and qualifications of R & D staff in Russia are of reasonably high quality (Table 4.7). About 60 percent of R & D personnel working in the federal research institutes under the Ministry of Agriculture and Food have doctor of science, candidate of science, or college degrees. The quality of personnel working in the RAAS institutes is similar. However, research staff generally lacks training in social sciences, particularly economics and business management, which are important disciplines for guiding appropriate agricultural research and establishing research priorities for emerging private agriculture. Average salaries for agricultural researchers are lower than in other sectors of the economy. For example, in 1995 the average salary in RAAS was one-third the economy-wide average. As a result, researchers are leaving for other jobs. As of mid-1995, one-third of researchers had left RAAS during the previous 2.5 years.

Table 4.5: Selected Indicators for Federal Research Institutes Subordinate to the Ministry of Agriculture and Food, 1994

Indicator	*Level*	*Equivalent US$*
R&D activity		
Number of R & D personnel	8,380	
Fixed assets (million rubles)	141,760	64.1
Scientific equipment (million rubles)	21,593	9.8
Working capital (million rubles)	23,903	10.8
Total R&D (million rubles)	50,868	23.0
R&D conducted directly by institutes — without subcontracting (million rubles)	44,509	20.1
R&D cost structure (%)		
payroll	46	
materials and equipment	20	
Average monthly wage (rubles)	161,200	73
Average monthly wages of researchers (rubles)	193,800	88
Production and economic activity[a]		
Fixed investment (million rubles)	16,989	7.7
Profits/losses (million rubles)	4,987	2.3
Memo: Average exchange rate (rubles per US$)		2,212

Notes: The RAAS is not included in this table.
a Production activities refer to production of crops, livestock, or seed for sale.

Source: Ministry of Agriculture and Food of Russia.

Table 4.6: R & D Expenditures for Federal Research Institutes Subordinate to the Ministry of Agriculture and Food, by Research Program, 1994

Research Funding	*Percentage Share*
Research Program:	86.0
Agricultural sciences	10.4
Natural sciences	3.6
Engineering sciences	0.03
Medical sciences	0.0
Social sciences	0.0
Humanities	
Program total	100
Funding Sources:	78
Internal R & D state budget[a]	
Extrabudgetary fund	7
Commercial sector	5
Own financing	5
Other sources	5
Total	100

a Of this, 85 percent of spending was on agricultural sciences, 8 percent on natural sciences, and 7 percent on engineering sciences.

Source: Ministry of Agriculture and Food of Russia.

Table 4.7: Qualifications of Researchers Working at Federal Research Institutes Subordinate to the Ministry of Agriculture and Food, 1994

Level of Education	*Number*	*Percentage Share*
College degrees	3,517	42
Doctor of science	160	2
Candidate of science	1,256	15
Specialized secondary education	1,076	13
Other[a]	2,371	28
Total	8380	100

a Calculated as a residual.

Source: Ministry of Agriculture and Food of Russia.

Financial Support to the Agro-industrial Complex

Financial support to the agro-industrial complex, while declining over time, remains large (Table 4.8). In 1994, total direct financial support (federal and local) was about $4.6 billion, or almost 20 percent of the agricultural GDP. Of this, 69 percent was for subsidies (Table 4.9), 14 percent for capital investment, and 17 percent for other expenditure. Only a fraction of direct financial support (1.2 percent) went to finance R & D for agriculture. There is no economic justification for large subsidies to loss-making agro-industrial enterprises. The subsidies not only delay needed adjustments to improve the efficiency of agricultural enterprises but they are also too expensive to finance.

Table 4.8: Financial Support to the Agro-industrial Complex in Russia

Type of Support	*Actual*			*Estimated*	
	1992	*1993*	*1994*	*1995*	*1996*
	(Billion rubles)				
Total direct support	703	3,966	10,158	13,000	13,170
Capital investment	178	935	1,375	2,893	4,918
Other expenditures	112	526	1,811	2,477	3,104
Subsidies	413	2,505	6,971	7,630	5,148
Total indirect support	n.a.	n.a.	n.a.	55,692	73,356
Tax discounts	n.a.	n.a.	n.a.	20,000	20,000
Commodity credits	n.a.	n.a.	n.a.	13,000	18,900
Forgiven and rescheduled loans	n.a.	n.a.	n.a.	17,500	26,100
Electricity discounts	n.a.	n.a.	n.a.	5,192	8,356
Total direct and indirect support	n.a.	n.a.	n.a.	68,692	86,526
	(Percent)				
Total direct and indirect support as share of:					
Consolidated budget expenditure	n.a.	n.a.	n.a.	14.1	n.a.
Federal budget expenditure	n.a.	n.a.	n.a.	24.9	19.9
GDP	n.a.	n.a.	n.a.	4.1	3.8
Memo: Ruble-dollar exchange rate	223	934	2,203	4,562	4,799

n.a. is not available.

Note: For 1992-94, the totals include both federal and local support; for 1995 and 1996, totals include only federal support. The data are in nominal terms.

Source: Institute for the Economy in Transition, Goskomstat of Russia; USDA (1995a).

Table 4.9: Direct Subsidies as a Portion of Total Gross Revenues for Individual Commodities in Russia

(Percent)

Commodity	*1993*	*1994*	*1995*
Grain	0.3	0.6	5.4
Sunflower seed	0.0	0.3	0.4
Sugarbeets	0.0	1.6	3.2
Potatoes	0.0	0.6	5.6
Vegetables	0.0	4.3	1.9
Flax	59.2	73.0	n.a.
Milk	25.5	22.8	11.2
Cattle	19.8	27.4	8.6
Hogs	18.8	22.9	10.9
Sheep	24.9	44.5	19.0
Poultry	17.7	20.5	10.9
Wool	31.4	55.5	40.0
Eggs	14.6	13.1	6.9

n.a. is not available.

Note: Data are based on a sample of eight former state or collective farms.

Source: Russian Ministry of Agriculture and Food; USDA (1995a).

NEEDED STRATEGY FOR TRANSFORMING THE RESEARCH SYSTEM

So how does Russia's agricultural research system measure up? Using the characteristics and orientation of emerging national agricultural research systems in other industrial countries as a benchmark, several broad areas of change are evident. Over the next 4-5 years Russia must:

- Fundamentally reorient its research decision-making, priority setting, and incentive system toward the needs of end-users rather than demands from the top.

- Significantly increase the efficiency and effectiveness of the agricultural research system, by reducing costs, increasing revenues, and improving the quantity and quality of research output.

- Rapidly increase expertise in critical research areas not adequately represented today, especially in agricultural economics, farm and agribusiness management, financial management, agro-ecology, modern biology (biotechnology), food technology, logistics, and extension.

- Alter the legal status and relationships of research institutions to federal agencies such as MOAF and RAAS.

- Improve and modernize technical knowledge and economic literacy throughout the agricultural research community.

- Modern national agricultural research systems should employ multiple outlets for technology transfer, both public and private. The agricultural research system does not need to control the technology transfer system, but it does need to know how to use it. Russia's agricultural research system must develop the capacity to transfer its products to end-users through the most appropriate and cost-effective means.

- Redefine federal and oblast partnerships and roles in financing, coordinating, and providing oversight to agricultural research, education, and extension. The goal of moving research closer to the customer suggests that funding and accountably be moved to the oblast level. On the other hand, research spillovers — research results financed in one region that benefit another — suggest a continuing role for the federal government. Opportunities to "free ride" can also cause systematic underinvestment in agricultural research when local funding sources are employed.

- Reduce professional isolation through increased use of low-cost communication technologies. Many Russian research institutes cannot access the Internet because they lack modems. A simple, low-cost system to allow Russian scientists to search databases (such as AGRICOLA or CAB Abstracts) and communicate with colleagues should be adopted as soon as possible.

- Significantly upgrade scientific equipment and facilities to meet world-class standards. Given the high cost of this investment, it must follow a priority-based strategy that is consistent with reform objectives for the entire system.

- Develop appropriate technology and effective transfer methods for smallholders. Private farms and household plots will play a critical role in transforming production agriculture and meeting future food needs, and Russian agricultural research must ensure that the needs of smallholder producers are being met.

- Import and adapt appropriate agricultural technology, where possible. Research knowledge and technology transferability are quite high in some areas — basic animal nutrition and food technology, for example. Russia needs to seek out cost-effective technologies that can be used to rapidly increase productivity in key areas (Box 4.2).

- Develop links with the Consultative Group on International Agricultural Research (CGIAR) and other international research institutions, particularly those serving similar agroclimatic regions.

- Continue to reform the agricultural sector to reduce price distortions and redirect funds from subsidies to activities with potentially higher payoffs, such as research and extension.

A number of longer-term issues of Russia's agricultural knowledge system that must be addressed to increase the effectiveness, efficiency, and sustainability are summarized in Table 4.10.

Box 4.2: Doing Research for Russian Conditions

One statement frequently made by Russian agricultural scientists is that certain research projects are needed to develop technologies that work "under our conditions." For some production enterprises this makes sense. Cropping or grazing systems certainly need to be tailored to the characteristics of soils, climate, or landscape. Often, however, "our conditions" simply means developing technologies to accommodate distorted price signals, inadequate managerial skills, or input shortages. Changing the conditions is clearly the better way to go.

This illustrates another point, however. The Russian agricultural establishment needs to carefully assess when research is needed and when knowledge and technology can be imported and adapted to local conditions. Food processing, transportation, and logistics is notoriously inefficient in Russia. However, a sizable stock of research findings and technologies is available from other countries. The same holds true in animal nutrition and genetics. It makes little sense to invest in basic genetic or nutrition research at this stage of scarce resources when such information can easily be obtained from similar research done elsewhere.

In areas where research or technologies can be imported, Russian scientists need to become skilled in technology evaluation, adaptation, marketing, and transfer and in intellectual property issues. Undertaking research for "Russian conditions" is certainly necessary— but only in specific situations. Acquiring, evaluating, and adapting existing technologies— particularly germplasm and management practices used in similar agroclimatic regions in other countries— have the potential to rapidly advance Russian agricultural science and technology.

Table 4.10: Analysis of Issues for Strengthening Agricultural Research, Higher Education, and Extension in Russia

Issue	*Approach to Solution*	*Comment*
POLICY		
1. Analytical capability for policy analysis limited by data inadequacies and scarcity of human resources.	Bolster economic and social science research capabilities and devote more resources to the collection of socio-economic data on the sector.	Existing institutions have very limited links to mainstream agricultural research institutes and agricultural universities.
2. Little or no integration of research, higher education, and technology transfer. The potentially diverse client base of production, processing, and marketing is omitted from sectoral planning.	Focus on one integrated agricultural knowledge center per region, providing services of higher education, research, and technology transfer for small, medium, and large producers, processors, and marketers in both public and private sectors.	Any incremental funding to the subsector must be well focused.
3. Benefits of research and extension not reaped unless the profitability of innovation is clear.	Implement pricing policy reforms, state procurement reforms, realistic taxation regimes for agriculture, and land tenure security.	Other interventions address these wider issues. Their impact is assumed within an appropriate timeframe to benefit agricultural research, higher education, and extension.
INSTITUTIONS		
4. Inadequate linkages between research and higher education.	Focus diminished resources on a single center of agricultural knowledge for each region, to gain cost efficiencies.	Returning to the past situation will not provide maximum benefit. Focusing on integrated systems will foster linkages.
5. Loss of irreplaceable human capital.	Preserve essential elements of the existing system to avoid the need for massive future investment. Increase staff salaries, research resources, and graduate student stipends and fellowships.	This is unlikely to occur without external assistance.
6. Inadequate research funding leads institutes to divert limited resources for production purposes or to seek external research contracts which do not reflect the cost/value of research or further their objectives. Integration with higher education is reduced by this trend.	Introduce contract research for agreed national and, in particular, regional applied research that encourages joint involvement of eligible universities and research institutes. Separate income generating activities from research.	Current research grants may not meet the required criteria of objectivity in selection, orientation to users, and involvement of external and independent persons.

Table continues on the next page

Issue	*Approach to Solution*	*Comment*
7. Difficulty in integrating research institutes and universities and in including extension activities because of the geographic and institutional separation of research institutes and universities.	Focus on research institutes that are close to universities and encourage institutional integration through joint professional positions, students' research, and other teaching. Introduce the extension concept to researchers as a user orientation and to universities as a new subject area.	Existing institutional arrangements render decisions on the funding of distant research institutes difficult. Early investment may be needed in order to strengthen such decision-making.
8. Financial inefficiencies at the central level that reduce funds received at regional level; central-level institutional responsibility unclear.	As far as possible, allocate project funds to targeted institutions while recognizing the objective of strengthening Russian capability to administer funds under new circumstances.	Regional institutions have limited administrative experience.
9. Absence of agricultural economics, marketing, agribusiness, and extension in university curricula.	Introduce new courses and departments at appropriate universities and reorient management to accommodate these areas to greatest benefit.	Management styles at universities appear to be top-down, which has a dampening effect on the benefits of diverse professional input.
10. Inefficient proliferation of research and higher education institutes in some regions.	Combine institutes to form an agricultural university in regions that lack one.	Efficiencies can be gained through close management of such mergers.
11. Too many research institutes and insufficient linkages between them; too much staff and ineffective institutional systems.	Conduct a management review of research institutes. Allocate budgets to participating research institutes (close to agricultural universities) that meet selection criteria.	Implications of combining institutes are staff reductions and reorientation of institute objectives and strategies.
12. Concept of extension is poorly understood. Some elements of extension in farmer training centers, but without full access to agricultural knowledge resources.	Introduce extension at the university level, initially to train extension educators and to develop an extension service linked to the research-higher education complex. Focus extension at the regional level.	The role of farmer training centers in higher agricultural education requires clarification.
13. Inadequate equipment and facilities for research and higher education; insufficient budgets to address these needs.	Invest substantially in research and higher education equipment and renovation of existing facilities. Provide materials, equipment, and facilities for extension.	Quality and maintenance of existing buildings is highly variable.

Table continued on the next page

Issue	*Approach to Solution*	*Comment*
14. Management systems, styles, capabilities, and tools not oriented to changed circumstances. Professional motivation and satisfaction given a low priority.	Provide management training and assistance. Improve staff salaries and conditions, including a role in decision-making.	Goodwill exists among staff and should be retained through sensitive handling of management training.
15. Inadequate financial support for agricultural research, increasing risk that irreplaceable elements will disappear.	Provide financial support to operations to preserve key elements.	Entrenched attitudes that incremental funds should preserve the status quo conflict with the reality of structural change.
TECHNOLOGY		
16. Lack of information technology and equipment for teaching.	Provide appropriate equipment.	Specific needs are still to be determined.
17. Outdated textbooks and technology at university level; not connected to international system.	Provide and translate textbooks, support staff exchanges with foreign universities, and provide library support.	Language is a constraint to gaining access to international knowledge.
18. Inadequate research equipment.	Provide adequate equipment.	Specific needs are still to be determined.
19. Lack of international exposure by researchers and unnecessary duplication of experiments.	Support exchanges of researchers, joint programs, library support, and advisers.	Language training may be necessary.
20. Technology promoted to farmers and other users not suitable to their actual needs.	Introduce the two-way communication concept of extension, initially through higher education and later through pilot advisory services.	Implementation should be slow to allow a gradual understanding of the process and its adaptation to Russian requirements.
21. Objective considerations of financial, economic, and adoption factors not included in research proposals.	Supplement research funds through an objective competitive grant system. Provide assistance for applied research proposal preparation.	The implication that some research areas may not receive funding should be made clear.
22. Depletion and pollution of natural resource base for agriculture.	Include sustainability and resource protection criteria in research planning criteria and university curricula.	These will require international collaboration.

Source: Adapted from World Bank (1994c).

CHAPTER V

TRANSFORMING THE AGRICULTURAL RESEARCH SYSTEM

Reform of Russia's agricultural research system will be an uphill battle under the best of conditions. Here are a few of the major obstacles.

- It will be difficult to develop a viable constituency, particularly in the Ministry of Finance, that supports agriculture and is committed to the need for agricultural research.

- Funds to support the needed restructuring and reinvestment will be in short supply. Competitors for public funds abound. Private funds will be difficult to attract until the needed reforms have been made.

- No tested model exists for restructuring a complex national agricultural research system developed under central planning to one appropriate for a market economy.

A number of reviews of Russia's agricultural knowledge system have been conducted over the past few years (OECD 1994; World Bank 1994c). What typically has emerged from these reviews is a mind-numbing list of problems and an equally discouraging list of broad recommendations. At a practical level, it is difficult to translate such recommendations into manageable programs. To some degree, this difficulty arises because the needed steps combine short-term crisis management with long-term institutional reform for Russia's national agricultural research system. What is needed is a framework that breaks down an enormously difficult task into smaller, coordinated steps.

CONCEPTUAL FRAMEWORK FOR MANAGING TRANSFORMATION

Conceptual Framework. Suppose that it were possible to examine each scientific research institute in Russia, or even better, each research program and rank them on the basis of the following three attributes: strategic value, vulnerability, and program quality. Doing so would shed light on the strategy needed for transforming the agricultural research system in Russia. These three attributes might be defined as follows:

- ***Strategic value*** reflects the present value of future benefits generated by an institute or program to Russian society or the world scientific community. This value might arise in a number of ways: Through a significant increase in productivity or reduction in losses in major agricultural enterprises that directly affect the economic well-being of producers and consumers; through agricultural research assets such as germplasm or scientific know-how that are unique and have value to both Russia and the world community; through ongoing research programs that maintain agricultural productivity (for example, breeding crops for disease and pest resistance); and through research programs that address critical national and regional needs, such as agricultural sustainability, rural development, policy evaluation, food technology, transportation and logistics, and farm management. Strategic value is not independent of its time context. For example, a publicly supported maintenance research program for wheat rust resistance might be strategically very important in the short run, but its strategic value may decline with the development of private wheat breeding companies or may be redirected toward more basic aspects of the problem.

- ***Vulnerability*** is a short-term concept reflecting the likelihood or risk of significant loss of research assets — biological, physical, and human — within, say, the next 1-3 years.

- ***Quality*** is a longer-term concept and is both an input and an output measure. How good is the science being produced relative to work conducted elsewhere in the world? How skilled and well-trained are the scientists? How good are the research facilities, field plots, equipment, or databases?

Strategic Value and Vulnerability. The hypothetical results for an agricultural research system consisting of five research institutes or individual programs that have been ranked on the basis of strategic value and vulnerability are presented in Figure 5.1. Within this short-term context, the research manager must develop a strategy for *stabilizing* the research system, given a fixed or declining funding base. Here are some possible approaches for the five institutions.

Institutes A and B are ranked low in strategic value but differ in their current vulnerability. Most research managers, if confident in their assessment of strategic value, would terminate both programs.

Institutes D and E are assessed to have high strategic value, but differ in vulnerability. For institute D, funding at current levels seems reasonable. Certainly, low-cost options to enhance institutional effectiveness should be explored -- cost control, program review, staff exchanges, or steps to overcome professional isolation such as connection with the Internet. Institute E is obviously at risk and merits aggressive intervention. Grants to protect high-value research assets would seem to be justified. Additional financial support for program or salaries might be required. Assistance to lower cost of the sort provided to institute D would be appropriate

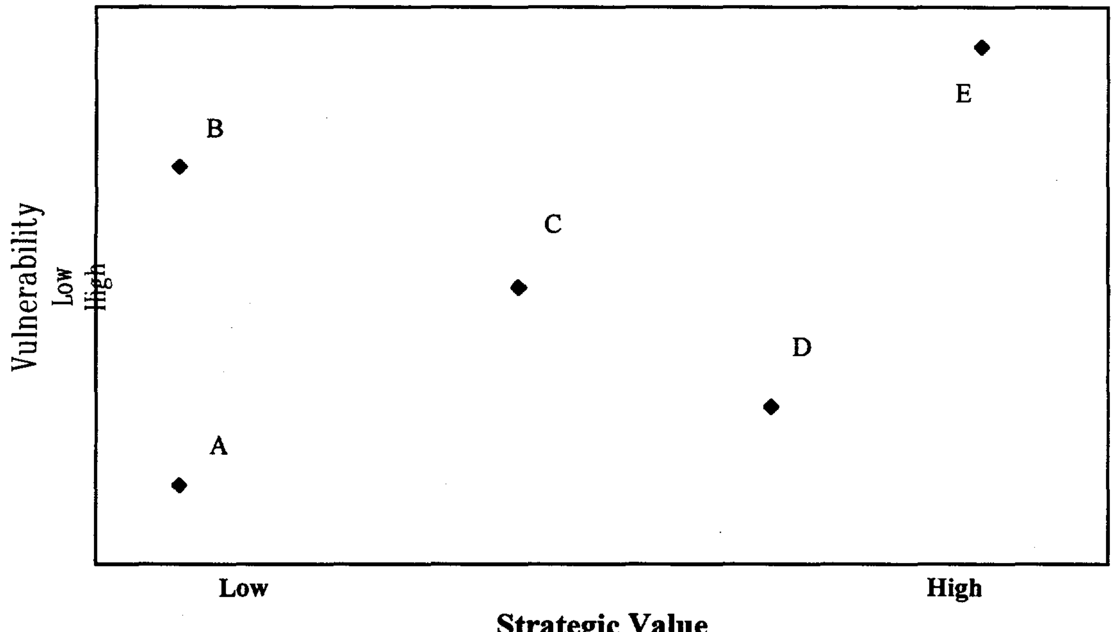
Institute C is clearly stuck in the middle — not very important, not terribly vulnerable. Benign neglect is one attractive option. Institute scientists could be considered for some low-cost assistance -- but not much more should be offered. Measures of strategic value might be difficult to make, and the irrevocable step of terminating the research program would not be undertaken immediately.

Strategic Value and Program Quality. The same hypothetical research institutions are next assessed from the perspective of program quality and strategic value (Figure 5.2). Program quality is a longer-term characteristic. In this situation, the research manager must develop a strategy that focuses on institutional reform and development.

In this example, ***institute C*** remains stuck in the middle. Benign neglect still seems like a reasonable approach. ***Institute A*** should be closed. The fact that it can survive in the short run does not compensate for its lack of strategic value or program quality. Continuing to operate this institution consumes resources that are needed to support higher-priority programs.

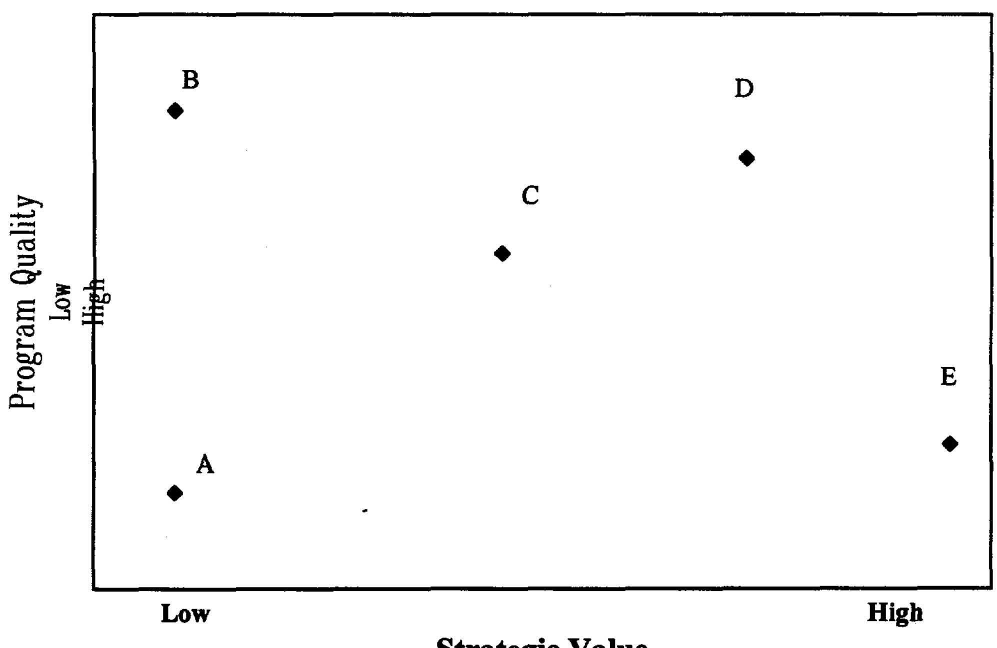
Institute B has a high-quality program, but is strategically not very important and is quite vulnerable. This situation might be representative of a more basic or pretechnology research institute and is fairly common in Russia, where mission drift has resulted in high-quality programs that do not support high-priority objectives. One option might be to seek a foreign partner, public or private, that has need of this institute's scientific expertise and privatize it. Alternatively, it might be possible to help

Figure 5.1: Research Program Assessment: Strategic Value and Vulnerability



Source: Author's Data

Figure 5.2: Research Program Assessment: Strategic Value and Program Quality



Source: Author's Data

scientists from the institute find work opportunities abroad or in other programs and then close the institute.

What about ***institutes D and E***? On the basis of short-term survivability, institute D required modest assistance. However, we now see that this institute's programs are of high quality and strategically important. In this case, long-term investment and program development are probably warranted. Institute E is a tough call — high strategic value but with a very vulnerable, low-quality program. An example of this situation might be found with an economics research institute. Economics is clearly of high value to Russia. However, most Russian economists are simply not competitive with their Western counterparts. Starting over may be warranted if the existing human or physical capital cannot be upgraded cost-effectively. Alternatively, if the institute is to be maintained, a combined strategy of stabilization, reform, and reinvestment must be developed.

5.12. ***Action Plan.*** The foregoing discussion illustrates some of the key considerations that research managers, government officials, and scientists must take into account in devising appropriate strategies for transforming Russia's agricultural research system. The exercise is admittedly easier said than done. But it does clarify the following four action steps that should form the basis of any strategy for reforming the agricultural research system:

- Evaluate and screen research institutes on the basis of strategic value, vulnerability, and program quality.
- Stabilize highly vulnerable programs that meet specific strategic value and quality standards.
- Reform and redirect targeted institutes and programs that meet minimal standards for strategic value and quality. Terminate programs that do not.
- Reinvest in physical and human capital to bring the research establishment up to needed standards.

5.13. The overall management objectives for this action plan are straightforward.

- ***Buy time.*** Identify and stabilize high-value, vulnerable programs and institutions. This protects Russia's agricultural research system in a cost-effective way and provides needed breathing room to transform the system. Furthermore, it provides a means to separate short-term crisis management from the time-consuming activities required to reform and refocus key agricultural research institutions.
- ***Facilitate organizational learning.*** Reforming a national agricultural research system established under central planning is uncharted territory. Russia needs to develop and pilot models of institutional reform. Organizational learning cannot proceed if a crisis mentality exists or if overall priorities and strategy are poorly articulated.
- ***Develop needed human capital.*** Several areas of science that are critical to a modern agricultural research system are not sufficiently developed in Russia. Economics and agroecology are the most obvious omissions. Furthermore, general upgrading of traditional agricultural fields is sorely needed. Finally, it is imperative that Russia's agricultural scientific community be re-integrated with the rest of the world.

- ***Implement appropriate long-term changes.*** Resource reallocation and reinvestment must be made slowly over a number of years. Closing facilities, merging staff, and rebuilding research capacity all require careful planning, political action, and staff support. These changes cannot be made over night.

FINANCING RESEARCH TO FACILITATE TRANSFORMATION

Conventional wisdom — and most international reviews — holds that Russia's agricultural research system is overgrown and too complex and must learn to operate on a leaner budget. Tight budgets can create incentives to reform. While it would seem reasonable to expect reform to occur within existing budget constraints, stubborn adherence to existing budgets often stymies institutional change. The following arguments justify supporting modest and carefully targeted increases in funds.

- ***Stabilizing the system.*** A number of high-value agricultural research assets and programs are at risk. They must be identified and stabilized quickly. This process cannot proceed rapidly enough if the required funds have to be carved out of existing programs. Intervention to stabilize targeted elements of Russia's agricultural research system requires new funding.

- ***Overcoming institutional inertia.*** Large organizations rarely act decisively. In times of financial adversity, the typical response of administrators is to preserve all the elements of an organization and reduce funding proportionately. Sharing the pain seems to be politically more expedient than making clear allocative decisions based on priorities. This across-the-board mentality prevents meaningful institutional change and ensures future mediocrity. Yet, it is extremely difficult, particularly when a high degree of uncertainty exists, to make decisions to terminate some activities and shift resources to others. Many research programs have a certain "option value" that will justify continuation until the long-term value becomes more apparent. In the short run, it is frequently much more effective to strengthen high-priority programs and then to begin the more difficult, long-term process of redirecting funds and scientists or shedding labor. Clearly this strategy requires additional funds.

- ***Creating incentives.*** Russia's agricultural research system must become more demand-driven, coordinated, and efficient. This requires a fundamental change in researchers' behavior and corporate culture. These changes can be greatly facilitated by creating the proper incentives. One option is to introduce a competitive grants program that supports the desired research or technology transfer activities. Well-crafted and administered grants programs can change research institutions much more effectively than directives and jaw-boning ever could. In addition, small salary bonuses, travel funds, and new scientific equipment can also do wonders to change corporate culture. This too requires additional funds.

- ***Rewarding highly qualified research administrators.*** Institutional reform cannot be accomplished through a reliance on competitive grants. At best, a grants program will result in a high-quality patchwork of scientific projects. Skilled research management is essential if programs are to fit together in ways that actually solve problems. Integration and coordination of the various research programs can only be accomplished through administration. Consequently, salaries for effective research managers must be sufficiently high to attract and retain them in these positions.

- ***Improving research facilities and equipment.*** Russia's research capital stock does not meet modern standards. A significant capital expenditure is required to modernize facilities and equipment. The major stumbling block is deciding which facilities should be improved and who should pay for it. These difficult decisions, however, should not obscure a simple fact: new investment in agricultural research facilities and equipment is needed if Russia's agricultural research system is to be viable. Furthermore, this long-term investment will likely require debt financing. Few agricultural research systems in industrial countries can handle major capital investments out of operating budgets. Capital expenditures must be amortized over a time horizon that is compatible with operating budgets and debt service capacities.

- ***Seeking alternative financing sources.*** In addition to budgetary allocations by federal and oblast governments, the agricultural research institutes must explore alternative funding sources to finance specific research programs. Possible alternative funding sources include multinational companies (for inputs, seeds, chemicals, biotechnology, food technology); domestic private companies; and endowments set up from the sale of surplus land (most agricultural research institutes have excess land) and commercial enterprises. However, use of these alternative financing sources would require institutional and program reforms.

This list of justifications, while not complete, does demonstrate ways in which new funds can increase the effectiveness and efficiency of Russia's agricultural research system. Societal gains from improved research output and cost savings from improved research management can be expected to more than off-set the incremental funding increases required to facilitate institutional change and recapitalize the reformed agricultural research system. The extensive evidence on returns to agricultural research assures us of this fact. But the additional funds obtained through loans, credits, or grants must go to reform Russia's agricultural research system, not simply maintain the status quo.

ISSUES IN TRANSFORMING THE AGRICULTURAL RESEARCH SYSTEM

Beyond the immediate needs to stabilize and transform Russian's agricultural research system lie several longer-term issues that must be confronted. Two of the most pressing are developing objective guidelines and mechanisms for setting research priorities and establishing the appropriate level and mix of research investment. To gain some insight into these issues for Russia and other transition economies, we turn once again to the experience of the international agricultural research community.

Guidelines for Establishing Research Priorities

As discussed in the US Task Force on Research Innovations for Productivity and Sustainability (1995), Falconi and Elliot (1995), Purcell and Anderson (1997), and the World Bank (1996b), research administrators typically distinguish between the following four types of research:

- ***Basic research,*** which creates new scientific knowledge to achieve new understanding but with no immediate commercial application.

- ***Strategic research,*** which provides knowledge and techniques to solve specific problems that have a wider applicability.

- ***Applied research,*** which develops new technologies and tangible inventions by adapting basic and strategic research to solve specific field problems.

- ***Adaptive research,*** which involves selecting and evaluating technological innovations to assess their performance in a particular agricultural system and adjusting technologies to fit specific environmental conditions.

There is a need for an appropriate balance among these four types of research in order to develop technologies to solve specific agricultural problems. Basic research generally requires financing by the public sector, whereas applied and adaptive research could generally be funded by both the public and private sectors (Umali 1992; Thirtle and Echeverria 1994). Finally, the generation of technology (agricultural research) must be closely integrated with a system to transfer technology (agricultural extension) so that it is responsive to the problems faced by clients (farmers).

Given the limited financial resources allocated by the public sector for agricultural research and ever increasing demands on these limited resources, there is a need for clear guidelines for establishing research priorities (see Bottomley and Contant 1988; McCalla 1994b; McCalla and Ryan 1992; Collin 1989; Collin and Kissi 1995; and Alston, Norton, and Pardey 1995). Based on international experience, guidelines for setting agricultural research priorities are summarized in Box 5.1. These guidelines are especially important for transition economies such as Russia, where the agricultural sector is passing through a major structural transformation and the financial resources for agricultural research are very limited. Following these guidelines will not only result in a cost-effective and transparent approach to reform agricultural research system but will ultimately lead to higher returns to investment in agricultural research. According to Purcell and Anderson (1997), the key elements of a viable agricultural research system are:

- human resource development;
- provision of research facilities and equipment;
- organization, management, planning, and linkages among research entities;
- linkages with client and relevant technology;
- funding of national agricultural research systems; and
- incentives for research performance.

Financing Agricultural Research Investment

In addition to the priorities assigned to agricultural research, how the investment is financed, at what level, and by whom all contribute to the efficiency of the research enterprise. There are four basic aspects to these choices:

- ***National or regional?*** In general, funding of agricultural research by the beneficiaries makes sense. This is one of the major forces driving decentralization of agricultural research worldwide. Local funding translates into local accountability. But because the benefits of agricultural research do not respect political boundaries (Khanna, Huffman, and Sandler, 1994; Alston, Norton, and Pardey 1995) some level of national funding is justifiable to account for the transferability of research benefits into and out of a region. The greater the spillover, the greater the case for national support. However, increased national funding can attenuate local accountability and the extent to which research is demand driven. There are no simple rules to resolve this dilemma.

Box 5.1: Guidelines for Agricultural Research Priority Setting

Market failure

Priorities for public research funding should be in areas in which there are 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 pre-research 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 adoption domestically;
- the faster the adoption of the research results domestically;
- the lower the adoption of research results in other countries;
- the sooner the reduction in unit cost is realized;
- the lower the rate of research depreciation;
- the lower the research cost;
- 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 effect of research on reducing distorting effects of price policies; and
- the greater the effect of research on reducing distorting effects of externalities.

Net domestic research benefits are not affected by many price-distorting policies, 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 for income or nutrition, compared with policy instruments such as taxes and subsidies. Research tends to be both an ineffective, and a very costly method for pursuing social policy objectives. Domestic "producer" benefits are increased 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;
- when the technology applies farther down the marketing chain towards farm-level production;
- the lower the adoption of research results in other countries; and
- the faster the adoption of research results domestically relative to other countries.

Source: Purcell and Anderson (1997); originally from Alston, Norton and Pardey (1995).

- ***Private or public?*** Public funding of research is justifiable only when the private sector is unable or unwilling to make investments at levels desired by society. Again, no simple allocation rule exists. And the allocation between public and private research is clearly evolutionary. It changes as firms become more able — through experience or institutional innovation — to extract rents from their research investment. The private sector in Russia is not yet developed enough to make significant contributions to agricultural research. (see Annex C for the role of public sector in financing research, and Annex D for the role of private sector in financing research.)

- ***Russia or the international community?*** Ideally, Russia should have the best agricultural research system it can afford to support. However, there are clearly roles for the international community in supporting the reform and transformation of Russia's agricultural research system. Most of these roles are short-term in nature, primarily to support stabilization and restructuring initiatives. However, the same spillover argument that justifies a mix of regional and national support within Russia can also be made between Russia and the international community. It makes sense for Russian scientists to receive partial funding from international agencies for agricultural research that benefits other regions or countries. (See Annex E for the role of international agricultural research system and Annex F for funding of agricultural research by the World Bank.)

- ***Budgetary support or loans?*** The final funding dilemma embodies most of the foregoing choices and depends on the mix of regional, national, and international support as well as on the relative roles of the public and private sectors. Budgetary allocations from regional or national governments finance ongoing programs through operating budgets. Budgetary allocations can also be used, in a limited way, for capital investment or debt service. The two uses compete with each other, and research administration must attempt to maintain an appropriate balance.

AGENDA FOR CAPACITY DEVELOPMENT AND INSTITUTIONAL REFORM

A ship's rudder works only when the ship is moving. So too with institutional reform. Getting a few things started is more important than waiting in hopes that some optimal plan can be developed and adopted. In this section we propose and briefly describe six priority areas that build on international experience but are intentionally limited in scope. By limiting project scope, we believe that the required course of action can be determined and implemented. And although the projects focus directly on needed action in Russia, they are appropriate for agricultural research reform in other transition economies.

The overarching objectives for the proposed projects are to stabilize critical elements of the agricultural research system and to develop workable models of institutional reform. In addition to these longer-term objectives, it is important that the world scientific community stay engaged with their Russian counterparts despite the political and economic uncertainties that will prevail in Russia for the next several years. In brief, the objectives of six priority areas are as follows:

- To develop and implement a plan to stabilize specific agricultural research programs that are considered to be of high strategic value and are extremely vulnerable to loss (see Box 5.2).

- To develop within RAAS, MOAF, and the Russian agricultural scientific community the capability to establish and implement appropriate science policy and advocacy.

- To reconnect the Russian agricultural scientific community with the rest of the world. In particular, to seek out and implement cost-effective ways to reduce the impact on Russian agricultural scientists of years of professional isolation.

- To develop and pilot models of professional development that can rapidly introduce critical skills into Russia's agricultural research system. These skills include agricultural economics, agribusiness management, agroecology, extension methods, and adult learning behavior and research management.

- To develop and pilot models of institutional reform at the oblast level that significantly increase the effectiveness and efficiency of research directed toward a critical need within the oblast that has national importance and consequences.

- To develop and pilot models for research institute mergers, closures, downsizing, or program termination.

Box 5.2: N. I. Vavilov Institute of Plant Industry

The N. I. Vavilov Institute of Plant Industry (VIR) in St. Petersburg, founded in 1894, holds one of the world's largest and most important germplasm collections — over 340,000 accessions of more than 2,500 species. VIR provides research support to all of Russia's plant breeding centers. Funding for VIR comes directly from the federal budget. Severe funding shortages have put, VIR's research program and its germplasm collection at risk. VIR's vulnerability has been recognized by the World Bank and other international agencies, which have accordingly provided support.

These steps are necessary antecedents to any large-scale transformation of Russia's agricultural research system. There is little doubt that long-term social returns from agricultural research will significantly exceed debt service requirements from any investment financed by borrowed funds. However, prudent allocation of loan funds requires time and management experience -- both lacking in the Russian agricultural research establishment. In certain situations, therefore, pilot projects supported by donor grant financing might be justified.

Stabilizing Agricultural Research System

The Russian agricultural research system needs to identify priority agricultural research institutions, assets, and programs with high strategic value that are vulnerable to significant or irreplaceable loss over the next two to five years. Each priority program needs an appropriate stabilization plan. A long-term plan is also needed to ensure the future viability of the research program.

Major participants in this project would be a small management team representing MOAF, RAAS, financing entities, and international consultants on science policy or specific areas of science. The success of this project depends entirely on the commitment of the MOAF and RAAS to reform the agricultural research system. Research managers must be willing to objectively evaluate each institute's program using clear economic criteria. Furthermore, they must be willing to consider strategies in which they deliberately share power with other entities and decentralize decision-making. It is not possible to evaluate the strategic value, vulnerability, and quality of a research program without confronting decisions to close or downsize institutions, shift priorities, or redirect scientific activities.

Expert consultation and advice can play a critical role to ensure objective evaluation and provide needed scientific expertise. Consultants should be drawn from the ranks of scientists and administrators in leading agricultural research universities and selected research institutes from the CGIAR.

Funding this activity is tricky business. Incentives to misrepresent institutional vulnerability and value are obviously high. Funding might be based on some of the following criteria:

- Require cost sharing between MOAF and RAAS, the international funding agency, the oblast government, if appropriate, and the specific institution receiving assistance.

- Cap total, one-time funds available from the funding agency at a relatively low level.

- Provide financial assistance primarily in the form of loans. Loans would seem preferable to grants since the intent is to preserve research assets that have high future value. Loans also create a repayment obligation, which should reduce the incentive to misrepresent program vulnerability, value, or quality. However, debt service requirements and operating budget requirements must be carefully reviewed. To the extent that strategic value accrues to the world scientific community, limited grant funding would also be appropriate.

Strengthening the Capacity for Agricultural Science Policy

During the Soviet era, agricultural science policy and advocacy were the domain of VASKhNIL. With the collapse of the USSR, the establishment of RAAS and, more recently, its merger with MOAF, the lines of authority for science policy and advocacy have become blurred and in some cases obliterated. Russian agricultural science needs a body that can develop and clearly articulate science policy and strategy. Russian agricultural science also needs a body that can clearly present to legislative bodies and other stakeholders the case for agricultural research and the benefits it yields. It is likely that the two bodies need to be distinct and independent. Russian agricultural science also needs to reestablish field-based professional societies that are well connected to the major international professional associations. Finally, Russian science administrators in RAAS and MOAF need a technical assistance program, possibly supported by donor grants. Technical assistance would be provided by research administrators and staff from leading agricultural research institutions. Key areas of assistance would include:

- study tours of leading agricultural research institutions, universities, and agricultural research advocacy groups

- training programs on agricultural research administration and evaluation. This would include choices in funding mechanisms, public and private sector research, establishment of priorities, and monitoring and evaluation

- training programs on agricultural research advocacy and legislative strategy

- preparation of a policy document governing agricultural science in Russia.

As transformation of Russia's agricultural research system proceeds, support and accountability will become closely tied to oblast governments. However, national representation and coordination of research will still be needed. And Russia's scientific community needs to develop leaders with a strategic perspective on agricultural research who can seek opportunities and react to potential threats. Strengthening agricultural science policy, ultimately, seeks to develop this strategic capability.

Providing Internet Access to the Agricultural Research Community

Political ideology, distance, poor communication systems, and declining budgets have isolated Russian agricultural scientists from colleagues elsewhere. At a time when instantaneous global communication over the Internet is almost commonplace, Russian scientists are nearly cut off from the world's scientific community.

Although a network of major Russian universities does exist, few agricultural institutions have access to it — usually because they lack dedicated phone line or a modem or the funds to cover the cost of access to the telephone network. These are small obstacles compared with the benefits that would accrue were Russian agricultural scientists to gain full access to the Internet. Internet access is certainly not a perfect substitute for journal subscriptions, attendance at professional meetings, scientific exchanges, or joint research. But it is cost effective. And on a daily basis, Internet access can play a major role in reuniting Russian agricultural scientists with their colleagues -- both inside and outside the country.

Developing Critical Scientific Skills

There are two basic approaches to developing critical scientific skills. The first would rely on a central institution that would receive needed training and then train trainers at specific agricultural academies or research institutes. The second approach would be more decentralized and offer training in critical needs directly to faculty and researchers at specific institutions.

The first approach would likely be more cost effective in the use of donor funds. However, it would also tend to centralize expertise and information -- a throw-back to Soviet era policies. This would clearly be an unfortunate consequence, since a vibrant research and educational community requires professional independence, institutional freedom, and competition. But with proper safeguards, the pitfalls of centralization can be avoided.

The Timiryazev Moscow Agricultural Academy (TMAA) has a well-established tradition of providing support and educational materials throughout Russia's agricultural knowledge system, and its administration and staff have clearly stated their willingness to engage in such activity (Box 5.3). Mentoring is an essential component of this effort. TMAA could be linked with a counterpart one North American and a European university that could provide training to selected TMAA faculty members. Centers of excellence could be established in TMAA in areas that are not adequately represented in Russian agricultural research. Selected research institutions in Russia could then pilot training programs developed by TMAA and its counterparts.

Box 5.3: Timiryazev Moscow Agricultural Academy

Timiryazev, Moscow Agricultural Academy is one of the oldest agricultural educational institutions in Russia. Established in 1865, it has been home to some of Russia's most distinguished agricultural scientists over the past 130 years: K. A. Timiryazev, D. N. Pryanishnieav, N. I. Vavilov, V. R. Williams, N. D. Kondratiev, and V. S. Nemchinov, among others.

Timiryazev Agricultural Academy has a well-established tradition in training Russian agricultural scientists and educators. Approximately 70 percent of all textbooks, laboratory, and other teaching materials in use in Russia were prepared by the academy's faculty. Recently, the academy's administration has attempted to establish international contacts to upgrade programs in economics, agribusiness management, agroecology, extension education, and research management. Because of its historical position, Timiryazev is uniquely suited to serve as Russia's training institute for these critical areas.

For each critical area, the counterpart institution and TMAA will develop and conduct a training program to upgrade scientific skills to an acceptable basic level. With support from the counterpart institution, TMAA would develop appropriate training materials and programs, and TMAA staff members would pilot basic scientific training programs at selected research institutes. TMAA faculty trained in critical skill areas would also participate in selected research programs through pilot consultancy programs. For example, TMAA faculty might collaborate on projects on technology evaluation, commodity marketing, or environmental management.

Restructuring Agricultural Research at the Oblast Level

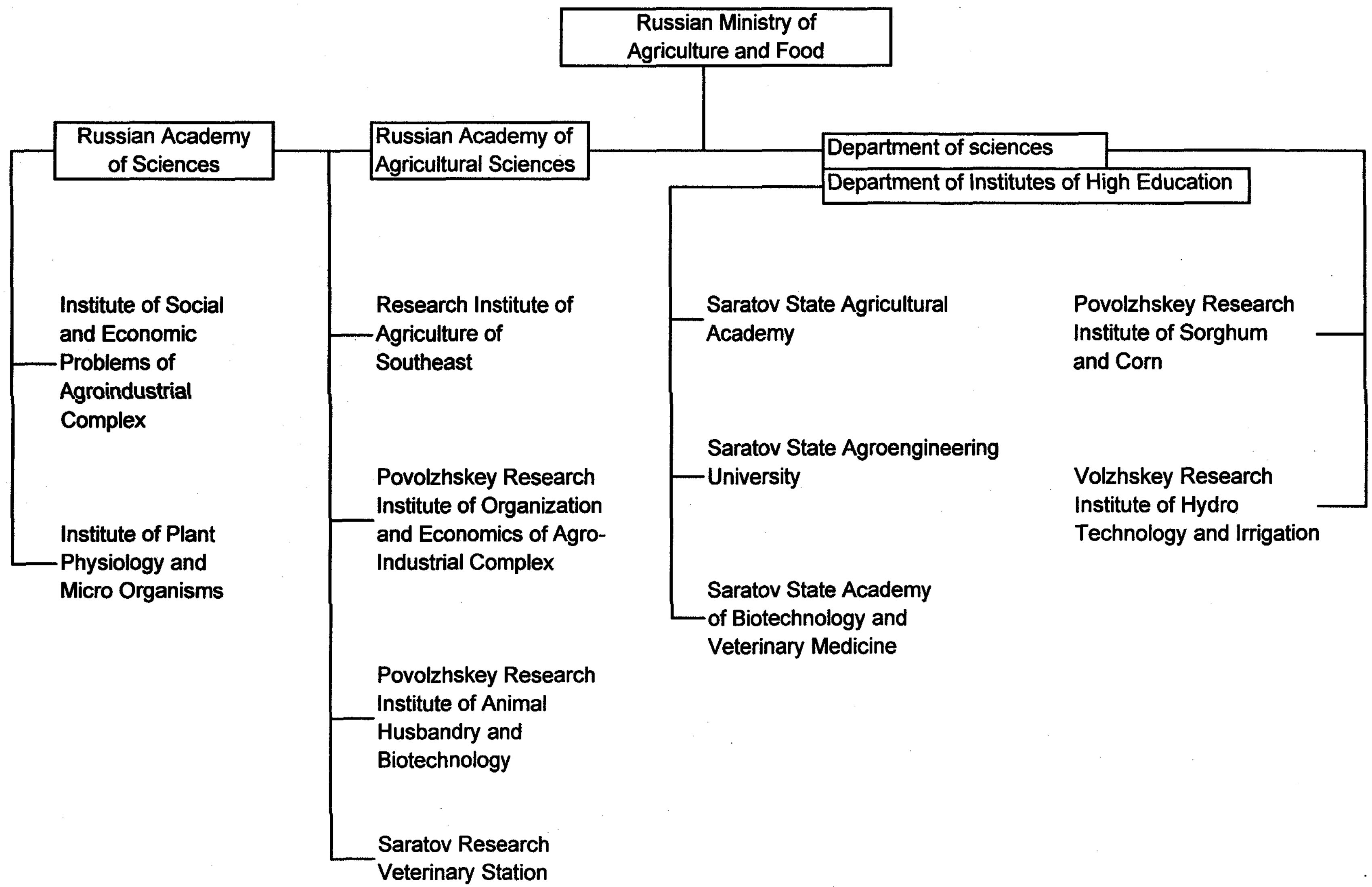
In most oblasts or krays in Russia, the agricultural knowledge system resembles a miniature version of the national system. Research institutes, agricultural institutes of higher education, tekhnikums, agricultural vocational training schools, retraining institutes, and a number of government agencies are all represented, each reporting through vertical channels to Moscow and its respective ministry (Box 5.4 and Figure 5.3). This is the setting within which models of institutional reform for agricultural research must be developed and tested.

Box 5.4: The Agricultural Knowledge System in Saratov Oblast

The agricultural knowledge system is Saratov Oblast is typical of that in many oblasts. Its major components are four research institutes reporting to RAAS, two research institutes reporting to the Russian Academy of Sciences, and two research institutes and three educational academies reporting to MOAF. Add to this list two retraining institutes, a teaching academy for general economics, and Saratov State University, a major educational institution with over 20,000 students, and the difficulty with institutional reform is clear — as the organization chart in Figure 5.3 shows as well.

Although there is clearly a role for the federal government in identifying national priorities and accounting for externalities, responsibility for financing and managing a decentralized agricultural

Figure 5.3. Organizational Structure of Research and Educational Institutes in Saratov Oblast



Source: Based on Ungenfucht (1996).

research program must ultimately devolve to the oblasts. Therefore, experiments with institutional reform, whether at the project, enterprise, or regional levels, must focus on the oblast. Institutional reform has to do with creating new ways of doing business -- new products, customers, collaborators, incentives and methods of planning, implementation, and control. Institutional change can be best fostered by creating incentives that encourage oblast agricultural research institutions and scientists to refocus their activities in order to develop a comprehensive agricultural research program that is:

- consumer-oriented
- demand-driven
- client-focused and participatory
- multidisciplinary
- cost effective
- linked to end users through appropriate channels, both public and private.

In short, the incentive system should move the oblast research community in the direction toward which agricultural research is headed elsewhere in the world.

5.37. In designing a pilot project for institutional reform at the oblast level, several issues need to be considered:

- Participating oblasts should be carefully screened to ensure that the oblast government is committed to the reforms and that agriculture is an important sector within the oblast.

- The project should be organized around an agricultural problem of significance to the oblast and that can quickly demonstrate significant societal benefits. For example, research to improve the overall profitability and environmental performance of bread wheat production systems in Saratov and neighboring oblasts. A project with this scope would require integration of plant and soil sciences with marketing, farm management, conservation planning, farm policy, and agricultural law. Furthermore, it requires direct attention on to spill-over and spill-in problems and associated government responsibilities. This type of project would be applied in nature and would require synthesis and adaptation of existing research results.

- The project should work with existing institutions in the oblast. A project that proposes eliminating or merging specific organizations is likely to be met with hostility and to involve a painful, protracted process. Too much energy would be expended and little would be learned about new ways of working together.

- The project should establish a consortium of research institutions and individuals that clearly have something to offer. This would require a well-supported project management structure with the authority to set clear limits and expectations.

- Longer-term relationships between the oblast consortium and one or two carefully chosen Western agricultural research institutions should be established, to provide the oblast consortium with a model of effective organizational behavior, opportunities for professional development, scientific expertise, mentoring, and other forms of support. Selected CGIAR institutions might also be involved -- particularly for technical support in targeted research areas.

- Funding needs to be provided jointly by participants and the international community. All parties need to be committed to the project's success. Shared financing helps establish that commitment.

A program of broad institutional reform requires broad participation. This inclusive approach certainly adds managerial complexity to the project, but it should also result in increased commitment. Key participants might include:

- Administrators and scientists of selected oblast or regional research institutes or institutes of higher education with research programs.

- Administrators and scientists from MOAF and RAAS, whose involvement is particularly important if the pilot project is to result in national reform strategies.

- Representatives of oblast administration. It is expected that the oblast will increase funding for research. In turn, it must play a greater role in research planning and oversight.

- Representatives of end-users, including participating farms, processing plants, and input suppliers. End-users could participate through advisory or review bodies. They might also explore direct participation in research and fund targeted research grants.

- Representatives of stakeholders within the oblast, including consumers and environmentalists. This would likely take the form of an advisory or review board for the project.

- Representatives from Western counterpart research institutions. Effective and committed counterparts are essential to the success of this project.

Given the level of uncertainty that surrounds pilot projects, grant funding along with in-kind contributions by participants might be considered. With better models of institutional reform and proven results, debt financing might be attractive to oblast and federal governments. Funding must be accompanied by a clear commitment by all parties to real reform of the agricultural research system within the oblast. Preserving the existing system is not an option.

Consolidating Research Institutes and Programs

Elimination, downsizing, and merging of research institutes and facilities must occur if Russia is to achieve a reasonable balance between budget and program. Because of the political and personnel problems associated with these actions, needed institutional adjustments are often avoided. This hesitation costs money and often exacerbates personnel problems. The objective of this activity is to:

- develop and test models of research institute or program closure, downsizing, or merger

- develop and test models to use surplus land, buildings and other assets to generate income to support research

- develop and test procedures for retraining or relocating discharged staff

- develop and test procedures for reallocating or liquidating assets from terminated programs.

The project would involve representatives from the private sector, MOAF, and RAAS as well as from one or two national agricultural research systems in other countries with experience in downsizing and program termination. For example, research administrators from New Zealand or Australia might be involved, as well as staff members from selected CGIAR centers. It is essential that MOAF and RAAS administrators play an active role in identifying institutions for closure or downsizing and take responsibility for these actions.

SUPPORT OF REFORM BY THE INTERNATIONAL COMMUNITY

The question of *how to finance reform of Russia's agricultural research system* has arisen repeatedly in this report. At issue is "how to best finance" the process of reform, restructuring, and rehabilitation of the Russian public agricultural research system. It is expected that the restructured system would be sustainable with funding from federal and oblast budgets and other research sponsors, both public and private. Ultimately, operating and capital budgets will be brought into line to support the best agricultural research system Russia can afford.

Restructuring and reform of the agricultural research system can be financed by:

- cost reduction, recovery, and reallocation of existing budgets
- increased appropriation from federal or oblast sources
- agricultural research foundations
- grants from international donors or the private sector
- loans from international financial institutions such as the World Bank.

In the short term, financing reform through reallocation will take time and a great deal of political capital. Increased appropriations seem rather unlikely if the reform process is to be expedited. Research foundations do not yet exist. What remains are grants and loans.

Grant funding is normally justified on the basis of public goods arguments. In the case of agricultural research in Russia, there are several public goods elements embedded in the reform process:

- Food security in Russia supports democratization and the development of civil society.

- Global food security will be enhanced if Russia's agricultural sector becomes more efficient and sustainable.

- The value of Russia's agricultural research assets, such as germplasm, know-how, or research products, may be lost to the world community without direct intervention.

That said, however, it is questionable whether the value of international public goods is sufficient to support the use of grant funds for agricultural research reforms. And even if it were, it can be very difficult to create incentives or adequately monitor grant-funded projects that would ensure that the desired reforms occur.

What about loans? Funds to finance reform and the restructuring of the agricultural research system can be borrowed at market rates of interest far below the rates of return that investments in agricultural research are capable of generating. Borrowing the needed capital is clearly profitable. Furthermore, borrowing money would align incentives to invest in research reforms and projects that generate the most societally beneficial income streams. Yet Russia authorities have repeatedly demonstrated a reluctance to finance agricultural research with debt. There are several possible reasons for this reluctance:

- The case for competitive rates of return from investing in agricultural research projects has not been adequately made to the relevant Russian authorities, particularly in the Ministry of Finance, MOAF, RAAS, and the oblast governments.

- Persistent inefficiency in Russia's agricultural sector is perceived to reduce actual rates of return well below rates estimated for other countries.

- Uncertainties associated with the benefits from reform, or the absence of proven modes of reform, are so great that Russian authorities will not accept loan obligations.

- Agency problems undermine the process--the Ministry of Finance is reluctant to take on debt because its agents, MOAF or RAAS or other research bodies, may not be able to implement the needed reforms or may choose to preserve the existing system.

- The terms of the loan do not match the expected income stream from the investment in agricultural research, thereby resulting in serious liquidity problems.

Under these conditions, a case can be made for using small, targeted grant-funded pilot projects to develop and test reform projects and to develop the needed skills for Russians to design and manage the projects. However, the grant funds can serve only as a catalyst to jump start the reform process. Ultimately, responsibility for financing the transition and ongoing operations of the reformed Russian agricultural research system rests with the Russians.

Agricultural research interests are well represented in the international community, in the World Bank, OECD, bilateral donors, the European Community, and North American and European agricultural universities, among others. The very real prospect of Russia's vast agricultural knowledge system collapsing just when the world community will need it most should be sufficient to provoke a response. Yet the response from the international community to Russia's agricultural research crisis has been limited and fragmented. Little, if any, effort has been made to assist Russia with the transformation of its agricultural research or higher education systems. Long-term capacity cannot be allowed to fall victim to short-term expediency.

As has been argued from several perspectives, the Russian agricultural research system merits assistance -- even in the midst of a difficult economic and political transition. This assistance needs to begin with two basic steps to stabilize and protect targeted agricultural research assets and to develop and pilot models of institutional change and human capital development. New financing is required to implement both these steps. However, the financing must be provided in a way that ensures deliberate transformation and reform. Using funds to preserve the past is unacceptable. It is also essential that funds extended to support stabilization and institutional learning reflect the uncertainty of the process and outcome in both areas. For this reason, both grants and loans should be considered as possible funding mechanisms in the near term

Projects to support agricultural research programs have been discussed with Russian administrators and scientists for the past five years. Yet after all the studies, needs assessments, vision statements, and memoranda of understanding, little of significance has occurred to relieve the serious problems facing Russia's agricultural research system. This is a consequence of collective failure -- by the Russian government, by oblast and municipal governments, by the Russian scientific establishment, and by the international community. The priority activities proposed here make a positive contribution toward redefining roles and responsibilities for agricultural research in Russia. And most important, they would help ensure that the human, biological, and physical capital invested in Russia's agricultural knowledge system is not only used effectively during transition but also is not lost to future generations.

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AGRICULTURAL INSTITUTES OF HIGHER EDUCATION IN RUSSIA

Number	*Agricultural Academies and Institutions*	*Location*
1	All-Russia Agricultural Institute of Extra-Mural Training	Balashikha
2	Timiryazev Agricultural Academy	Moscow
	Agricultural Universities	
1	Gorsky State Agricultural University	Vladikavkaz
2	Krasnoyarsk State Agricultural University	Krasnoyarsk
3	Kuban State Agricultural University	Krasnodar
4	Novosibirsk Agricultural University	Novosibirsk
5	St. Petersburg State Agricultural University	Pushkin
6	Voronezh State Agricultural University	Voronezh
7	Altai State Agricultural University	Barnaul
8	Bashkir Agricultural Univesity	Ufa
	Agricultural Institutes	
1	Belgorod Agricultural Institute	Maiski
2	Blagovestchensk Agricultural Institute	Blagovestchensk
3	Bryansk Agricultural Institute	Kokino
4	Buryat Agricultural Institute	Ulan-Ude
5	Chuvash Agricultural Institute	Cheboksari
6	Daghestan Agricultural Institute	Makhachkala
7	Don Agricultural Institute	Persianovka
8	Irkutsk Agricultural Institute	Molodezhny
9	Ivanovo Agricultural Institute	Ivanovo
10	Izhevsk Agricultural Institute	Izhevsk
11	Kabardino-Balkar Agricultural Institute	Nalchik
12	Kazan Agricultural Institute	Kazan
13	Kirov Agricultural Institute	Kirov
14	Kostroma Agricultural Institute	Kostroma
15	Kurgan Agricultural Institute	Lesnikovo
16	Kursk Agricultural Institute	Kursk
17	Nizhegorodsky Agricultural Institute	Novgorod
18	Novgorod Agricultural Institute	Novgorod
19	Omsk Agricultural Institute	Omsk
20	Orenburg Agricultural Institute	Orenburg
21	Oryol Agricultural Institute	Oryol
22	Penza Agricultural Institute	Penza
23	Perm Agricultural Institute	Perm
24	Primorsky Agricultural Institute	Primorsky

Annex A continues on the next page

Number	Agricultural Academies and Institutions	Location
25	Ryazan Agricultural Institute	Ryazan
26	Samara Agricultural Institute	Kinel
27	Saratov Agricultural Institute	Saratov
28	Smolensk Agricultural Institute	Smolensk
29	Stavropol Agricultural Institute	Stavropol
30	Tumen Agricultural Institute	Tumen
31	Tver Agricultural Institute	Tver
32	Ulyanovsk Agricultural Institute	Ulyanovsk
33	Ural Agricultural Institute	Ekaterinburg
34	Velikolukski Agricultural Institute	Velikie Luki
35	Volgograd Agricultural Institute	Volgograd
36	Yakutsk Agricultural Institute	Yakutsk
37	Yaroslavl Agricultural Institute	Yaroslavl
	Agricultural Engineering Institutes and Universities	
38	Azovo-Chemomorsky Institute of Agricultural Mechanization	Rostov
39	Chelyabinsk Agricultural Engineering State University	Chelyabinsk
40	Moscow Institute of Agricultural Engineers	Moscow
41	Saratov Institute of Agricultural Mechanization	Saratov
42	Tabmov Institute of Chemical Machine Building	Tabmov
	Dairy Institutes	
43	Vologda Dairy Institute	Molochnaya
	Fruit and Vegetable Growing Institutes	
44	Michurin Fruit and Vegetable Growing Institute	Michurinsk
	Land Improvement Institutes	
45	Moscow Institute of Land Improvement	Moscow
46	Novocherkassk Engineering and Land Improvement Institute	Novocherkassk
	Land Use Universities	
47	Moscow State University of Land Use	Moscow
	Veterinary Academies and Institutes	
48	Kazan State Veterinary Institute	Kazan
49	Omsk State Veterinary Institute	Omsk
50	Moscow Veterinary Academy	Moscow
51	Saratov State Zooveterinary Institute	Saratov
52	St. Petersburg Veterinary Institute	St. Petersburg
53	Troitsky Veterinary Institute	Troitsky

MAIN AGRICULTURAL RESEARCH INSTITUTES IN RUSSIA

No.	Agricultural Research Institute	Location
1	All-Russia Research Institute of Economics, Labor, and Management in Agriculture.	Moscow
2	Research Institute of Economics and Organization of the AIC of the Central Black-Earth Zone.	Voronezh
3	Volga Research Institute of Economics and Organization of the AIC	Saratov
4	All-Russia Research Institute of Agricultural Economics	Moscow
5	All-Russia Research Institute of Cybernetics of AIC	Moscow
6	All-Russia Research Institute of Economics and Norms	Rostov-on-the-Don
7.	Agrarian Institute	Kursk
8	Kursk Research Institute of Agro-Industrial Production.	Moscow
9	Potapenko All-Russia Research Institute of Wine-Growing and Wine-Brewing.	Novocherkassk, Rostov Oblast
10	All-Russia Research Institute of Corn	Piatigorsk, Stavropol Krai
11	Research Institute of Agriculture of South East	Saratov
12	All-Russia Research Institute of Vegetable Growing	Mytischi, Moscow Oblast
13	All-Russia Research Institute of Potato Growing	Korenevo, Moscow Oblast
14	Krasnodar Research Institute of Vegetable and Potato Growing	Krasnodar
15	All-Russia Research Institute of Selection of Horticulture	Oryol
16	Lukianenko Krasnodar Research Institute of Agriculture	Krasnodar
17	Don Zone Research Institute of Agriculture	Rassvet, Rostov Oblast
18	Samara Research Institute of Agriculture	Bezenchuk, Samara Oblast
19	Orenburg Research Institute of Agriculture	Orenburg
20	North Caucasus Zone Research Institute of Horticulture and Wine-Growing	Krasnodar
21	Tambov Research Institute of Agriculture	Chakino, Tambov Oblast
22	Stavropol Research Institute of Agriculture	Shpakovskoe, Stavropol Krai
23	South Urals Research Institute of Fruit, Vegetable, and Potato Growing	Cheliabinsk
24	Research Institute of Agriculture of Central Region of Non-Black Earth Zone	Nemchinovka, Moscow Oblast
25	Tula Research Institute of Agriculture	Molochnye Dvory, Tula Oblast
26	All-Russia Selection and Technological Institute of Horticulture and Plant	Moscow
27	Nursery. Vavilov All-Russia Research Institute of Crop Growing	St. Petersburg
28	All-Russia Research Institute of Agricultural Biotechnology	Moscow
29	Pustovoit Research Institute Of Oil Crops	Krasnodar
30	All-Russia Research Institute of Beans and Groats Crops	Oryol
31	All-Russia Research Institute of Irrigation Vegetable Growing and Melons	Kamyziak, Astrakhan Oblast
32	Michurin All-Russia Research Institute of Horticulture	Michurinsk, Tambov Oblast
33	All-Russia Research Institute of Flow Growing and Subtropical Crops	Sochi, Krasnodar Krai
34	All-Russia Research Institute of Selection and Seed Growing of Vegetable Crops.	Lesnoi Gorodok, Moscow Oblast

Annex B continues on the next page

No.	Agricultural Research Institute	Location
35	Michurin All-Russia Research Institute of Genetics and Selection of Fruit Plants	Michurinsk, Tambov Oblast
36	All-Russia Research Institute of Medicine and Aromatic Plants	Moscow
37	Bashkir Research Institute of Crop Growing and Selection of Field Crops	Ufa
38	Povolzhie Konstantinov Research Institute of Selection and Seed Growing	Kinel, Samara Oblast
39	Karachaevo-Cherkess Research Institute of Agriculture	Kavkazskiy, Karachaevo-Cherkess Republic
40	Viliams All-Russia Research Institute of Fodder	Lugovaia, Moscow Oblast
41	All-Russia Research and Technological Institute of Lucerne and Rape	Gikalo, Chechen Republic
42	All-Russia Research, Design, and Technology Institute of Rape	Lipetsk
43	All-Russia Research Institute of Lupine.	Briansk
44	Penza Research Institute of Agriculture	Penza
45	Bashkir Research, Design, and Technology Institute of Animal Husbandry and Fodder Production	Ufa
46	Tatar Research Institute of Agriculture	Kazan
47	All-Russia Research Institute of Biosynthesis of Proteins.	Moscow
48	All-Russia Research, Design, and Technology Institute of Chemicalisation of Agriculture	Nemchinovka
49	North Caucasus Institute of Mountain Agriculture	Mikhailovskoe, Republic North Ossetia
50	Ulianovsk Research Institute of Agriculture	Timiriazevskoe,Ulianovsk Oblast
51	Low Volga Research Institute of Agriculture	NovozhiznenskiyVolgograd Oblast
52	Dagastan Research Institute of Agriculture	Makhachkala
53	Cheliabinsk Research Institute of Agriculture	Timiriazevskiy, Cheliabinsk Oblast
54	North Caucasus Research and Technology Institute of Agro-Chemistry and Soils	Krasnodar
55	.Caspian Research Institute of Arid Agriculture	Astrakhan
56	Adygey Research Institute of Agriculture	Maikop
57	All-Russia Research Institute of Agriculture and Protection of Soils from Erosion	Kursk
58	Agro-Physics Research Institute	St. Petersburg
59	Prianishnikov All-Russia Research Institute of Fertilizer and Agro Soil Science	Moscow
60	Dokuchaev Soil Institute	Moscow
61	All-Russia Research Institute of Agricultural Microbiology	St. Petersburg
62	All-Russia Research Institute of Agricultural Radiology and Agro-Ecology	Obninsk, Kaluga Oblast
63	All-Russia Research, Design, and Technology Institute of Chemical Amelioration of Soils	St. Petersburg
64	All-Russia Research, Design, and Technology Institute of Mineral Fertilizers	Viatkino, Vladimir Oblast
65	Dokuchaev Research Institute of Agriculture of the Central Black Earth Zone	Voronezh Oblast
66	All-Russia Research Institute of Plant Protection	St. Petersburg
67	All-Russia Research Institute of Phyto-Pathology	B. Viazemy, Moscow Oblast

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No.	Agricultural Research Institute	Location
68	All-Russia Research Institute of Biological Protection of Plants	Krasnodar
69	All-Russia Research Institute of Irrigation Agriculture	Vologograd
70	All-Russia Research Institute of Agricultural Use of Ameliorated Lands	Tver
71	All-Russia Research Institute of Hydro-Technology and Amelioration	Moscow
72	All-Russia Research Institute of Agro Forest Amelioration	Volgograd
73	All-Russia Research, Design, and Technology Institute of Mechanization and Electrification of Agriculture	Zernograd, Rostov Oblast
74	All-Russia Research, Design, and Technology Institute of Animal Husbandry Mechanization	Znamia Oktiabria, Moscow Oblast
75	All-Russia Research, Design, and Technology Institute of Maintenance and Exploitation of the Machine and Tractor Park	Moscow
76	All-Russia Research, Design, and Technology Institute of Electrification of Agriculture	Moscow
77	All-Russia Research, Design, and Technology Institute of Technology and Economics of Storage, transportation, and Mechanization of Fertilizer Application	Riazan
78	Research, Design, and Technology Institute of Liquid Fertilizers	Klin, Moscow Oblast
79	All-Russia Research, Design, and Technology Institute of Use of Machines and Petroleum Products in Agriculture.	Tambov
80	All-Russia research Institute of Technology of Strengthening, Rehabilitation, and production of Parts	Moscow
81	All-Russia Research Institute of Organization, Economics, and Technology of Material Procurement in AIC.	Riazan
82	All-Russia Research Institute of Animal Husbandry	Dubrovitsy, Moscow Oblast
83	All-Russia Research Institute of Horse Breeding	Institute Konevodstva, Riazan Oblast
84	All-Russia Research Institute of Physiology, Biochemistry, and Nutrition of Agricultural Animals	Borovsk, Kaluga Oblast
85	All-Russia Research Institute of Sheep and Goat Breeding	Stavropol
86	All-Russia Research and Selection Institute of Animal Husbandry	Bykovo, Moscow Oblast
87	All-Russia Research Institute of Meat Husbandry	Orenburg
88	All-Russia Research Institute of Genetics and Breeding of Agricultural Animals	St. Petersburg
89	All-Russia Research, Design, and Technology Institute of Poultry Breeding	Sergiev Posad, Moscow Oblast
90	North Caucasus Research Institute of Animal Husbandry	Znamenskiy, Krasnodar Krai
92	Stavropol Research Institute of Animal Husbandry and Fodder Production.	Stavropol
93	Volga Research Institute of Animal Husbandry and Biotechnology	Saratov
94	Kalmyk Research Institute of Agriculture	Elista
95	All-Russia Research, Design, and Technology Institute of Pig Breeding	Togliatti, Samara Oblast
96	Afanasiev Research Institute of Animal and Rabbit Breeding	Rodniki, Moscow Oblast
97	All-Russia Research Institute of Irrigation Fishery	Vorovskogo, Moscow Oblast
98	All-Russia Research Institute of Poultry Processing Industry	Rzhavki, Moscow Oblast
99	Zhitkov All-Russia Research Institute of Game and Animal Breeding	Kirov
100	Kovalenko All-Russia Research Institute of Experimental Veterinary	Moscow
101	Skriabin All-Russia Research Institute of Helminthology	Moscow
102	All-Russia Research Institute of Veterinary Virusology and Microbiology	Pokrov, Vladimir Oblast

Annex B continues on the next page

No.	Agricultural Research Institute	Location
103	All-Russia Research Veterinary Institute of Pathology, Pharmacy and Therapy	Voronezh
104	All-Russia Research Institute of Veterinary Sanitation, Hygiene and Ecology	Moscow
105	All-Russia Research Veterinary Institute of Poultry Breeding	St. Petersburg
106	North Caucasus Zone Research Veterinary Institute	Novocherkassk, Rostov Oblast
107	Caspian Zone Research Veterinary Institute	Makhachkala
108	All-Russia Research Institute of Meat Industry	Moscow
109	All-Russia Research Institute of Milk Industry	Moscow
110	All-Russia Institute of Butter and Cheese Industry	Uglich, Yaroslavl Oblast
111	All-Russia Research Institute of Preserve and Dry Vegetable Industry.	Vidnoe, Moscow Oblast
112	Research Institute of Baby Nutrition	Istra, Moscow Oblast
113	All-Russia Research Institute of Refrigeration Industry	Moscow
114	Research Institute of Food Concentrate Industry and Special Food Technology	Moscow
115	All-Russia Research Institute of Starch Products	Konevo, Moscow Oblast
116	All-Russia Research Institute of Sugar Industry	Kursk
117	All-Russia Research Institute of Tobacco, Makhorka and Tobacco Products	Krasnodar
118	All-Russia Research Institute of Fats	St. Petersburg
119	All-Russia Research Institute of Beer Brewing, Soft Drink, and Wine-Making Industry	Moscow
120	Research Institute of Confectionery Industry	Moscow
121	All-Russia Research Institute of Food Biotechnology	Moscow
122	All-Russia Research Institute of Food Aromatizers, Acids and Colors	St. Petersburg
123	Research Institute of Information and Technological and Economic Research in Food Industry.	Moscow
124	Research Institute of Wool Procurement and Primary Processing	Nevinnomyssk, Stavropol, Krai
125	.North Caucasus Research Institute of Sugar Beet and Sugar	Krasnodar
126	Krasnodar Research Institute of Storage and Processing of Agricultural Outputs	Krasnodar
127	Volgograd Research, Design and Technology Institute of Meat and Milk Husbandry and Processing of Livestock Products	Volgograd
128	Altai Research Institute of Agriculture and Crop Selection	Barnaul
129	Altai Research, Design and Technology Institute of Animal Husbandry	Barnaul
130	Buriat Research Institute of Agriculture	Ulan-Ude
131	Institute of Experimental Veterinary of Siberia and Far East	Krasnoobsk, Novosibirk Oblast
132	Kemerovo Research Institute of Agriculture	Kemerovo
133	Krasnoiarsk Research Institute of Agriculture	Krasnoiarsk
134	Kurgan Research Institute of Grain Economy	Sadovoe, Kurgan Oblast
135	Research Institute of Horticulture in Siberia	Barnaul
136	Research Institute of Far North	Norilsk
137	Research Institute of Agriculture of Northern Trans-Urals	Tiumen'
138	Research Institute of Veterinary of East Siberia	Chita
139	Siberian Research Institute of Agriculture and Chemicalisation	Krasnoobsk, Novosibirsk Oblast

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No.	Agricultural Research Institute	Location
140	Siberian Research Institute of Fodder	Krasnoobsk, Novosibirsk Oblast
141	Siberian Research Institute of Mechanization and Electrification of Agriculture	Krasnoobsk, Novoribirsk Oblast
142	Siberian Research, Design and Technology Institute of Animal Husbandry	Krasnoobsk, Novoribirsk Oblast
143	Siberian Research, Design and Technology Institute of Crop Growing and Selection	Krasnoobsk, Novorisbsirsk Oblast
144	Siberian Research Institute of Agriculture	Omsk
145	Siberian Research Institute of Agricultural Economics	Krasnoobsk, Novosibirsk Oblast
146	Yakut Research Institute of Agriculture	Yakutsk
147	Irkutsk Research Institute of Agriculture	Pivovarikha, Irkutsk Oblast
148	Siberian Research, Design and Technology Institute of Physics and Technological Problems.	Krasnoobsk, Novosibirks Oblast
149	Siberian Research, Design and Technology Institute of Processing of Agricultural Output	Krasnoobsk, Novoribirsk Oblast
150	Krasnoiarsk Research, Design and Technology Institute of Animal Husbandry	Krasnoiarsk
151	Trans-Baikal Research Institute of Agriculture	Chita
152	Research Institute of Agricultural Problems in Khakassia	Zelionoe, Khakassia
153	Research Institute of Amelioration and Rational NatureUse	Tiumen
154	.Siberian Research Institute of Peat	Tomsk
155	All-Russia Research Institute of Veterinary Entomology	Tiumen
156	All-Russia Research Institute of Tuberculosis of Animals	Omsk
157	Mountain Altai Research Institute of Agriculture Mountain Altai Research Institute of Agriculture	Maima, Altai Republic
158	North West Research Institute of Agriculture	Belogorka, Leningrad Oblast
159	Rudnitskiy Research Institute of Agriculture of North East	Kirov
160	Urals Research Institute of Agriculture.	Yekaterinburg
161	Oryol Research Institute of Agriculture	Znamenka, Oryol Oblast
162	Pskov Research Institute of Agriculture	Radian, Pskov Oblast
163	Novgorod Research, Design and Technology Institute of Agriculture	Borki, Novgorod Oblast
164	Perm Research Institute of Agriculture	Lobanovo, Perm Oblast
165	Mari Research Institute of Agriculture.	Ruem, Mari-EL
166	Riazan Research, Design and Technology Institute of AIC	Podviazy, Riazan Oblast
167	Nizhegorod Research, Design and Technology Institute of AIC	Roika, Nizhegorod Oblast
168	North West Research Institute of Milk and Pasture Economy	Vologda
169	Yaroslavl Research Institute of Animal Husbandry and Fodder Production	Mikhailovskoe, Yaroslavl Oblast
170	Research Veterinarian Institute of Non-Black Earth Zone of Russian Federation	Nizhny Novgorod
171	Research, Design and Technology Institute of Mechanization and Electrification of Agriculture of Non-Black Earth Zone of Russian Federation	St. Petersburg
172	Research Institute of Economics and Organizatin of Agricultural Production in Non-Black Earth Zone of Russian Federation	St. Petersburg
173	Research, Design and Technology Institute of AIC of Komi Republic	Syktyvkar

Annex B continues on the next page

No.	Agricultural Research Institute	Location
174	Kaluga Research, Design and Technology Institute of AIC	Kaluga
175	Archangel Research Institute of Agriculture	Archangel
176	Kaliningrad Research Institute of Agriculture	Slavinskoe, Kaliningrad Oblast
177	Vladimir Research Institute of Agriculture	Seltso, Vladimir Oblast
178	Chuvash Research Institute of Agriculture	Ivanovo, Chuvashia
179	Ivanovo Research Institute of Agriculture	Bogorodskoe, Ivanovo Oblast
180	Smolensk Research Institute of Agriculture	Smolensk
181	Kostroma Research Institute of Agriculture	Minskoe, Kostroma Oblast
182	All-Russia Research Institute of Soy	Blagoveshchensk
183	Far EastResearch Institute of Agriculture	Khabarovsk
184	Far East Zone Research Institute of Veterinary	Blagoveshchensk
185	Sakhalin Research Institute of Agriculture	NovoaleksandrovskSakhalin Oblast
186	Magadan Research Institute of Agriculture	Magadan
187	Primorskiy Research Institute of Agriculture	Timiriazevskiy, Primorskiy Krai
188	Far East Research Institute of Mechanization and Electrification of Agriculture	Blagoveshchensk
189	Far East Research Institute of Plant Protection	Kamen-Rybolov, Primorskiy Krai
190	Far East Research Institute of Economics and Organization of AIC	Khabarovsk
191	Kamchatka Research Institute of Agriculture	Sonosnovka, Kamchatka Oblast
192	Kabardino-Balkaria Research Institute of Agriculture	Nalchik
193	All-Russia Research Institute of Grain and Processed Products from Grain	Moscow
194	State Research Institute of Bakery Industry	Moscow
195	Main Computing Center	Tver
196	Scientific and Technological Center of Food Industry	Moscow
197	Archangel Experimental Amelioration Station	Archangel

ROLE OF PUBLIC SECTOR IN FINANCING RESEARCH

The level of public sector investment in agricultural research and development varies a great deal from one country to another and from region to another. The status and emerging trends in the level of investment in agricultural research are the following:[1]

- Public investment in agricultural research (measured as percent of agricultural GDP) in the developing countries as well as the transition economies is much lower than in the developed countries (for global levels and trends see Tables C.1 and C.2). The investment levels in developing countries are almost 20 percent of the corresponding levels in developed countries.

- Generally, there has been an increase in the levels of investment in agricultural research in both developing and developed countries till mid-1980s. Since then there has been a decline but the actual change varies from one country to another and from one region to another (see Table C.3).

Table C.1: Intensity of Public Sector Investment in Agricultural Research in the Early 1990s

Countries/regions	*Nominal investment in agricultural research as % of the nominal agricultural GDP*
Developing countries	0.50
Developed countries	2.50
Russia	0.25
China	0.42
United States	2.22
United Kingdom	3.80
Australia	5.00
Canada	5.30

Sources: Alston, Pardey and Roseboom (1997); Alston, Chalfant and Pardey (1995); and Authors' calculations.

1 There is a continuing debate on the best mechanisms for funding agricultural research (National Research Council, 1994). Competitive grants are being considered as one of the best ways to allocate scarce resources to finance agricultural research. However, according to Huffman and Just (1994), the empirical evidence from the United States indicates that the current trend toward competitive grants and earmarked funding, as opposed to formula funding from federal sources, apparently reduced productivity of research expenditure.

Table C.2: Changes in the Intensity of Public Sector Investment in Agricultural Research Over Time

(Percentage of Agricultural GDP)

Region	*1971-75*	*1976-80*	*1981-85*	*1986-90*	*1991*
Developing Countries	0.38	0.47	0.50	0.49	0.51
Sub-Saharan Africa	0.78	0.84	0.86	0.74	0.70
China	0.40	0.48	0.41	0.38	0.36
Asia and Pacific (excl. China)	0.26	0.36	0.44	0.50	0.55
Latin America and the Caribbean	0.43	0.51	0.59	0.49	0.54
West Asia and North Africa	0.50	0.49	0.52	0.52	0.52
Industrial Countries	1.38	1.60	1.98	2.18	2.39
Total [a]	0.67	0.76	0.81	0.79	0.81

a Excluding Cuba and the former Soviet Union.

Source: Alston, Pardey and Roseboom (1997).

Table C.3: Global Trends in Public Expenditure for Agricultural Research

Region	*Expenditures (million in 1985 dollars)*			*Annual Growth Rates (percent per year)*	
	1971	1981	1991	1971-81	1981-91
Developing Countries	2985	5535	8017	6.4	3.8
Sub-Saharan Africa	699	927	968	2.5	0.8
China	457	934	1494	7.7	4.7
Asia and Pacific (excl. China)	862	1922	3502	8.7	6.2
Latin America and the Caribbean	508	1008	951	7.2	-1.1
West Asia and North Africa	459	738	1102	4.3	4.0
Industrial Countries	4298	5713	6941	2.7	1.7
Total [a]	7283	11248	14958	4.4	2.8

a Excluding Cuba and the former Soviet Union.

Source: Alston, Pardey and Roseboom (1997).

According to World Bank (1981), average public expenditure as a proportion of agricultural GDP in developing countries as a group should rise from less than 0.5% to 2%. Agriculture is much more efficient and productive in countries with higher levels of investment in agriculturl research and development. One lesson for the developing and transition economies, including Russia, is that the policymakers must consider increasing the levels of investment in agricultural research. However, this investment may not have economic payoffs comparable to those in developed countries unless the agricultural research system is reformed and made more responsive to client needs.

However, for various reasons the investment in agricultural research in all countries, but particularly in the transition economies, is declining. As summarized in Box C.1, there are many reasons for this decline. There is a need to convince the national leaders of potential payoffs to investment in agricultural research or the lost output for not making such investments. However, it must be recognized that merely increasing budget allocations is not likely to generate the desired results. Clearly there is a need for improving efficiency, consolidating research facilities, establishing research priorities that respond to local and national needs and increasing accountability.

Box C.1: Likely Reasons for Decline in Funding for Agricultural Research

Based on the international experience, the likely reasons for decline in funding for agricultural research are the following:

- budget cuts as a result of fiscal austerity;
- lack of understanding by national leaders of the crucial role of agriculture in overall development policies;
- lack of recognition of the public-good nature of much agricultural research;
- withdrawal of support by donors;
- inefficiency of research system and lack of accountability;
- lack of relevant research outputs from many research programs;
- a long-term decline in agricultural commodity prices, which acts as a disincentive to investment in the agricultural sector

Source: Byerlee and Alex (1998)

ROLE OF PRIVATE SECTOR IN FINANCING RESEARCH

The role of private sector in funding agricultural research is gradually increasing. This is particularly true for modern agriculture in developed countries. The public sector, however, remains the dominant source of funding agricultural research in developing countries and in transition economies. For example, the alternative sources for funding agricultural research in Latin America are national agricultural research institutes, universities, farmer groups and the private companies (Table D.1). The available information indicates that almost 25 percent (in Chile) to 50 percent (in Mexico) of total agricultural research expenditure was accounted for by a combination of universities, farmer groups and private companies.[1]

As reported in Table D.2, the main agricultural research areas in which the private sector (multinational private companies) is active are:

- agro-chemicals
- agricultural machinery
- veterinary pharmaceuticals
- plant breeding (e.g. hybrid seeds)
- post harvest food processing.

In other words, the private sector investment is targeted to those areas in agricultural research where the private companies are able to capture all or most of the returns from their investment. In the United States, the private sector expenditure on agricultural research was 27 percent higher than the corresponding amount spent by the public sector in 1992. Beginning in 1975, private expenditure on agricultural research has been larger than the public expenditure on agricultural research in the US (Huffman and Evenson, 1993). The private sector has become a major partner and a funding source for research on biotechnology in the US land grant universities. Good overviews of the status, progress, opportunities, constraints and potential payoffs for investment in biotechnology to solve specific agricultural problems are available in Persley (1990a, 1990b) and Hobbelink (1991). The major multinational companies with a broad range of agricultural activities are reported in Table D.3. The total amount spent on agricultural R & D by these multinational companies is substantial, ranging from 2-14 percent of their annual revenue. At this stage there is limited scope for agricultural research by the private sector in Russia and in other transition economies. However, the role of the private sector in research is expected to increase over time with the introduction of the enabling policy environment and generation of demand for research in the private sector.

1 Echeverri, Trigo, and Byerlee (1996) address the issue of financing agricultural research in Latin America. They identify successful elements of a strategy to fund research through joint ventures, sale of research products (commercialize them), competitive funds (through bidding schemes), research foundations, farmers' contributions (e.g., levy on agricultural production) and private sector agribusiness research. They also advocate need for flexible systems, better management and increased budgetary allocations for agricultural research.

Table D.1: Estimated Share of Agricultural Research Expenditure by Alternative Funding Sources in Selected Countries in Latin America

Country	*Percentage of Total Expenditure*				
	National Research Institutes	*Universities*	*Farmer Groups*	*Private Companies*	*Total*
Argentina	89	5	0	6	100
Brazil[a]	63	29	0	8	100
Chile	75	20	1	4	100
Colombia[b]	61	2	29	8	100
Ecuador	52	5	7	36	100
Mexico	50	17	5	28	100
Peru	65	20	10	5	100
Venezuela	80	10	1	9	100

a 1991
b 1993

Source: Adapted from Echeverria, Trigo, and Byerlee (1996).

Table D.2: Trends in Private Sector Spending on Agricultural R & D in the United States

(millions of current dollars)

Year	*Input-Oriented*				*Postharvest Food Processing*	*Total*
	Chemicals	*Agricultural Machinery*	*Veterinary/ Pharmaceuticals*	*Plant Breeding*		
1960	10	76	6	6	80	177
1970	126	89	45	26	206	493
1980	1390	287	111	97	456	1341
1992	1123	394	306	400	1088	3311[a]

a Private sector agricultural research expenditure of US$3.3 billion in 1992 was 27% more than the corresponding amount spent by the US public sector.

Source: James (1996); originally from USDA (1995b).

Table D.3: R & D Expenditure for Selected Private Companies with a Broad Range of Agricultural Activities, 1994

Company	*Annual Revenue*[a] *($million)*	*R&D Expenditure*[a] *($million)*	*Expenditure as % of Revenue*
American Cyanamid	4276	595	13.9
DeKalb Genetics	320	44	13.7
Sandoz AG	15870	1635	10.4
Zeneca AG	2420	242	10.0
Ciba-Geigy	19341	1931	9.8
Pioneer	1478	114	7.7
Monsanto	8272	609	7.4
Hoechst Celanese	7794	313	7.3
Sumitomo Chemical	9798	554	5.7
Dupont	39333	1404	3.6
Unilever	45419	831	1.8

a Annual revenue and R&D expenditure are available only for the publicly traded companies.

Source: James (1996).

ROLE OF INTERNATIONAL AGRICULTURAL RESEARCH SYSTEM

The international agricultural research system consists of the Consultative Group on International Agricultural Research (CGIAR), the Technical Advisory Committee (TAC) to CGIAR and a network of International Agricultural Research Centers (IARCs). At present, there are sixteen CGIAR supported International Agricultural Research Centers and these are located in different parts of the world (Box E.1). The main focus of research in these centers is improvement in productivity for crops, livestock, inputs (irrigation), farming systems, agro-forestry, research management and food policy. CGIAR's research expenditure during 1993 ($235 million) was allocated as follows, expressed in percent terms:

Institutional building	25.3
Production systems	23.7
Germplasm enhancement	21.9
Natural resources	19.0
Agricultural policy	10.3
Total	100.0

According to CGIAR (1997), the major agricultural research priorities over the next 20 years are:

- reducing poverty
- improving productivity;
- protecting the environment;
- saving biodiversity;
- improving policies; and
- strengthening national programs.

The CGIAR system was established in early 1960s. New international agricultural research centers were added over time. The economic impact of agricultural research in these centers has been enormous, in the form of improved yields and higher agricultural output and food production. The impact of CGIAR on rice, wheat and maize (three important grain crops) yields in developing countries from 1970 to 1990 is reported in Table E.1. The following are the three main conclusions:

- First, between 50 percent (rice) to 100 percent (wheat) increase in crop yields over 20 years' period from 1970 to 1990 is attributed to varieties developed at the CGIAR centers.

- Second, an increase in yields for rice, wheat and maize due to CGIAR germplasm has avoided potential encroachment of about 200,000 ha of arable land. This is very important in the light of increasing demand for food and the limits to good quality land under cultivation.

- Third, the estimated annual value of incremental production in rice, wheat and maize that is attributable to CGIAR is about $4.6 billion.

These are significant contributions of the CGIAR system. An increase in food production alone in developing countries had a major impact on avoiding hunger and malnutrition and contributing to much needed food security.

Table E.1: Impact of CGIAR on Rice, Wheat, and Maize Yields

Indicator	*Rice*	*Wheat*	*Maize*
Area in Developing countries (000 ha)	143569	105794	83623
Area under modern varieties (%)	74	70	57
CGIAR Germplasm in modern varieties (%)	20	49	45
Yields (ton/ha): 1970	2.3	1.2	1.5
1990	3.5	2.4	2.6
Yield increase (%)	52	100	73
Potential Land Encroachment Avoided by Yield Increase (000 ha)	60,000	90,000	50,000
Annual value of Production increase attributable to CGIAR ($ billion)	1.5	1.6	1.5

Source: CGIAR (1996a).

Box E.1: CGIAR Supported International Agricultural Research Centers (IARCs)

CIAT -- Centro Internacional de Agricultura Tropical. Cali, Colombia. Founded 1967. Focus on crop improvement and ecoregional approaches to developing agriculture in the lowland tropics of Latin America. Research covers rice, beans, cassava, forages and pasture.

CIFOR -- Center for International Forestry Research. Bogor, Indonesia. Founded 1992. Focus on research on forest conservation and sustainable development.

CIMMYT -- Centro Internacional de Mejoramiento de Maiz y Trigo. Mexico D. F. Mexico. Founded 1966. Focus on crop improvement. Research covers maize, wheat, barley and triticale.

CIP -- Centro Internacional de la Papa, Lima, Peru. Founded 1971. Focus on potato and sweet potato improvement; special attention paid to ecoregional aspects of mountain area agriculture.

IPGRI -- International Plant Genetic Resources Institute. Rome, Italy. Founded 1974. Focus on conserving gene pools of current and potential crops and forages.

ICARDA -- International Center for Agricultural Research in the Dry Areas. Aleppo, Syria. Founded 1977. Focus on improving farming systems for North Africa and West Asia. Research covers wheat, barley, chickpea, lentils, pasture legumes and small ruminants.

Box continues on the next page

ICLARM -- International Center for Living Aquatic Resources Management. Makati, Metro Manila, The Philippines. Founded in 1977. Focus on research on all aspects of fisheries to improve efficiency and productivity of culture and capture fisheries.

ICRAF -- International Center for Research in Agroforestry, Nairobi, Kenya. Founded 1977. Focus on initiating and supporting research on integrating trees in land-use systems in developing countries.

ICRISAT -- International Crops Research Institute for the Semi-Arid Tropics. Patancheru, Andhra Pradesh 503 324, India. Founded 1972. Focus on crop improvement; cropping systems. Research covers sorghum, millet, chickpea, pigeonpea and groundnut.

IFPRI -- International Food Policy Research Institute, Washington D.C., 20036-3092, USA. Founded in 1975. Focus on food policy and socio-economic research related to agricultural development. Provides policy research and institution building assistance to developing countries.

IIMI -- International Irrigation Management Institute. Colombo, Sri Lanka. Founded in 1984. Focus on performance of irrigation in developing countries. Research covers institutional conditions for managing irrigation systems and facilities; management of water resources, irrigation support to farmers.

IITA -- International Institute of Tropical Agriculture. Ibadan, Nigeria. Founded 1967. Focus on crop improvement and land management in humid and sub-humid tropics; farming systems. Research covers maize, cassava, cowpea, plantain, soybean, rice and yam.

ILRI -- International Livestock Research Institute. Nairobi, Kenya, and Addis Ababa, Ethiopia. Founded in 1994. Focus on research to improve livestock productivity and animal health. Is responsible for the System-Wide Livestock Research Program.

IRRI -- International Rice Research Institute. Manila, Philippines. Founded 1960. Focus on global rice improvement.
ISNAR -- International Service for National Agricultural Research. The Hague, Netherlands. Founded 1979. Focus on strengthening and developing national agricultural research systems.

WARDA -- West Africa Rice Development Association. Bouake 01, Cote d'Ivoire. Founded 1970. Focus on rice improvement in West Africa. Research covers rice in mangrove swamps, inland swamps, upland conditions, irrigated conditions.

Source: CGIAR (1996a, 1996b, 1997).

The main sources of funding for CGIAR-supported international agricultural research are bilateral donors, private foundations and the World Bank. The annual financial support for the CGIAR system has increased from $21 million in 1972 to $304 million in 1996. The World Bank's share in total funding for the CGIAR system has increased from about 10 percent in the 1970s, to almost 15-20 percent in the 1990s. Clearly, the CGIAR system has played a very significant role in international agricultural research not only in the form of developing new plant varieties and providing support to the national agricultural research systems (NARSs) but also in facilitating increased participation in agricultural research by the private sector. The World bank, on the other hand, has played an important role in financing international and national agricultural research.

During 1996, CGIAR established a Task Force on Central/Eastern Europe and the former Soviet Union (CGIAR, 1996b). The Task Force has recommended that CGIAR extend its mandate to include these regions, with a particular focus on the following five activities:

- Access to information
- Access to genetic resources
- Transformation of NARSs
- Intensification of existing activities
- CGIAR strategy for the regions

As far as Russia is concerned, there are already agreements on collaborative research with several CGIAR centers. These agreements include:

- CIMMYT and VASKhNIL (now replaced by the new Russian Academy of Agricultural Sciences), September 1990;

- ICARDA and (i) the Vavilov All-Russian Scientific Research Institute, May 1993; (ii) Krasnodar Research Institute, May 1993; and (iii) the South-Eastern Regional Agricultural Research Institute, 1994.

- ICRISAT and VASKhNIL (now replaced by the new Russian Academy of Agricultural Sciences), April 1990;

- IRRI and All-Russian Rice Research Institute, June 1995.

It is expected that as part of the new mandate, these existing arrangements will be strengthened and new agreements on collaborative agricultural research will be developed.

FUNDING AGRICULTURAL RESEARCH BY THE WORLD BANK

In addition to financing international agricultural research through the CGIAR system (as has been reported in Figure F.1), the World Bank has been a major source of financing national agricultural research in the developing countries through credits (IDA credits) and loans (IBRD loans). As shown in Table F.1, the total World Bank lending for agriculture has declined from 31 percent in 1977-80 to 14 percent in 1993-96. However, the share of agricultural research and extension in total lending for agriculture has increased from 7.5 percent in 1977-80 ($0.9 billion) to 14 percent in 1993-96 ($1.9 billion). In the 1970s, agricultural research accounted for only 25 percent of the Bank lending for agricultural research and extension; this share increased to 50 percent in the 1990s.

Table F.1: World Bank Lending for Agricultural Research and Extension[a]

(US$ billion)

Period	*Total*	*For Agriculture*		*For Research and Extension*			
		Amount	*% of Total*	*Total Amount*	*% of Agriculture*	*% for Research*	*% for Extension*
1977-80	37.04	11.56	31.2	0.87	7.5	26	74
1981-84	56.21	14.03	25.0	1.29	9.2	48	52
1985-88	70.73	16.09	22.7	1.43	8.9	36	64
1989-92	87.82	14.75	16.8	1.75	11.9	46	54
1993-96[b]	95.79	13.80	14.4	1.94	14.1	50	50
Total	*347.59*	*70.22*	*20.2*	*7.27*	*10.4*	*43*	*57*

a In terms of commitments which refer to the nominal Bank loan and credit funds approved.
b Estimate.

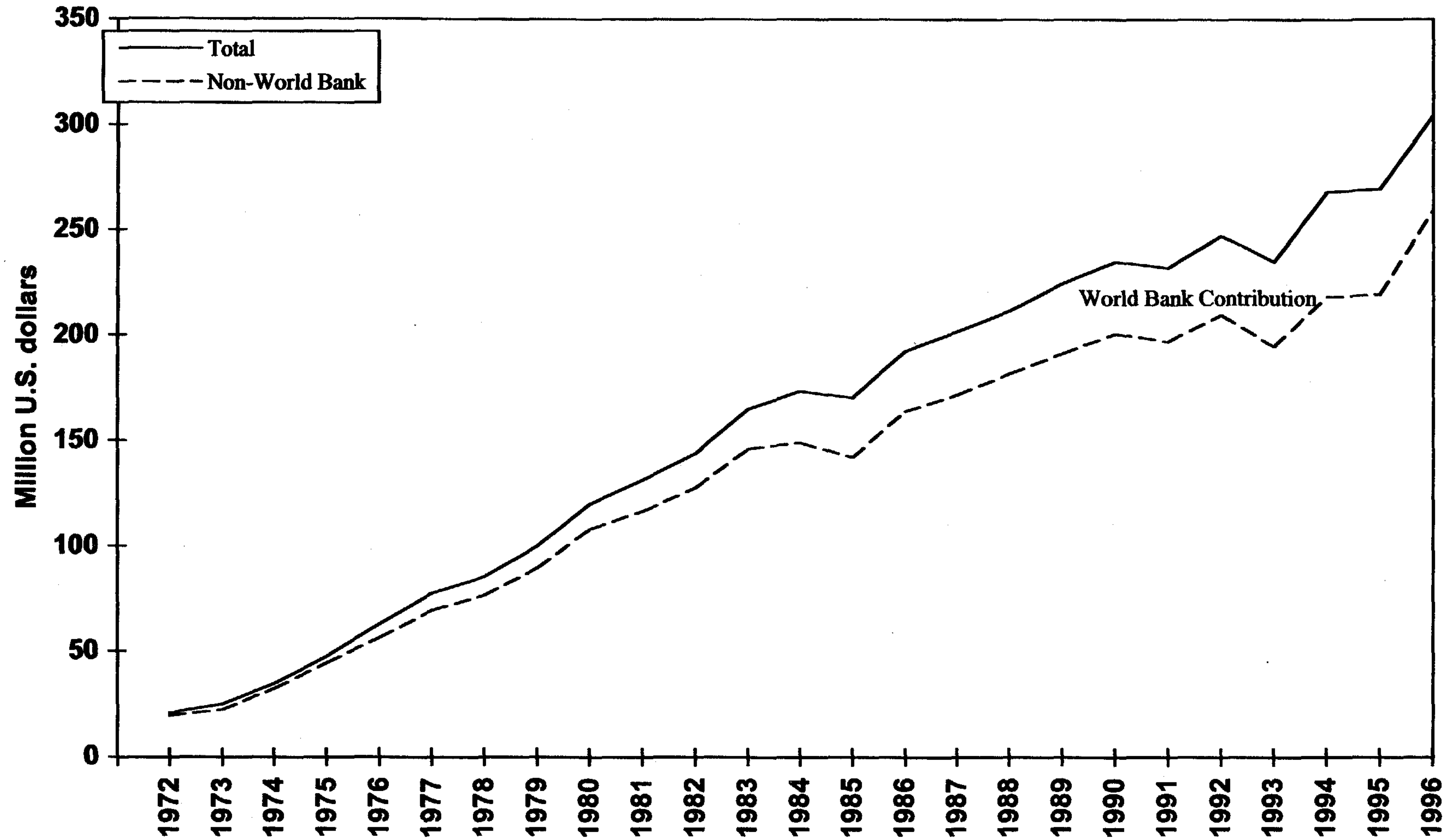
Source: Purcell and Anderson (1997); with additional calculations by the authors.

As summarized in Byerlee and Alex (1998), the World Bank funding for agricultural research over the past 25 years from 1981 to 1996 is as follows:

Overall:

- Total projects with research componets 458
- Full research projects 145
- Total funding for research (US$ million) 3868

Figure F.1: Growth in Financial Support for International Agricultural Research System



Source: The World Bank and CGIAR.

Europe and Central Asia (ECA):

• Total projects with research components	30
• Full research projects	11
• Total funding for research (US$ million)	198
• Share of ECA is overall funding for research (%)	5

The Operations Evaluation Department (OED) of the World Bank has reviewed Bank-financed agricultural research portfolio in 32 developing countries (World Bank 1996b; Purcell and Anderson 1997). The examination of agricultural research projects financed in the 1980s and 1990s indicates that the Bank financed agricultural research projects have made a significant economic impact. However, deficiencies in the NARSs persist with respect to: (i) development of sound research planning, priority setting and evaluation has been slow; and (ii) the sustainability of the NARSs has often been weak. The following four recommendations, that are made to improve quality of Bank assistance to the NARS, are very relevant for Russia:

- There must be a clear commitment to appropriate policies, adequate budget allocation and scientific rigor.

- There is a need for strategic alliances to enhance effectiveness of resource use in the NARSs.

- There is a need for greater use of economic analysis to assist in priority setting among various programs in NARSs.

- There is a need to support monitoring and evaluation systems to facilitate research planning and ex-post evaluation.

Other important lessons for agricultural research and extension, that are based on Bank financing of three agricultural research and extension projects in China, are reported in Box F.1. A summary of the status of existing World Bank involvement in the agricultural knowledge system in the transition economies of Central/Eastern Europe and the former Soviet Union is provided in Srivastava and Reinhard (1996). Finally, the problems identified in a 1997 review of World Bank-supported agricultural research projects are summarized in Box F.2; further supporting the problems identified by OED examination.

The final funding dilemma embodies most of the foregoing choices and depends on the mix of regional, national and international support as well as the relative roles of the public and private sectors. Budgetary allocations from regional or national governments support ongoing programs through operating budgets. Budgetary allocations can also be used, in a limited way, for capital investment or debt service. The two uses compete with each other and research administration must attempt to maintain an appropriate balance.

Box F.1: Agricultural Research and Extension: Lessons from China

China's agricultural research system is the largest publicly funded and administered system in the world. About 60,000 researchers and technicians work in about 400 research institutes and 70 agricultural universities throughout China. World Bank support of China's national agricultural research and extension system followed a two-pronged approach: (i) strengthening research to expedite the output of technology; and (ii) strengthening extension and the links among research, extension and farmers. Following lessons can be drawn from successful implementation of three Bank-supported projects:

- Bank assistance over a series of projects helps build agricultural research capabilities in a logical sequence to maximize the efficiency of investment i.e. research (technology generation) followed by extension (technology dissemination);

- a multipurpose extension services center can be cost-effective and efficient means of delivering agricultural services to farmers. There is now one ATEC (agrotechnical extension centers) in each of the 2300 counties in China;

- a sufficient, timely and reliable recurrent budget for research is critical for developing new technology;

- two additional issues, not included in these projects, that need to be addressed in future projects are appropriate cost recovery and role of the private sector.

Source: World Bank (1996a)

Box F.2: Problems Identified in a 1997 Review of Agricultural Research Projects

In 1997, under the Portfolio Improvement Program, the Bank reviewed research and extension projects categorized as at risk of producing unsatisfactory outcomes. Common problems found were:

- Lack of a consensus in-country on a strategic vision for public sector research institutions and the evolution of the national agricultural research system (NARS).

- Ineffective national leadership for many research institutions, resulting in both internal management problems, as well as lack of political support, especially for funding research.

- Difficulties in establishing institutional autonomy for research institutions because of lack of understanding of the special needs for research management, and lack of imagination in formulating the mandates and rules of business of the new organizations.

- Inadequate attention to sustainable financing for research, especially for new research initiatives after project completion.

- Weak monitoring and evaluation systems for both research programs and institutional changes.

Source: Byerlee and Alex (1998)

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