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INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL FINANCE CORPORATION

INTERNATIONAL DEVELOPMENT ASSOCIATION

APPRAISAL OF

DAWOOD HERCULES CHEMICALS LIMITED UREA PROJECT

AND GENERAL PROSPECTS FOR

NITROGENOUS FERTILIZERS

IN

WEST PAKISTAN

June 20, 1968

IFC - Department of Investments
Africa, Asia and the Middle East

CURRENCY EQUIVALENTS

US $1	=	Rs 4.76
Rs 1	=	US $0.21

DAWOOD HERCULES CHEMICALS LIMITED, PAKISTAN

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APPRAISAL OF DAWOOD HERCULES CHEMICALS LIMITED UREA PROJECT AND GENERAL PROSPECTS FOR NITROGENOUS FERTILIZERS IN WEST PAKISTAN

I. INTRODUCTION

1. IBRD and IFC have been asked to join the financing of a 345,000 tons[1/] per year capacity urea fertilizer project jointly sponsored by the Dawood industrial group (Dawood) of Pakistan and Hercules Incorporated (Hercules) of the U.S.A. A new company, Dawood Hercules Chemicals Limited (DH Chemicals), has been formed to carry out the project which consists of a plant with daily capacities of 620 tons of ammonia and 1,100 tons of urea, at Chichoki Mallian, Sheikhupura District, West Pakistan, using as feedstock, natural gas available from the Sui gas field.

2. The total project cost is estimated at $78.2 million, including provisions for working capital of $2.6 million, of which the foreign exchange component would be $46.6 million. It is proposed that IBRD and IFC would participate in the financing of DH Chemicals for the amount of $34.9 million, comprising an IBRD loan of $32.0 million and an IFC equity investment of $2.9 million. In addition, a contingent IFC commitment of up to $1.0 million would be made in the form of a shareholders loan if needed to finance project cost overrun. The balance of the financing would be provided through share subscription by the sponsors and the Pakistani public, rupee loans from the U.S. Agency for International Development (AID) and customs debentures.

3. IBRD and IFC were first asked by the sponsors to assist in the financing of the project in November 1966 and, since then, IBRD and IFC staff have met with the sponsors on several occasions to draw up a financial plan and to discuss various aspects of the project. The sponsors' feasibility study and technical assessment had been prepared with the help of two U.S. engineering firms, Bechtel Corporation and Fluor Corporation. A separate study on the market prospects of the project was also conducted by a Hercules mission. In July 1967, the Hercules Board decided to proceed with its participation in the project, based upon the above surveys. On August 29, 1967, the National Economic Council of Pakistan gave its approval of the project and, subsequently, on November 4, 1967, an official letter of sanction from the Government, describing its detailed terms and conditions, was issued. In April 1968, DH Chemicals was incorporated in Karachi by the sponsors.

1/ Reference in this report is to metric tons unless otherwise indicated.

This report was prepared by Messrs. Williamson and Hori on the basis of IFC's discussions with the sponsors (held both in Washington and Wilmington), and the findings of the IFC technical appraisal mission (Mr. Ewing of IFC Engineering Department) which visited Pakistan in January 1968.

II. THE PROPOSED LOAN AND INVESTMENT

4. The main features of the proposed IBRD loan and IFC investment would be as follows:

(a) IBRD Loan

Borrower	:	Dawood Hercules Chemicals Limited
Guarantor	:	Islamic Republic of Pakistan
Amount	:	Equivalent of US $32,000,000 in various currencies.
Length of Loan	:	Term of 15 years (including a grace period of approximately 4-1/2 years) with 22 equal semi-annual installments of principal beginning in 1972 and ending in 1983.
Commitment Fee	:	3/4% per annum on the undisbursed amount of the loan.
Proposed Interest	:	6-1/4%

(b) Proposed IFC Investment: US $2,919,000, plus an additional contingent commitment of up to US $1,000,000 as follows:

(i) Equity	:	1,390,000 ordinary shares at price of par (Rs 10). If the aggregate amount eventually paid for such 1,390,000 shares is less than US $2,919,000, IFC will lend the difference in dollars by unsecured loans subordinated to long-term debt carrying an interest rate of not more than 9% with repayment scheduled over five years commencing 12 months after project completion.
(ii) Contingent Commitment	:	Up to US $1,000,000 in unsecured loans, on terms as in (i) above, if required to meet part of cost overruns in foreign exchange.

III. THE COMPANY

5. In April 1968, a new limited company, Dawood Hercules Chemicals Limited, with an authorized capital of Rs 250 million (approximately $52.5 million) was set up in Karachi to construct and operate the proposed urea plant and would have a paid-in capital of Rs 139 million (approximately $29.2 million), of which Dawood and Hercules would each contribute 40%, and IFC and the Pakistani public 10% each.

6. The by-laws of DH Chemicals would provide both partners with veto power over Board decision. Dawood and Hercules would each appoint an equal number of directors (4), who collectively constitute 80% of the Board and all Board decisions would require a simple majority vote plus one additional vote for approval. At shareholders' meetings, a vote of at least two-thirds of the total issued and paid-up capital would be needed for the passage of any resolution, and quorum requirements would be two-thirds of the total issued and paid-up capital.

7. With regard to management organization, full managerial responsibility for day-to-day operations will be vested in the General Manager to be appointed by the Board of Directors. A person designated by Hercules will be chosen for the position of General Manager. While Dawood Industries Limited (DIL), an industrial management company of the Dawood group, will be appointed as Managing Agent, it will function under the supervision of the General Manager and will provide DH Chemicals with administrative services. Commercial sales will be handled solely by DH Chemicals and the seeding program, already started by Dawood Corporation, will be transferred to DH Chemicals at a date to be agreed by the sponsors.

IV. THE SPONSORS

Dawood Industrial Group

8. Dawood Industries Limited was established in May 1949 and is wholly-owned by the Dawood family. It has a paid-in capital of Rs 5.0 million. As of March 31, 1967, DIL had a net worth of Rs 10.6 million, including reserves and surplus of Rs 5.6 million. For financial year 1967, its gross revenue amounted to Rs 3.0 million out of which DIL netted Rs 0.7 million as profit after taxes.

9. Dawood is one of the leading industrial groups in Pakistan, headed by Mr. Ahmed Dawood, with extensive investments in many industrial firms. The following is a list of companies controlled by Dawood:

	Paid-in capital Rs mil.	% of Dawood ownership		Remarks
Dawood Industries Limited	5.0	100%		Managing agent
Dawood Corporation Limited	10.0	100		Sales organization
			Par value	Recent quotation Karachi Stock Exch.
Dawood Cotton Mills Limited	30.0	80	10	40
Burewala Textile Mills Limited	22.5	55	10	25
Lawrencepur Woolen and Textile Mills Limited	9.4	33	100	212
Karnaphuli Paper Mills Limited	46.0	50	10	16
Karnaphuli Rayon & Chemicals Ltd.	45.0	30	10	13
Dawood Mines Limited	0.5	100	10	not quoted
Central Insurance Company Ltd.	2.5	75	10	14
Memon Cooperative Bank Limited	1.0	75	10	not quoted

10. Dawood will invest in 40% of the DH Chemicals equity, underwrite the 10% public share issue, and provide administrative services under their managing agency agreement. DIL, as managing agent, will be entitled to receive a monthly office allowance of Rs 5,000 plus an annual remuneration equal to 5% of annual profits of DH Chemicals (profits after depreciation but before taxes). However, DIL's fee is limited to a maximum of Rs 2.0 million per year and cannot exceed as percentage of profits, the percentage of dividend declared on share capital.

Hercules Incorporated

11. Hercules Incorporated, formerly called Hercules Powder Company, was incorporated in Delaware in 1912 in conformity with a Federal Court anti-trust decree against E.I. Du Pont de Nemours Powder Company. Hercules has since expanded into a diverse chemical company with worldwide interests in cellulose and protein products, explosives and chemical propellants, fibers, color and pigments, paper chemicals, polymers, agricultural chemicals and synthetics.

12. Hercules' international operations extend over 15 countries and include several joint ventures established in partnership with local companies. Hercules has been engaged in ammonia synthesis since 1939 and in the manufacture of urea since 1960. Currently, Hercules operates three ammonia plants (total capacity of about 500 short tons per day) and three urea plants (total capacity of about 205 short tons per day) in the U.S.. It also has a substantial experience in methanol production, the technology of which is similar to ammonia manufacture. Hercules is now building an 800 short tons per day methanol plant at Planquemines, Louisiana. While it appears that Hercules has comparatively limited experience with modern ammonia technology, IFC believes that Hercules is technically competent in general chemical plant construction and engineering, and is therefore capable of providing necessary technical support to the project with adequate design and engineering support.

13. As of December 31, 1967, Hercules had a net worth of $356 million, represented by $20 million in common and preferred stock and $336 million in surplus. For financial year 1967, it recorded net sales and operating revenue of $642 million with a net income after taxes of $47 million, returning 13% on equity.

14. Hercules will acquire 40%, equivalent at present exchange rate to $11.7 million, of DH Chemicals' equity. Hercules will also provide full technical assistance to the project, which includes supervision of process design and construction, assistance in starting up and operating the plant. Besides the general manager, Hercules will provide a start-up team of ten men for up to one year and 18 technical staff members for plant supervision for three years after the start of commercial operation. Hercules' technical services will be provided on a no-profit, no-loss basis. In addition, Hercules will receive, for the technical data and information it will offer to DH Chemicals, an annual know-how fee of $300,000 for the first five years of operation. The remuneration to Hercules for these services is considered to be reasonable.

V. THE PROJECT

Outline of the Project

15. The project, which is more fully described in the technical appraisal report (Attachment 1), consists of construction, start-up and operation of a fertilizer plant at a site at Chichoki Mallian, 17 miles west of Lahore, for the manufacture of 345,000 tons of urea per annum on the basis of 310 operating days per year.

16. Time Schedule. Hercules anticipates completion of construction and erection within 36 months after completion of the financing. Detailed design engineering is expected to take five to six months with physical construction estimated to require 30 months.

17. Start-up of the plant is expected to require three to six months, however, some 70,000 tons of commercially salable urea will be produced during this period. Based on the present timetable, commercial operations will commence in January 1972 at which time DH Chemicals expects to be producing at 75-80% of capacity on a monthly basis.

18. Natural gas, the principal raw material, will be supplied by Sui Northern Gas Pipeline Limited, who will expand its existing pipeline facilities to provide gas for two plants in the Lahore area. Financing of this expansion is being partially provided by IBRD.

Cost of the Project

19. The total investment cost of the project is estimated at $78.2 million, including a provision of $2.6 million for permanent working capital at project completion date. Foreign exchange requirements are approximately 60% of total cost.

20. The cost, which is set out in more detail in Attachment 1, is summarized as follows (in US$ '000):

	Foreign exchange	Local currency	Total
Fixed plant	44,886	21,339	66,225
Preliminary and pre-operating expenses	1,709	2,420	4,122
Interest during construction	-	5,250	5,250
Total fixed asset expenditure	46,595	29,009	75,597
Net current assets at completion date	-	2,586	2,586
	46,595	31,595	78,190
			say, $78.2 million

21. Included in the above estimate is a $9.2 million allowance for customs duties and port handling and $8.4 million for escalation and contingencies. Permanent working capital requirements cover one month's inventory and one month's receivables.

Financial Plan

22. The proposed financial plan for the project is as follows (in US$ million):

	Foreign exchange	Local currency	Total	%
Equity				
Hercules	11.7	-	11.7	40
Dawood	-	11.7	11.7	40
IFC	2.9	-	2.9	10
Public	-	2.9	2.9	10
Total Equity	14.6	14.6	29.2	100%
Long-term Debt				
IBRD	32.0	-	32.0	
AID	-	14.2	14.2	
Customs debentures	-	2.8	2.8	
Total Long-term Debt	32.0	17.0	49.0	
Total	46.6	31.6	78.2	

23. DH Chemicals will be capitalized with share capital of Rs 139.0 million (approximately $29.2 million) which represents slightly less than 40% of the total long-term funds. Hercules and Dawood will each contribute Rs 55.6 million (approximately $11.7 million) to own 40% of DH Chemicals' voting stock. The remaining 20% of the total equity will be contributed equally by IFC and the Pakistani public. The public issue will be made in 1971/72 and will be underwritten by Dawood, whose commitment will be guaranteed by the Habib Bank, Karachi. Dawood will receive a 2-1/2% commission for the underwriting of the public issue.

24. The AID loan of $14.2 million in equivalent rupees will carry a 7% interest and be repaid in 14 semi-annual installments after a 42-month grace period which commences at first loan disbursement, i.e. late 1969. Customs debentures of $2.8 million will bear an interest rate of 1% above the central bank rate (currently 5%) and be repayable in six semi-annual installments after an interest-free grace period of two years which begins with the import of the dutiable equipment.

25. No fixed schedule of equity calls are planned beyond the original call of 5% which is required to make the IBRD loan effective. All other calls on equity will be made on a pro rata basis to loan draw-down and in such amounts that equity paid in will at all times equal or exceed two-thirds of total long-term debt outstanding.

Protective Covenants

26. It is agreed between IBRD and the sponsors (Dawood and Hercules) that special protective and restrictive covenants would be included in the investment agreements to provide further assurance that the project would be satisfactorily completed and that the IBRD service would be amply covered. These provisions can be summarized as follows:

(a) Provision of Additional Funds for Project Completion

(i) Foreign Exchange. Hercules and IFC agree to provide an aggregate of not more than $5 million if needed for completion of the project. Hercules will provide 80% and IFC 20% of any requirement met under this provision.

Hercules and IFC have further agreed that, in the event that, because of change in the par value of the rupee, their respective dollar disbursements to pay for their equity shares would be less than their commitment in terms of dollars, they will lend to DH Chemicals the unused funds.

(ii) Rupees. Dawood has agreed to assume responsibility to provide or make arrangements for any rupee funds needed to complete the project.

(iii) Loans make to DH Chemicals under both of the above conditions will be subordinated to the IBRD loan and carry an interest rate of not more than 9% with repayment to be made over five years commencing 12 months after project completion subject to service of the senior debt and a current ratio test.

(b) Security for IBRD Loan

The IBRD loan will be secured by a first mortgage and a floating charge on the assets of DH Chemicals to be shared equally and ratably with AID. The usual exceptions are provided to permit securing short-term working capital loans.

(c) Restriction on Cash Distribution to Shareholders

Cash distribution to shareholders will be permitted out of earnings and only to the extent that, after giving effect to such distribution, the quick assets of DH Chemicals are not less than 100% of its current liabilities including current long-term debt maturities.

(d) Restrictions on Other Expenditures during Construction Period

During the construction period, DH Chemicals will not make any expenditures other than those required for the completion of the project as specified in Hercules' project report.

(e) Restrictions on Capital Expenditures after Start-up

DH Chemicals will not make capital expenditures other than for replacement exceeding $1.0 million in any one business year.

(f) Restrictions on Indebtedness

Short-term borrowings shall not exceed 75% of receivables and inventories.

(g) Restrictions on Prepayment of Long-term Debt

DH Chemicals, unless otherwise agreed by IBRD, will not prepay other long-term debt.

The restrictive covenants may be waived or modified with IBRD's consent.

VI. THE MARKET AND MARKETING

The Market

27. A separate note (Attachment 2) has been prepared by IFC to assess the market potential for urea in West Pakistan. IFC has concluded that, while nitrogenous fertilizer consumption in West Pakistan is still relatively low, and the past rate of growth in consumption has been lower than projected for the Third Five-Year Plan, it may be realistically assumed that consumption of nitrogenous fertilizer will grow from 150,000 tons in 1967/68 to some 470,000 tons in 1974/75 or by an average annual rate of about 20%. The basis for the above assumption is the apparent success in fertilizer response on the new strains of wheat and rice recently introduced. Assuming the above growth rate, there is justification for two additional urea plants of 330-345,000-ton capacity in West Pakistan, which would allow this project and another similar urea plant to be installed more or less simultaneously.

28. Current nitrogen fertilizer capacity, expansions under way and the Esso urea plant will provide approximately 160-170,000 tons of nitrogen by 1970. While most of this capacity is located geographically in areas not well suited to compete economically in the Lahore area, i.e. the planned location of the two plants under consideration by IBRD, there are possibilities that some production from these facilities will be shipped into the proposed DH Chemicals marketing area, especially in the early years. This factor has been taken into consideration by DH Chemicals and, based upon their market surveys, should not cause serious disruption in pricing or production.

29. The Government has been giving consideration to promote the installation of further nitrogenous fertilizer capacity in addition to the proposed DH Chemicals plant and another similar plant in the Lahore area. These two plants, together with the existing capacity in Pakistan, should take care of the demand for nitrogen in the early 1970s, unless the development of consumption in the next few years should be substantially in excess of what has been projected. Therefore, consideration of adding further nitrogen capacity should be deferred at least for a year and decided in the light of the experience gained with the development of the market during that period.

30. The anticipated growth of consumption is dependent on the Government's pursuing a coordinated policy to stimulate the demand. The market report comments in detail on the various aspects of such a policy. Of particular importance is that the Government arrange to provide substantial quantities of phosphatic fertilizers. Efficient plant utilization of nitrogen is dependent upon companion application of phosphatic and potassic fertilizers. While soil analysis of West Pakistan has not clearly established a definite potash requirement, however, the need for phosphatic

fertilizer has been definitely confirmed. The Government will also have to make arrangements for substantially larger rupee funds to provide the expanded credit needs that arise from the sharply increased volume of fertilizer consumption.

Marketing

31. The marketing area of DH Chemicals will be within a 200-mile radius of the plant site. To provide complete coverage of the marketing area, DH Chemicals will select 3-500 dealers, including three major distributors, who, together with their sub-agents, are expected to provide more than one thousand retail outlets. DH Chemicals will, furthermore, establish four regional offices and warehouses in Lahore, Peshawar, Sargodha and Multan to handle off-season inventory build-up and supplement the stock carried by distributors.

32. DH Chemicals will organize a technical service group to promote the sale of urea through instruction to farmers in the proper use of fertilizers. The group will provide technical service through field and model farm demonstration, soil testing, individual counseling and village meetings in the marketing area.

33. Prior to start-up, the sponsors plan to develop the fertilizer market through a seeding program. The Government has agreed to the seeding program and has allocated 40,000 tons annually of N (in various forms) from West Pakistan Agricultural Development Corporation stocks to Dawood Corporation for distribution over the period of three years from October 1967. The seeding program will be transferred to DH Chemicals once the new company is operating. During the current year, 1968/69, Dawood has proceeded to establish marketing outlets and to date one shipment of 14,000 tons of fertilizer has been successfully marketed.

34. The average freight haul of urea is expected to be less than 150 miles. Primary transport will be by trucks and railroad and supplemented by bullock carts beyond mandi towns. At present the sponsors anticipate shipping approximately 50% of urea by trucks because of the overstrained conditions of the railroad.

35. The proposed retail price for DH Chemicals' urea is $105 per ton, which is broken down as follows ($ per ton):

Ex plant price	93.00
Distribution and transport expenses	12.00
Retail price	105.00

36. This compares with the present subsidized retail price of urea officially fixed at Rs 500 ($105) per long ton and the recent average price of imported urea of about $105 CIF Karachi. The sponsors believe

that the proposed price level will remain firm for some years to come for the following reasons:

(a) Increasing knowledge on the part of farmers that the use of fertilizers is highly profitable.

(b) GOP policy has placed increased agricultural production as an item of highest priority for future development and is, therefore, likely to maintain a favorable investment climate for fertilizer manufacturers.

(c) Pakistan will continue to face a foreign exchange shortage, thus placing increasing reliance on local manufacturers and import substitution.

37. IFC expects, however, that the downward trend in the world market for urea would continue, and by the time DH Chemicals' plant is commissioned, the Government will discontinue the present subsidy program. As local competition increases and world market prices decline, the proposed price may require adjustment several years after start-up.

38. Because of the shortage of fertilizers, farmers have traditionally paid cash for fertilizers. However, it will undoubtedly be necessary for dealers and retailers to extend credit as fertilizer consumption increases. Such credit will be essentially in the form of crop term credit so that farmers can repay when they receive proceeds of their products. Therefore, credit requirements will vary depending upon the end-use pattern of fertilizers and the timing of marketing agricultural products. The Government and AID are discussing an agricultural credit program which will increase by $29.4 million rupee equivalent the resources now available for fertilizer financing.

VII. PROFITABILITY AND FINANCIAL POSITION

39. There are attached a projected income statement, a projected balance sheet and a cash flow statement, as Annexes 1, 2 and 3, respectively.

40. The project is expected to be commissioned 36 months after project financing is finalized. Hercules assumes that the rate of operation will gradually rise from 50% of capacity in the first year of operation to 90% in the second year, reaching full capacity in the third year and continuing thereafter. For the purpose of profitability projections, a selling price of $93 per ton ex-plant is used for operations. The project will enjoy a tax holiday through 1975 during which no income tax is payable on net earnings, however, 40% of the tax-free earnings must be retained and are not available for cash dividends.

41. Based upon these assumptions, DH Chemicals is expected to show a nominal net profit in the first year increasing to approximately $12 million (35% of net sales) in the fourth year of operation, however, profits will decline after the tax holiday but net earnings will stabilize at about $7 million thereafter. Pre-tax and pre-interest return on total long-term funds employed is projected on the average at about 20% per annum after capacity operation is achieved. Debt service coverage ratio will exceed two except during the first few years. On a 100% pay-out basis, DH Chemicals will be in a position to declare a first dividend in the second year of operation, increasing to about 20% after the fifty year of operation.

42. The project has a high proportion of fixed costs, amounting to 40% of the estimated sales price. However, DH Chemicals will be able to meet its fixed costs at capacity operation as long as sales price does not drop below $62 per ton or as long as the sales volume does not drop below 196,000 tons per year, which is 57% of capacity.

43. The initial debt/equity ratio of 62:38 will improve to approximately 40:60 by the fifth year of operation when the plant is operating at capacity. The current ratio will rise from a low of 1.0 in the first year of operation to 2.9 in the fifth year.

44. The AID loan fixed maturities will be scheduled over seven years, to be fully repaid approximately at the same time as the IBRD loan. However, DH Chemicals anticipates returning the AID loan in four years by utilizing the excess cash generation resulting from the tax holiday restrictions. The financial forecasts have been prepared accordingly, however, actual prepayment of the rupee debt would require the consent of IBRD.

45. Shareholders may look forward to an adequate return on their total investment and equity. Dividend returns on share capital and return on total investments are conservatively estimated to be 19% and 17.5%, respectively, both discounted.

VIII. EVALUATION OF THE PROJECT

46. On the above basis, the project appears technically feasible and commercially attractive. Both sponsors are financially responsible and have extensive industrial management experience. Additionally, Hercules is expected to provide technical, marketing and industrial management support to the project. Cash generation, on the basis of projections, appears adequate to assure servicing of the total long-term debt, and projected earnings indicate that the returns on IFC equity would be very satisfactory. Thus, IBRD looks forward to satisfactory protection on its loan and IFC can reasonably expect an attractive return on its equity.

47. The project will materially contribute to the economy of Pakistan by providing a substantial quantity of urea for increasing agricultural production and by broadening the industrial base of the country. Since the project is based upon locally available natural gas, substantial savings in foreign exchange will result if the current pattern of growth in fertilizer consumption continues. The project will also provide direct employment for approximately 600 persons as well as indirect employment for an even larger number to be required in transport and distribution.

48. On the whole, the project appears well-conceived and suitable for IBRD/IFC financing. However, there are several factors which need particular attention: first, prices of nitrogenous fertilizer may well decline as the new generation of large ammonia plants come on-stream throughout the world and, under these circumstances, it is possible that indigenous producers would be forced to reduce prices in parallel with international prices, with a corresponding reduction of the return on investment of DH Chemicals. Second, even though the sponsors plan to use the latest proven technology and equipment, and rely on the services of one of the leading consultant firms as engineering manager, the project may well encounter start-up troubles as happened to some of the modern, large fertilizer facilities in developed countries built by well-experienced manufacturers. The scope and magnitude of possible technical problems during construction and start-up are not easily assessable, however, major problems could lead to financial losses. It is reasonable to assume, however, that the possibility of start-up problems should be materially reduced in the next few years due to increasing experience and knowledge gained in the start-up of these large plants. A third factor is the critical importance of provision for sufficient phosphatic fertilizers to assure a balanced input of nutrients. According to the IFC mission, Pakistan must either make provision for import of approximately 225,000 tons of P_2O_5 by 1974 or install local capacity. Failure to provide this P_2O_5 could seriously handicap the build-up of nitrogen use, since the benefits derived from nitrogenous fertilizer application is dependent upon proper application of phosphatic fertilizers.

49. IFC has carefully examined these factors and, in its judgment, the risks are not unreasonable and fall well within the scope of acceptable industrial risks, therefore, no more than normal risks for the IBRD loan or the IFC investment.

DAWOOD HERCULES CHEMICALS LIMITED

Projected Income Statements
(US$ '000)

Fiscal years ending June 30,	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Net sales in metric tons	159,000	310,000	345,000	345,000	345,000	345,000	345,000	345,000	345,000	345,000
Net sales proceeds @ $93/ton	14,785	28,830	32,085	32,085	32,085	32,085	32,085	32,085	32,085	32,085
Cost of sales	7,715	10,931	11,596	11,792	12,115	12,436	12,436	12,436	12,436	12,436
Depreciation 7.5% declining balance	2,209	5,504	5,023	4,714	4,361	4,033	3,731	3,451	3,192	2,878
Gross Profit	4,861	12,395	15,466	15,579	15,609	15,616	15,918	16,198	16,457	16,771
Indirect expense 1/	1,152	1,476	1,524	1,530	1,510	1,226	1,226	1,226	1,226	1,226
Operating Profit	3,709	10,919	13,942	14,049	14,099	14,390	14,692	14,972	15,231	15,545
Interest expense	3,302	3,249	2,805	2,161	1,474	1,222	986	755	539	333
	407	7,670	11,137	11,888	12,625	13,168	13,706	14,217	14,692	15,212
Managing agent's fee 5%	-	383	556	594	631	658	685	710	734	760
Pre-tax Profit	407	7,287	10,581	11,294	11,994	12,510	13,021	13,507	13,958	14,452
Income tax at 42.5%	- - - - - Tax holiday - - - - -					5,097	5,316	5,533	5,740	5,932	6,142
Net Profit	407	7,287	10,581	11,294	6,897	7,194	7,488	7,767	8,026	8,310

1/ Indirect expense includes Hercules know-how fee, sales and administrative overheads.

ANNEX 1

IFC/AAME
June 18, 1968

DAWOOD HERCULES CHEMICALS LIMITED

Projected Balance Sheets - Fiscal Year ends June 30
(US$ '000)

	End of construction 6-30-71	Start of commercial production 2-1-72 *	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Current Assets												
Cash	4,518	3,018	2,800	3,454	3,735	3,828	4,225	5,306	6,127	6,668	6,950	6,918
Accounts receivable	-	1,604	3,255	3,255	3,255	3,255	3,255	3,255	3,255	3,255	3,255	3,255
Inventories	-	-	670	2,717	2,843	2,887	2,941	2,983	2,983	2,983	2,983	2,983
Total Current Assets	4,518	4,622	6,725	9,426	9,833	9,970	10,421	11,544	12,365	12,906	13,188	13,156
Less:												
Current Liabilities												
Accounts payable	-	445	391	598	659	659	659	659	659	659	659	659
Maturing long-term debt	-	1,455	5,925	4,940	4,940	3,910	2,910	2,910	2,910	2,910	2,910	2,910
Total Current Liabilities	-	1,900	6,316	5,538	5,599	4,569	3,569	3,569	3,569	3,569	3,569	3,569
Net Current Assets	4,518	2,722	409	3,888	4,234	5,401	6,852	7,975	8,796	9,337	9,619	9,587
Net Fixed Assets	73,672	75,597	73,388	67,884	62,861	58,147	53,786	49,753	46,022	42,571	39,379	36,501
	78,190	78,319	73,797	71,772	67,095	63,548	60,638	57,728	54,818	51,908	48,998	46,088
Long-term Debt												
IBRD loan	32,000	30,545	29,090	26,180	23,270	20,360	17,450	14,540	11,630	8,720	5,810	2,900
AID rupee loan	14,200	14,200	13,185	11,155	5,155	-	-	-	-	-	-	-
GOP customs debentures	2,800	2,800	-	-	-	-	-	-	-	-	-	-
Total Long-term Debt	49,000	47,545	42,275	37,335	28,425	20,360	17,450	14,540	11,630	8,720	5,810	2,900
Capital and Surplus												
Ordinary share capital	29,190	29,190	29,190	29,190	29,190	29,190	29,190	29,190	29,190	29,190	29,190	29,190
Restricted surplus	-	1,584	2,088	5,003	9,236	13,754	13,754	13,754	13,754	13,754	13,754	13,754
Free surplus	-	-	244	244	244	244	244	244	244	244	244	244
	78,190	78,319	73,797	71,772	67,095	63,548	60,638	57,728	54,818	51,908	48,998	46,088

ANNEX 2

* This interim balance sheet is projected to coincide with project completion.

IFC/AAME

June 18, 1968

DAWOOD HERCULES CHEMICALS LIMITED

Condensed Source and Application of Funds Statement
(US$ '000)

Fiscal years ending June 30,	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Source										
Net profit	407	7,287	10,581	11,294	6,897	7,194	7,488	7,767	8,026	8,310
Depreciation	2,209	5,504	5,023	4,714	4,361	4,033	3,731	3,451	3,192	2,878
Interest earned & capitalized	1,925	-	-	-	-	-	-	-	-	-
Total	4,541	12,791	15,604	16,008	11,258	11,227	11,219	11,218	11,218	11,188
Application										
IBRD loan	-	2,910	2,910	2,910	2,910	2,910	2,910	2,910	2,910	2,910
AID loan	-	1,015	6,000	6,185	1,000	-	-	-	-	-
GOP customs debentures	800	2,000	-	-	-	-	-	-	-	-
Increase (decrease) current maturities	5,925	(985)	-	(1,030)	(1,000)	-	-	-	-	-
Additions to fixed assets*	1,925	-	-	-	-	-	-	-	-	-
Dividends	-	4,372	6,348	6,776	6,897	7,194	7,488	7,767	8,026	8,310
Increase (decrease) in net current assets	(4,109)	3,479	346	1,167	1,451	1,123	821	541	282	(32)
	4,541	12,791	15,604	16,008	11,258	11,227	11,219	11,218	11,218	11,188

* Capitalized interest

ANNEX 3

IFC/AAME
June 18, 1968

DAWOOD HERCULES CHEMICALS LIMITED

UREA FERTILIZER PROJECT

WEST PAKISTAN

Attachment 2 -- Market Cont'd. Page

This report was prepared by Messrs. W.R. Ewing and S. Cottrell, IFC Engineering Department.

June 12, 1968

Attachment 1

DAWOOD HERCULES CHEMICALS LIMITED

UREA FERTILIZER PROJECT

WEST PAKISTAN

TECHNICAL APPRAISAL

I. THE PROJECT

The project consists of the construction in the Lahore area of West Pakistan of a fertilizer plant to produce 345,000 tons* of agricultural grade urea per annum. The proposed facilities will include a 620 tons per day single train ammonia unit and a 1,100 tons per day double train urea unit. The Kellogg and Toyo total recycle processes will be used for ammonia and urea manufacture, respectively. All the ammonia would be utilized in the manufacture of urea. In addition to the usual bagging, storage, shipping, maintenance, laboratory and administration facilities, the plant will have its own power station with a capacity of 18,000 kw. Outside power connections would be maintained for emergency use. Natural gas from the Sui field would be used as feedstock and fuel. No other raw material would be required.

Total fixed cost of the project is estimated at $75.6 million of which about 60% would be required in foreign exchange. When the plant is producing at full capacity, annual sales will be about $32 million. Assuming that the project would go ahead in mid-1968, mechanical completion of the plant is expected in late 1971 with full commercial production available by mid-1972.

The location near Lahore (see map - Annex 1) is in the midst of the principal agricultural region of West Pakistan. IFC engineers have inspected the proposed site and have examined and discussed the technical details of the project with the Pakistani and American sponsors. In addition, a separate report has been prepared covering the market for fertilizer in West Pakistan. This report is attached as Attachment 2.

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* Ton as used in this report means a metric ton.

(Rs 4.76 = $1.00 U.S.)

II. THE FACILITIES

A. Plant Site

The plant will be located at Chichoki Mallian, 17 miles west of Lahore. The site lies in the plain traversed by numerous irrigation canals between the rivers Chenab and Ravi, tributaries of the Indus, which, with its tributaries, waters the most productive agricultural area in West Pakistan.

The plant site is on the broad gauge railroad connecting Lahore with Lyallpur and other principal cities of the region, with a connection to north-south rail line at Sangla Hill some 40 miles to the westward. It is planned to ship approximately half the product by rail and the balance by highway.

Negotiations with the Government on a suitable plot of 260 acres started last September, and the company has recently been granted access to the land. Additional land desired for experimental farms and for possible future expansion will be purchased directly from private land owners over a period of some years.

The terrain is flat and neighboring sites have a soil bearing pressure of about 3,000 pounds per square foot. Soil tests on the plant site itself have not yet been carried out, but will be made within the next two months. Some foundation piling may be necessary for the heavier plant items.

The area was flooded in 1955 when the River Ravi reached a flow rate of 550,000 cusecs. Danger of future site flooding is much less than in 1955 because of new flood control constructions and diversion of the headwaters of the three southernmost tributaries of the Indus (including the River Ravi) to India. Consultants to WAPDA have calculated the possibility of a Ravi flow of 538,000 cusecs in future at only once in 500 years. The sponsors plan to mount motors and other electrical equipment some two to three feet above grade where they should be above any possible future water levels.

The site meets all requirements for a project of this sort and involves less than the usual expenditures for non-manufacturing facilities.

B. Manufacturing Units

1. Ammonia

Facilities for producing 620 tons of ammonia per day, or approximately 200,000 tons of ammonia annually in 320 operating days would be installed. A single train plant is planned, utilizing centrifugal compressors and other features of the latest proven technology.

The ammonia plant furnishes both ammonia and carbon dioxide (CO_2) for the urea plant. When operating on Sui natural gas the ammonia plant would not normally produce enough CO_2 for the urea process. Hercules propose to use excess natural gas in the reforming step and so produce some extra CO_2. Some extra hydrogen would also be produced but this would be recycled and used as fuel. Hercules (and Fluor, who have done preliminary engineering) believe this course would be cheaper than recovery from stack gases, and it is an acceptable method.

Storage for two-and-a-half days production of ammonia (1,600 tons) would be installed to tide over short outages of ammonia and urea units.

2. Urea

It is proposed to install a dual train Toyo Koatsu (Japan) total recycle plant with a single prill tower producing low biuret prilled product. The plant is designed to reach capacity (345,000 tons per annum) in 310 operating days producing at 1,110 tons per day.

A two-train plant was tentatively chosen for two reasons: first, no one has operating experience with a single train 1,000 ton per day urea plant; secondly, Hercules believe that the added flexibility of the two-train plant would result in sufficient additional production to justify the added cost, estimated at $1.5-2.0 million.

Hercules propose that the Fluor Corporation, acting under a license from Toyo, would design, engineer and construct the urea plant. Fluor has done this for two 375 tons per day plants in Korea (now reported by Fluor to be making 420 tons per day each), for a single stream 620 tons per day plant for Esso in Rotterdam, and are now in the course of building a 570 tons per day plant for Esso in West Pakistan. Fluor has adequate experience in this field.

A 60,000 ton (good for two months) storage for bulk urea is planned with about two weeks storage (14,000 tons) for bagged goods. Some producers reverse these tonnages, with limited storage for bulk and large storage for bagged goods, fearing that the bulk material will cake when stored for a longer period. Based upon the experience of ICI and others, it appears that the Toyo high analysis product can be stored in bulk successfully. This is somewhat less costly than storage of bagged goods. The bulk storage building could be air-conditioned later on if this were to be desirable.

C. Utilities

1. Water

The ground water of the basin of the Indus and its tributaries constitutes one of the largest acquifers in the world. The company therefore plans to obtain its water supply from tube wells. It is expected that even a long drought would have only a small effect on the ground water level, and hence the supply of processing water is assured.

Total cooling water requirements are estimated at 55,000 GPM which would be circulated through a large cross flow induced draft cooling tower, and only make-up water would come from tube wells. Make-up plus boiler feed water plus potable water requirements are estimated at 2,210 GPM and it is expected that one, or at most, two wells could handle this requirement. A surge tank would be provided to tide over well outages of approximately eight hours.

Boiler feed water and potable water would be produced by suitable treatment of the well water.

A separate fire main system would be provided. The basin of the cooling tower would be made larger than usual so as to provide a fire water reservoir good for two hours at 1,500 GPM.

Sewage, both sanitary and from process, would be collected in treating systems and discharged in acceptable condition to the irrigation drain skirting the property. Since some water from this drain is used not only for irrigation but for watering stock (and probably for some human consumption) rigorous effluent treatment and control is planned.

2. Power

While the plant will be connected to the public power system, this source of power is regarded as not sufficiently dependable for steady ammonia plant operation. Hence, as is common practice, the factory will have its own power generating facilities. Total power requirements, including those of the housing colony, are estimated at 14,825 kw. It is tentatively planned to install three 6,000 kw generators, two driven by gas turbines and one by a steam turbine. Final decision will rest on detailed engineering and heat balance calculations.

For emergency and stand-by operations, an electricity connection will be made to the 66 kv transmission line which runs alongside the plant site. The capital cost estimates include an in-plant substation for this connection. The factory under normal conditions may export a little power to the public system. These arrangements have been tentatively discussed with the Power Company, but no details have been finalized.

D. Off-sites and Auxiliaries

The project would have the usual facilities ancillary to production in a grass roots installation. Among these are the following.

1. Rail and Highway Connections

Details of the rail connection have not yet been worked out in detail, but since the plant site is on the broad gauge line connecting Lahore with Lyallpur this presents no great difficulty. Railroad officials have indicated orally that they would make the necessary equipment available for moving the urea. While there are no firm plans yet for sidings, marshalling yard or the like, the capital cost estimate includes an allowance for 6,000 feet of track with switches, turn-outs, etc.

The plant site is on the main highway between Lahore and Lyallpur. However, the present two lane highway is badly congested. Government proposes to widen this road to four lanes within the next five years.

2. Storage

Since the only raw material to be used is natural gas and this will also serve as fuel, no storage is needed.

Storage for ammonia (1,600 tons) and urea (74,000 tons) has already been discussed under the headings of Ammonia and Urea. Ammonia would be stored at atmospheric pressure in a refrigerated spherical tank.

The storage buildings for bulk and bagged urea would be ridge-type concrete structures. Two lines of bagging equipment will be installed to handle full production on a three shifts per day schedule plus a spare line to be put into service as needed. There would be storage space for six weeks requirements of empty bags.

3. Maintenance

An adequately equipped shop with a store for parts and supplies is planned, together with suitable portable tools and mobile equipment. Ample allowance has been made for spare parts, catalysts and chemicals.

4. Buildings

Aside from the previously mentioned reinforced concrete construction to be used for the main storage buildings, the type of construction for the other plant buildings has not yet been selected. It is planned to retain a local architect to maximize

the use of local design and materials. About 60,000 square feet of floor space are planned for offices, shops, laboratory and the like. This is an adequate allowance.

The administration building, laboratory and other offices would be air-conditioned as would the dwellings planned for the housing colony.

5. Housing Colony

Although an extensive housing colony at the plant site was originally visualized, Hercules now believe that adequate dwellings for expatriates and other staff are available in the Lahore area.

Hercules plan to give expatriates an allowance of 40 percent of salaries to cover the cost of housing and amenities in the Lahore area.

The sum of one million dollars has been allocated to the capital cost of "housing" to cover the cost of a guest house, dispensary and such other amenities as are finally determined to be required.

III. CAPITAL COSTS

The total fixed cost of the project is estimated at $75.6 million. The breakdown of project cost is as below:

Table 1 - Capital Cost
($ million)

Plant	Total
Ammonia plant	15.39
Urea plant	13.93
Urea storage and shipment	5.20
Electric power generation	5.08
Auxiliary boiler plant	1.06
Water supply and treatment	1.01
Cooling towers	1.12
Mobile equipment	1.51
Buildings and furnishings	1.12
Spare parts	3.57
Catalyst and chemicals	1.32
Others	1.67
Total Plant	51.98
CARRIED FORWARD	51.98

	Total
BROUGHT FORWARD	51.98
Land and site improvements	.94
Housing	1.00
Engineering expenses	8.36
Licenses and know-how fees, etc.	3.80
Start-up expenses	.35
Pre-operating expenses	4.12
Interest through start-up	5.05
Total Cost	$75.60

Included in the above estimates are provisions for import duties and other clearing charges of $9.2 million, spare parts of $3.6 million, and provisions for escalation and contingency of $8.4 million. Import duties and other clearing charges are calculated at the rate of 40% of the C&F value of imported equipment and machinery, and 60% of the C&F value of other items. Provisions for spare parts are based upon Hercules' standards for stocking at their own plants and include a two-year supply of imported parts. Provisions for escalation and contingencies are allowed at a rate of 15% of the total fixed assets exclusive of pre-operating expenses and interest during construction.

The capital costs estimates have been based on costs of constructing and installing similar plants, including one now being completed in West Pakistan by Fluor, D-H consultants. The detailed estimates have been checked by IFC engineers, and are considered adequate although some revisions are likely as more detailed engineering is carried out.

IV. PRODUCTION

Urea with the following analysis is to be produced:

Nitrogen	46% minimum
Biuret	1% maximum
Moisture	0.5% "
Coating	None
Screen analysis (Tyler)	
Through 8 mesh and on 20 mesh	95% minimum
" 20 mesh	1% maximum

These specifications are satisfactory for agricultural grade urea. In practice it can be expected that the biuret content will be below 1% after some experience in operating the facilities. High biuret (above 1%) is reported to have a toxic effect on some plants. However, since recent Pakistan tenders for imported urea stipulate a biuret content of a maximum of 0.3%, the sponsors are considering whether they should add a crystallization step to meet this requirement. This may increase capital costs by up to half a million dollars.

There is a difference of opinion in the industry about the need for coating. In the past, most U.S. companies have produced a coated product. In the U.K. an uncoated product has been produced and handled successfully by ICI. Uncoated product is planned for the ICI project at Kanpur in India in which IFC has made an investment. There seems to be a preponderance of opinion that the modern Toyo product need not be coated.

There is much discussion going on in the industry as to the dependable on-stream time of large ammonia and urea plants. Most of these plants are so new that information--to the limited extent to which it is available--is probably not yet reliable. Experts with experience in this field believe that the ammonia plant should achieve 340 stream days a year. They also believe that a large urea plant should operate 330 days a year were it not dependent upon the ammonia plant for its ammonia and CO_2. IFC has made some independent checks on this question and it would appear that 310 days/year for the urea plant is probably a conservative figure to use for, say, the first two years, but after that it should be possible to achieve 330 days. As was mentioned earlier, the capacity of the urea plant is based on 310 days.

Hercules expect urea production to reach full capacity utilization in two years. While such a buildup is possible, on the basis of our market expectation it may take another two years to reach capacity operation if two fertilizer projects were to go ahead more or less simultaneously. Also with such a large plant operating in Pakistan there are bound to be teething troubles in the first years of operations.

V. PRODUCTION COST

Production costs have been conservatively estimated and were evaluated by IFC in discussions with the sponsors. The largest cost item is depreciation, taken at 10% on plant and equipment, and 5% on civil works and housing. The cost of the next largest item, natural gas, has been estimated using rates about 4% higher than those included in a provisional gas contract already signed and discussed under Gas Supply below. Bags at $10 per ton of urea constitute the next important cost item. Operating and maintenance materials and supplies are based on the current operations of Hercules' facilities modified by knowledge of costs in West Pakistan. Allowances have been made for normally expected increases in wage rates and prices, and an appropriate provision for contingencies is included.

VI. GAS SUPPLY

The plant will consume on the average of about 33 million and a peak of 35 million cu.ft. of gas per day, or some 10,700 million cu.ft. per year when producing at full capacity. Gas costs have been calculated on the basis of a fixed annual charge of $1.05 million plus $0.279 per

1,000 cu.ft., representing an average gas price of 37.6¢ per 1,000 cu.ft. The variable price portion is about 2¢/1,000 cu.ft. above the price agreed on in a provisional contract which D-H Chemicals signed with Sui Northern Gas Pipeline (SNGPL). This higher price most likely will have to be paid.

Gas will be obtained from the Sui field some 350 miles southwest of the plant site. Although there is now a 16" gas pipeline from Sui to Lyallpur and a 10" line onward to Lahore, these will not carry the additional load imposed by two new fertilizer plants. The gas transmission company, SNGPL, plans to install 128 miles of partial loop lines of 18" diameter between Sui and Lyallpur and 16" diameter onward some 40 miles towards the two new fertilizer plants. The estimated capital cost of additional facilities is about $27 million and SNGPL has applied for a Bank loan of $12 million. A Bank mission has visited Pakistan to appraise the gasline project, and the appraisal report recommends the financing.

With the expected gas offtake from the Sui field to meet both the requirements of the north and the south of, together, 112 billion cu.ft. per year (including the two urea plants in the Lahore area) present reserves would last for 50 years. Since the proved reserves have increased from 3.8 to about 6 trillion cu.ft. over the past decade and are expected to continue to increase as the field is exploited, gas reserves are more than adequate to also support the two urea plants.

While the provisional gas contract signed by SNGPL and Dawood (on behalf of D-H Chemicals) guarantees a maximum sulfur content of 20 grains per 100 cubic feet, actual sulfur content has not exceeded 3 grains per 100 cubic feet. The ammonia plant, therefore, will be designed to handle gas containing up to 5 grains per 100 cubic feet.

There is some chance that the sulfur content might increase as larger volumes of gas are passed through the transmission system to supply the fertilizer projects, although part of the expected increase in the assumed gas price mentioned above is to allow for the installation of additional sulfur removal equipment at the gas field.

If the sulfur content should increase beyond 5 grains per 100 cubic feet, the designed seven day regeneration cycle in the ammonia plant would have to be reduced. Finally, a point could be reached where additional equipment at the ammonia plant would be less costly than shorter term regeneration and at this point D-H Chemicals could decide whether to continue on with the higher regeneration costs or to install additional sulfur removal equipment.

VII. ENGINEERING, PROCUREMENT AND CONSTRUCTION

The company plans to engage the Fluor Corporation of Los Angeles as Engineering Manager on the basis of a cost plus fixed fee contract.

Since Fluor has a license from Toyo Koatsu, and since a large number of successful Toyo plants have recently been built, Fluor under its contract with Toyo will design and build the urea process unit. In addition, the company will enter into a fixed price contract with Toyo Koatsu on additional services in connection with the design and construction of the urea plant. Toyo will guarantee the performance of the plant. Also, since Kellogg has built more large ammonia plants than any other firm, the company intends to award the ammonia facilities' design and engineering to Kellogg. Finally, Hercules will give on a "no profit" "no loss" basis supervisory assistance to the company during construction. These arrangements are satisfactory.

To the extent practicable equipment for the plant will be subjected to international competitive bidding. All identifiable imported goods, of together $23.2 million, will undergo international competition except about $5.5 million. Of these about $2.0 million worth of goods--for reasons of reliability and standardization of design--will undergo restricted bidding and for another $2.5 million of goods the company plans to approach only one supplier. In these two categories equipment would be expected to come from the U.S., Italy, Japan and Germany. The remaining $1.0 million represents spare parts which are related to items not subjected to full bidding.

We are satisfied that for this type of plant these procedures meet IBRD's bidding requirements, and it is proposed that the whole of the $23 million of imported equipment be eligible for disbursement under the proposed Bank loan. It is also recommended that design and process engineering services to be rendered by Fluor, Kellogg and Toyo be eligible for Bank disbursement. Before the company selected Fluor as their Managing Contractor it investigated four other engineering firms, Bechtel, Foster-Wheeler, Friedrich Uhde and Toyo and concluded that Fluor was best qualified.

Insofar as possible, off-sites and auxiliaries would be built by Pakistani contractors under the overall supervision of Fluor. Likewise as much procurement as possible would be done through Pakistani sources.

Only preliminary engineering has been done and only tentative arrangements have been concluded with Fluor, Toyo and Kellogg. Assuming reasonable progress in financial negotiations during June, Hercules is prepared to finalize arrangements with the three major contractors and to set engineering in motion in July. In this case detailed engineering would be well under way by August.

A team of Hercules and Fluor personnel would go to Pakistan in late June to finalize arrangements for soil bearing tests and other site improvements. Legal access to the site has just been made available. The team would also pre-qualify Pakistan contractors and material suppliers and make other necessary arrangements for beginning construction.

VIII. MANAGEMENT, STAFF AND LABOR

Full managerial responsibility for day-to-day operations of the new company will be vested in a General Manager who will be a director of D-H Chemicals nominated by Hercules and to be appointed by the Board of Directors. A Hercules expatriate is expected to be chosen for this position. While Dawood Industries Limited, a nucleus company of Dawood, will be appointed Managing Agent, it will function under the supervision of the General Manager and will provide D-H Chemicals with administrative services. Commercial sales will be handled by D-H Chemicals and the seeding program, already started by Dawood Corporation, will be transferred to D-H Chemicals at a date to be agreed by the sponsors.

The sponsors have completed drafts of their agreements relating to management and operation of D-H Chemicals, which describe in detail the technical services to be rendered by Hercules as foreign partner and Dawood's role in management. The basic principles incorporated in these drafts appear satisfactory.

Total staff and labor requirements of the plant at full production are estimated at about 600, including 29 Hercules expatriates. The expatriates are expected to be gradually replaced by Pakistani staff over a four-year period after start-up. If necessary, the expatriate General Manager and one or two key technical executives may be employed after this four year period. There is available a large pool of skilled and unskilled labor in Lahore and Sheikhupura. Lahore, the second largest city in West Pakistan has a population of more than two million. An adequate labor force can be recruited without any major problems.

IX. CONCLUSIONS

1. The project is technically sound and the company is able to muster adequate management skills, both technical and administrative.

2. The proposed production units are of economic size and the latest proven process technologies will be employed. Although some of these are rather advanced for use in developing countries, with adequate management the plant should be able to achieve its rated output.

3. The estimates of fixed capital and production costs are realistic and the provisions for contingencies and price escalations included in the cost estimates are adequate.

4. The future fertilizer market is an area of some uncertainty. While there is a good possibility that (if the Pakistan Government pursues its present policies of increasing agricultural output) consumption of

nitrogen in fertilizers will reach the projected 470,000 metric tons by 1974/75, consumption actually may fall short of this figure. But even if this were the case, the more or less simultaneous completion during 1971 or early 1972 of one more 1,000 ton per day urea plant, in addition to the Dawood/Hercules plant, should not cause more than temporary under-utilization of plant capacity.

June 12, 1968

Attachment 2

DAWOOD HERCULES CHEMICALS LIMITED

UREA FERTILIZER PROJECT: MARKET

WEST PAKISTAN

1. Introduction

Agriculture is the most important industry in West Pakistan and provides the livelihood of about 35 million people, or roughly 70% of the total population. Agriculture contributed about 42% to the Gross Provincial Product in 1965, and the agricultural products and derivatives accounted for nearly three-fourths of all exports from West Pakistan in that year.

The total land area of West Pakistan is 199 million acres, of which some 39 million acres or about 20% are being cultivated; in addition there are a further 30 million acres which are potentially arable. The most important agricultural areas lie in the plains which are traversed by the Indus River and its tributaries; these plains run from the Himalayas in the north to the Arabian Sea in the south, and are bordered by the hills of Baluchistan on the west, and by deserts on the southeast.

Of the total cultivated acreage 25% is estimated to lie within 100 miles of Lahore, and 50% within 200 miles, as shown in the map, Annex 1. The agriculture in West Pakistan is sustained by one of the world's largest irrigation systems and at present about 27 million acres are irrigated.

Wheat is the main staple diet in West Pakistan and is cultivated on about one-third of the arable land. Other major crops are rice, coarse grains, gram and oilseeds; non-food crops are cultivated on 25% of the available area. Although the land in the plains is inherently fertile, repeated cropping has depleted the plant nutrients in the soil.

Yields have been increased only marginally and are still low in comparison to some other countries for some selected crops, as follows:

Note: "Ton" in this report means a long ton of 2,240 lbs. unless otherwise stated.

Yields of Selected Crops in Other Countries
1961-1963 - Pounds/Acre

	Wheat	Rice	Oilseeds
West Pakistan (1964/65)1/	750	840	367
Burma	337	1,309	-
Turkey	888	3,085	617
Yugoslavia	1,423	3,142	773
France	2,220	3,350	1,365
Netherlands	3,470	-	2,065
U.S.A.	1,365	3,407	-
Japan	1,785	4,263	987

1/ Latest year for which complete statistical data were published.

Source: Irrigation and Agriculture Consultants Association (IACA) Program for Development of Irrigation and Agriculture in West Pakistan, Vol.7, Annex 9.

The need to increase agricultural output is pressing. The daily per capita calorie intake of the West Pakistan population in 1964/65 is believed to have been in the neighborhood of 2,000 calories and this was only achieved with imports of 1,100,000 tons of wheat equivalent to about one-quarter of the domestic production. FAO considers 2,300 calories to be the minimum average daily per capita requirement. In addition, the growing population, which is expected to increase by 29.4% from the 1965 level of 51 million to 66 million in 1975, will require greater food production even to maintain present calorie intake levels. Finally, the country could conserve scarce foreign exchange, and reduce its dependence on U.S. PL-480 grain shipments, if imports of staple foods were no longer required. The Government is making a major effort to achieve self-sufficiency in food grains by 1970.

To achieve an increase in per capita calorie intake of growing population to FAO standards by 1975, an increase in total calorie intake of 49% will be required (1.15 x 1.294 equals 1.49). If we assume no further imports of food grains, and an increase of cropped acreage from 39 to 46 million acres, it may be calculated that the overall increase in yield per cropped acre required will be 26%.

To attain its goal of food self-sufficiency by 1970 (the last year of the current Five-Year Plan), the West Pakistan Government has worked out a comprehensive program and approved an Implementation Plan1/ in which it promotes the use of fertilizer and better seed varieties, aims

1/ Implementation Plan for the West Pakistan Food Self-Sufficiency Programme (1965-1970), Government of West Pakistan, December 1967.

at improvement in agricultural practices and the extension of arable and irrigated land and sets out guidelines in other related fields such as transportation and agricultural credit. With some exceptions, discussed further below in the report, the targets are about being met. Of particular importance is the large-scale introduction of Mexican wheat varieties which have already shown spectacular improvements in yields and are expected to triple the present per acre wheat production. Indigenous varieties of wheat do not respond well to increased use of fertilizer, but substantially increased application of fertilizer will be needed on these new varieties.

2. Past Consumption of Fertilizers

Estimates of past fertilizer consumption are conflicting since distribution has been handled by different agencies, and apparent consumption and aggregate sales do not agree.

Various estimates were compared and what is believed to be a good approximation is given below:

Fertilizers Consumption in West Pakistan
(Thousand tons of plant nutrient)

1955/56	6.2	1962/63	40.2
1956/57	9.0	1963/64	68.7
1957/58	16.0	1964/65	87.2
1958/59	18.0	1965/66	70.0*
1959/60	19.4	1966/67	116.0*
1960/61	31.4	1967/68	150.0-170.0 (est.)
1961/62	37.5		

Source: 1959/60 through 1965/66 - "Import Requirements of Fertilizer and Pesticides in 1967/68", Government of Pakistan Planning Commission.

Note: *Sales were adversely affected in July-December 1965 due to outbreak of war and in January-June 1967 due to drought conditions.

Experts in Pakistan estimate fertilizer consumption to increase to about 170,000 nutrient tons in the current year 1967/68. Actual consumption of plant nutrients during the nine month period July 1967 through March 1968 is reported by the Pakistani Government to have been 141,000 tons. In 1966-67 about 72% of year's total was consumed during this nine month period. A similar pattern of consumption in 1967-68 would result in the use of 175,000 tons for the year, thus tending to confirm advance estimates. Other sources (Dawood/Hercules) believe that total nutrient consumption will not surpass about 150,000 tons.

The table below compares the Government's targeted fertilizer consumption in the first two years of the current Plan in terms of N, P and K with actual (or estimated) consumption (in 1,000 tons of nutrients):

Actual Fertilizer Consumption vs. Targets

	Actual Consumption				Targets			
	N	P_2O_5	K_2O	Total	N	P_2O_5	K_2O	Total
1965/66	70	1	-	71	112	3	-	115
1966/67	112	4	-	116	174	14	3	191
1967/68	N.A.	N.A.	N.A.	150/170	218	42	-	260

Fertilizer consumption so far has remained well below the target. However, this should not detract from the fact that fertilizer usage in West Pakistan has increased by about 30% during the period 1955/56 to 1966/67 also maintaining this rate in the past four years (1962/63-1966/67). An even greater increase may be attained during the current year. In this, account should be taken that sales in 1965 were adversely affected by the Indo-Pakistan hostilities and those of 1966 by a severe drought.

It is also generally accepted that fertilizer consumption would have been higher had not changes in distribution policy as well as lack of available supply introduced constraints beyond the control of the farmers. Finally it is evident that one of the most difficult hurdles to increased fertilizer usage in developing countries has been overcome, in that, on the whole, farmers have already become aware of the benefits that fertilizer can bring to them.

Of concern however is the low application rate of phosphatic fertilizer (P_2O_5). A continuation of such unbalanced application of the different plant nutrients over more than a few years will adversely affect agricultural yields and must thus retard a further increase in the fertilizer consumption. The Pakistan Government has agreed to make more phosphate available by importation and later by manufacture.

At present fertilizer is produced in West Pakistan in three plants (see also the table on page 15) with total annual capacities of some 64,500 tons of N and about 3,000 tons of P_2O_5. These plants were built during the period 1957/61 and are in course of being expanded. While full capacity has been achieved at times operational and distribution problems are holding production at about 80% of installed capacity, the balance of the country's needs are being imported.

3. Demand Forecast

A good many studies have been made (primarily in late 1965 and 1966) in an attempt to forecast fertilizer demand in West Pakistan through the Fourth Plan period (ending June 30, 1975) and beyond. As the Table below shows, these forecasts - made for nitrogen only - diverge already for the year 1969/70 (the last year of the Third Plan) and substantially more so for 1974/75. A Chart, Annex 2, shows this graphically.

Past Sales and Demand Forecasts of Nitrogen

(1,000 tons)

	1965/66	1966/67	1967/68	1969/70	1974/75	1984/85
Actual Sales	70	112	125-150 (est.)	-	-	-
Group A-IACA (IBRD Consultant)	100	110	120	150	210	570
Group B-Esso	70	82	120	220	-	-
Dawood	70	85	125	240	500	-
IBRD	106	134	171	250	470	620
Hercules	85	115	150	250	510	-
Group C-WPIDC	-	110	150	270	630	-
Kaiser	100	150	210	340	670	-
Govt. of W. Pakistan	-	-	218	353	-	-
Cyanamid	-	85	210	450	880	-
Fisons	100	195	390	500	680	-

While to a certain extent this divergence is due to the use of different base periods and different demand assumptions for the final reference year (final figures for 1965/66 were not then available) and because some studies may not have been prepared as carefully as others which incorporate a great deal of detailed analysis and back-up data (such as those of IACA[1/] and IBRD), the fact remains that an accurate assessment of future fertilizer needs, particularly in the early years of widespread usage, is difficult to make. While individual inputs in agriculture for bringing about desired outputs can be calculated - such as water, seeds, fertilizer, insecticides, and requirements for their distribution - the needs for mechanization and other improvements in farming, for agricultural credit and for farmers education are much more difficult to forecast. They are so closely interrelated that, while none of them in isolation would make much of an impact by itself, failure of one of these factors would have serious consequences on the others. Furthermore, apart from climatic influences, in the end the proper application of many of these inputs - including fertilizer - depends on the skill and judgement of the individual farmer and his realization of the potential advantages that they have for him.

The above demand forecasts have been categorized roughly in three Groups (A, B and C), based on tonnage expectations for 1974/75. The very low forecast of IACA constitutes Group A. Group B combines the estimates which arrive at around 500,000 tons of N (Esso, Dawood, IBRD and Hercules), and Group C combines the estimates which exceed 600,000 tons (WPIDC, Kaiser, Government of West Pakistan, Cyanamid and Fisons). Since we cannot make a detailed assessment of the basis of all of these forecasts we have chosen the IBRD estimate to represent Group B and the Government of West Pakistan's estimate to represent Group C.

1/ Irrigation and Agriculture Consultants Association.

IACA was a group of consulting firms including Sir Alexander Gibb and Partners of U.K., International Land Development Consultants, N.V. of Netherlands, and Hunting Technical Services, Ltd. of U.K., which in mid-1964 were engaged by IBRD to prepare a program for the development of irrigation and agriculture in West Pakistan. IACA presented their report in May 1966 after a thorough field study.

It now appears that their estimates were too conservative. Actual fertilizer nitrogen growth rates in the past few years since the study was made have remained at about 28-30% per annum, while the study expected a nitrogen growth rate of only about 10%. While IACA's estimated sales for 1967/68 may be only slightly below actual sales during this year, their assumption for the starting year 1964/65 was considerably higher than actual sales finally reported for that year. There is no indication that with all the measures that the West Pakistan Government is taking to increase agricultural production, demand for fertilizer nitrogen in the next seven years should not increase more than the 10% per year that would be required to meet IACA's demand expectation for 1974/75. The major reasons for this conservative estimate appear to be that IACA had judged that farmer acceptance of fertilizer would be slower and difficulties in distribution would be greater than they have so far turned out.

The IBRD report on the Water and Power Resources of West Pakistan (setting out a program for the Development of Irrigation and Agriculture) which evaluated IACA's study and which was issued in July 1967, also came to the conclusion that IACA's demand expectations for fertilizer were too conservative, and revised them upward.

IBRD projected that nitrogen fertilizer consumption would increase by about 23% per year to reach 250,000 tons (in terms of N) in 1969/70. Thereafter during the Fourth Plan period (1969/70 - 1974/75) it expected the growth rate to decline to about 13%. IBRD also projected that fertilizer usage would have become fairly widespread by this time and that further expansion in demand was, therefore, to come largely from farmers who were already using fertilizer (but were beginning to use larger quantities per acre than in the past) and from higher cropping intensities. IBRD's estimates were based on the following major assumptions:

(a) The cultivable irrigated acreage in West Pakistan would be about 31 million acres in 1974/75, up from 27 million acres in 1965.

(b) The average intensity of cultivation would be about 107% (up from 97%); this means that on an average 7% of all available irrigated acreage would be cropped twice a year.

(c) The total cropped irrigated acreage would thus be about 33 million acres in 1974/75.

(d) New varieties of wheat and rice would be introduced at a rapid rate, with about 45% of wheat acreage covered by 1975 (and close to 90% by 1985).

(e) The Government would continue to promote fertilizer consumption and maintain a favorable ratio between crop value and fertilizer prices.

(f) Foreign exchange would be available to purchase all the imported fertilizer that can be consumed and of the appropriate types as long as West Pakistan is not self-sufficient in food or fertilizer.

(g) Farmers would be applying in 1974/75 an average of 31 lbs. of nitrogen per acre on 33 million irrigated, cropped acres, as compared to about 6 lbs. in 1965. In addition, it was expected that the non-irrigated areas of about 13 million acres on which in 1965 virtually no fertilizer was applied, would receive a modest application of about 4 lbs. of nitrogen per acre.

Annex 3 gives in greater detail and for different crops the underlying assumptions on cropped acreage, specific nitrogen application (lb/acre), both in absolute terms and as percent of the desired application, as well as West Pakistan's expected total nitrogen consumption for 1970, 1975 and 1985, with actual consumption in 1965.

The adoption of Mexican wheat was considered to be the major single factor in the increased use of fertilizers, and was expected to account for about 32% and 43% respectively of all nitrogen demand in West Pakistan in 1970 and 1975. Any delay in the intended shift from the indigenous to the Mexican wheat variety or any fertilizer application rate different from the one assumed will, therefore, substantially affect projected nitrogen consumption. The figures also indicate that in the irrigated areas on the average only about 15% of the desirable quantity of nitrogen would be applied by 1970, and only some 25% by 1975. There is, therefore, ample room for further increases in fertilizer usage provided that the other necessary agricultural inputs such as water, seed, pesticides, etc., would also be available in sufficient amounts. Even these desirable application rates contain a potential for further growth if one recognizes that in countries such as Japan and the Netherlands nitrogen is applied at rates in excess of 200 lbs. per acre (or about three times the average desirable rates assumed here).

Although there are no official figures available yet on the West Pakistan Government's targets for nitrogen consumption and other agricultural inputs at the end of the Fourth Plan (1975), the Government expects nitrogen consumption to be well in excess of 600,000 tons by that time. This is in continuation of the Government's general plan to make West Pakistan self-sufficient in food by 1970. This plan, which was prepared by the West Pakistan Planning and Development Department and which was approved by the Governor's Conference early in 1967, has been followed up - as mentioned earlier - by detailed implementation directives which have set nitrogen fertilizer consumption in 1969/70 at 353,000 tons or some 40% above IBRD's expectations.

The Government's food self-sufficiency plan is based on the following major targets for 1969/70:

1. Bring 4 million acres (out of the present total irrigated wheat acreage of 8 million) under Mexican wheat giving it an average fertilizer application of about 40 lbs. per acre in terms of ammonium sulphate or approximately 92 lbs. of N, and to provide each acre with one to two additional waterings, representing an average increase in the water delta of 33%.

2. Provide additional fertilizer for two million irrigated acres under indigenous wheat at a rate of 110 lbs. per acre in terms of ammonium sulphate, or approximately 23 lbs. of N.

3. Increase irrigated wheat acreage by 1.5 million acres.

4. Make organizational changes, increase credit availability and devise a system of incentives and subsidies to ensure that input targets are in fact met.

5. Allocate funds in the Agricultural Development Program (ADP) for water and agricultural projects on a priority basis, especially encouraging those which are linked to wheat self-sufficiency.

The above targets are virtually the same as those assumed by IBRD in its study except that they provide for a faster build-up in fertilizer usage. In order to attain these goals the Government - as set out in the implementation directives mentioned further above - is prepared to import the expected fertilizer deficiencies of some 780,000 tons of nutrients, of which 160,000 tons is in terms of P_2O_5 during the last three years of the current Plan (1967/68 - 1969/70). The targets also provide for an increase in irrigation water by about 17 MAF (million acre feet), close to 95% of which is expected to come from additional (some 51,000) tubewells; for the necessary seeding materials; for insecticides/pesticides (some 10,600 tons during the remaining three years of the Plan); and for an increase during the Plan period in institutional credits to agriculture by some Rs 136 crores ($290 million), which the Government estimates should be sufficient to maintain the present relation of 10:90 between institutional and non-institutional credit. The directives also evaluate the availability of power transmission and transport facilities and the capacities to produce locally agricultural inputs such as fertilizers, insecticides, seeds, materials for tubewells, etc. They also give guidelines for improvement of agricultural practices, training and marketing.

4. Evaluation

IBRD has recently had a mission in the field to review the economic performance of Pakistan during the present Plan. The mission's findings, made available in a report dated April 17, 1968 have confirmed that progress under the Third Plan is in general on schedule but with some lag in road construction (and facilities) and fertilizer usage. Unless total fertilizer consumption (in terms of nutrients) in 1967/68 actually reaches more than the 150,000 - 170,000 ton estimate shown in the Table on page 3 (which may

mean between 125,000 and 150,000 tons of N), it is highly unlikely that the Government's expectations of 353,000 tons of N for 1969/70 will be met, although the 250,000 tons forecast in the IBRD report may be attained. It is estimated that at present already some 2 million acres are under the improved Mexipak wheat cultivation and that such acreage will increase to not more than 4 million by 1969/70. Therefore, there does not appear to be a reason for the recent historic growth rate of about 30% per year in nitrogen consumption to increase to nearly 50% as it would have to do to meet the Government's expectations. Furthermore, while there appears to be adequate provision to have sufficient additional water available (mainly through new tubewells) to match the Government's target of fertilizer usage by 1969/70, and while private tubewell installations are in fact proceeding as planned, the major portion of the tubewells to be provided by WAPDA and the Irrigation Department (and they are responsible for about half of the additional water to be provided by tubewells) will only come in towards the end of the Plan period. A more realistic estimate of nitrogen consumption in 1969/70 would therefore appear to be in the order of between 220,000 tons and 250,000 tons. Any forecast beyond 1969/70 becomes increasingly more difficult, because for one thing, no definite targets have yet been drawn up for the Fourth Plan period.

The following discusses some of the major factors that in the past have restrained or influenced fertilizer consumption in order to facilitate some judgment as to the extent to which they may still be relevant (or increasingly so) in the early 70's. These factors are primarily related to water supply, distribution organization, transport and storage, agricultural credit, low farmer purchasing power, crop and fertilizer prices and availability of nutrients other than nitrogen.

5. Water Supply

The shortage of irrigation water in the Indus Basin and more particularly the unreliability of supply has probably contributed more than any other factor to the reluctance of the farmers in that area to use more fertilizer. At the prevailing low level of farm yields, farmers have found it often more profitable to apply their supplies of water to a larger area than can be properly watered. A general estimate is that crops receive on average about 80% of the desirable application of water.

This underwatering has inhibited the introduction of improved inputs such as fertilizers and Mexipak wheat since the benefits of these are seriously reduced or even neutralized in the absence of adequate water supplies. In particular, Mexipak wheat needs not only three to four times as much fertilizer as ordinary wheat, but also much larger quantities of water. Nitrogenous fertilizers are applied to irrigated wheat mainly at the first and second waterings. Inadequate and uncertain water supply greatly increases the risks, and makes additional investment in fertilizers more hazardous.

Fortunately, the mean combined flow of waters of the three of the six Indus Basin rivers (Indus, Jhelum and Chenab rivers), full use of which is to be enjoyed by Pakistan, has been estimated at 142 million acre feet (MAF) per year after full implementation of the Indus Water Treaty. Present average canal diversions total 70 MAF per year, leaving considerable potential for future water conservation and use.

Fresh groundwater, containing less than 1,000 parts per million of total dissolved solids, and thus suitable for irrigation without mixing with fresh surface water, is estimated to lie under 14.2 million acres. The current usable recharge to the acquifer, which can be recovered for use by tubewells, is about 30 MAF per year, but this would increase to 44 MAF in the future as more water is distributed by the canal system. Both Government and private farmers are pressing ahead with the installation of tubewells, and more than 5,000 of these are being installed each year.

With the increases in water supplies now becoming available, much larger quantities of fertilizer can be used and water should soon cease to be a restraining factor to increased fertilizer usage.

6. Distribution Organization

Currently more than 60% of West Pakistan's fertilizer requirements are imported, and the balance is produced in three Government factories. All imports are handled on behalf of the Government by the Agricultural Development Corporation (ADC). There are no import duties on fertilizers, and the Government sells fertilizers to the farmers at prices about equal to the c. and f. cost of imports. Government thereby subsidizes selling prices to the extent of the distribution costs, which range from about 22% of c. and f. prices for the more expensive urea to about 29% for cheaper ammonium sulphate. The proportion of subsidy is somewhat higher for fertilizers produced in existing Government plants where production costs are generally above c. and f. prices of equivalent imports.

The distribution organization so far has not been too satisfactory and has undergone several changes. Before the first fertilizer plant came into production in 1957, fertilizers had been imported and sold privately. Then ADC was given responsibility for all fertilizer distribution. Towards the end of 1963 both the Multan and Daud Khel fertilizer plants were overflowing with fertilizers which could not be sold, and construction of new fertilizer storage was put in hand. In December 1963 PIDC obtained permission from the Government to sell domestically produced fertilizers directly to the farmers. Within a few months, PIDC had appointed some 1,000 selling agents all over West Pakistan and within six months these agents had disposed of over 200,000 tons of fertilizer stocks. PIDC, as a matter of policy, selected as agents the wealthier farmers who could afford to pay cash for fertilizers. In appointing agents, particular attention was given to their reputation and honesty, since adulteration of fertilizers with gypsum had been

discouraging farmers from the continued use of fertilizer. On ammonium sulphate the agents were paid a commission of Rs 19 per ton out of a selling price to the farmers of Rs 200 per ton, which was calculated to give the agents a net profit of about Rs 10, or 5%.

By mid-1965, fertilizer consumption had outstripped supplies (some of which were immobilized due to lack of transport), and since imports were restricted due to the Indo-Pakistani hostilities some black marketing became apparent. Thereupon the Government returned all selling to ADC and RSCC[1/] which up to November 1967, have distributed all fertilizer, both domestic and imported, with ADC selling about 25% and RSCC about 75%.

In August 1967, Government appointed three private parties as principal selling agents, Esso, Dawood, and Pakistan National Oils (PNO) Limited (a major distributor of petroleum products), with the idea of stimulating fertilizer sales. There have been some weaknesses in the ADC and RSCC distribution organizations, and it is hoped that keen competition between private selling agents, each of whom intends to cover the whole of West Pakistan, will foster sales. PNO sold their first consignment of imported fertilizers in November 1967. Dawoods have already appointed more than 150 sales agents and have sold their first shipment in February. We anticipate that the entry of these three private parties (to be followed shortly by Adamjees) will improve the overall distribution organizations, and lead to a sustained increase in sales.

7. Transport

Transport has been a serious problem in the distribution system, and will remain one in the future. Pakistan imports at Karachi large quantities of food grains, more than 80% of which have to be transported north by rail as well as other imports. Also, a large proportion of imports into Afghanistan are carried by this same railway.

Assuming that the two Lahore based urea plants will work at 90% of capacity by 1974/75, they will together produce about 270,000 tons of nitrogen which would otherwise have to be imported. This quantity of nitrogen would be equivalent to about 600,000 tons of urea, or about 1.3 million tons of ammonium sulphate. Less than half of the local production will be shipped by rail, and then only about 150 miles on average, whereas practically all fertilizers making the 813 mile trip from Karachi to Lahore are carried by rail. Producing locally instead of importing will therefore avoid the load on the railways. In addition, load will be reduced by lower grain imports.

On the other hand, the sheer weight of fertilizers to be distributed in West Pakistan and the expected sharp increase in movement of food from surplus areas to consumption centers will put a severe strain on both rail and road transport. While the Government railway authorities and local trucking entrepreneurs are optimistic about their ability to handle the large tonnage of fertilizer together will all the other products requiring transport, there are bound to be transport difficulties

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1/ Rural Supply Credit Co-operative Corporation.

in various parts of the marketing area, particularly between mandi towns and the farmers. The question of transport will require continued review.

8. Storage

Wholesale fertilizer sales in the decade up to 1964 have averaged two peaks, the first in September (with sales 24% of annual sales) and the second in June (with sales 10% of annual sales). With the recent introduction of Mexipak wheat which is sown in November and December, the seasonal pattern has changed. In the past two years there have been large peaks in August/September and November/December, and a smaller peak in May.

During the peak months of fertilizer usage it is impossible to move the required tonnage from a central stock pile (as at the manufacturing plant) to the farms as rapidly as it is needed. Hence all fertilizer manufacturers and distributors have found it necessary to establish numerous stock piles as close as possible to the point of use. In West Pakistan these storage facilities have been inadequate and consequently serious shortages have occurred at peak selling seasons while stocks built up at the manufacturing plants. The Government agencies have tried to alleviate the storage problem by renting godowns in market towns, but rented space has often been of poor quality and in units of too small a size. The Third Plan had proposed construction of 2,500 godowns with capacities of 50 to 175 tons, giving new storage space totalling more than 250,000 tons. However, we could not ascertain how much storage has been constructed.

The forecasts of monthly shipments and sales and resulting requirements for storage, both in the plants and in the field need to be reviewed by the fertilizer companies. It may be found that at least four month storage will be needed, more than has been provided by either sponsor.

9. Agricultural Credit

Credit needs for agriculture are very great. Credit is required for fertilizers, seeds, water and land development, agricultural equipment, etc. So far very few fertilizer sales have been financed by institutional credit. But with the relatively limited supply of fertilizer available (and black market operations reported) lack of credit has not been a serious constraint on farm inputs. However, unless adequate credit facilities are provided in the future, farmers will have great difficulty in financing the purchase of the large tonnages of fertilizer and other farm inputs that will be available and necessary to implement the Food Self-Sufficiency Program. The Third Five-Year Plan recognizes the need for increased credit but does not attempt to do more than maintain the present ratio of institutional to non-institutional credit of about 10:90.

With the particular aim of making more credit available to facilitate the sale of fertilizer through private sector channels in West Pakistan, the Pakistani Government and US AID are working on an agreement which would set up a fertilizer and pesticide refinance and credit guarantee fund. Within its intended functions the fund would: (i) issue guarantees

to wholesalers and retailers to cover a portion (possibly up to 65%) of the losses in providing fertilizer on credit, and (ii) refinance a portion of the credit provided to wholesalers by commercial banks.

The two fertilizer companies fully recognize the importance of adequate credit and will follow the establishment of this fund closely. Also, one of the local sponsors who is already in the banking business plans to establish a number of new rural offices for handling farmer credits.

10. Low Farmer Purchasing Power, Crop and Fertilizer Prices

An important limitation on fertilizer sales is farmer income. In West Pakistan agricultural yields have been much below those of more developed countries resulting in low gross income per acre. The use of better seed varieties and more fertilizer will help yields and so provide more income per acre.

The introduction of Mexipak wheat has already shown spectacular results. Yields of 3,000 lb. to 4,000 lb. per acre (and a record of 6,600 lb.) have been reported as compared to the average of about 750 lb. for indigenous wheat. Similar increases in rice yields are being obtained by the introduction of Irri-rice from the Philippines.

Farmer income and hence fertilizer consumption is also dependent upon the relation between the prices he receives for his crops and the prices he has to pay for fertilizer and other farm inputs. In April 1966 the Pakistani Government increased prices for food grains by 10% to 26% in order to give farmers more incentives to increased production. The minimum wheat price has been increased to Rs 17 per maund or $98 per ton. Average incremental yields in Mexipak wheat so far from applications of nitrogen have been about 7 lb. of wheat per lb. of nitrogen applied. In other words, a farmer applying 2.3 tons of urea, containing one ton of nitrogen and costing $242, to 50 irrigated acres can expect an increase in its wheat crop of 7 tons worth $686. This indicates a return of $444 or 184% of his investment in fertilizer. In some cases incremental yields have been well above 7 lb. of grain for 1 lb. of nitrogen.

Although fertilizer prices to farmers in Pakistan are higher than in some other countries, grain prices are also higher. (At present rates of exchange a Pakistani farmer is paid approximately $2.60 per 60 lb. bushel for his wheat while a U.S. farmer in 1967 received approximately $1.50 per bushel). There is no doubt that the net returns available from applications of fertilizer make it well worth while for farmers to increase their consumption of fertilizers, with the important requirement that they can obtain sufficient water.

11. The Availability of Nutrients Other Than Nitrogen

Applications of plant nutrients other than nitrogen especially phosphate (P_2O_5) have so far been insufficient. Existing phosphatic fertilizer capacity and capacity under construction in West Pakistan is only some 8,500 tons per year in terms of P_2O_5 as compared to 175,000 tons of N. Total targeted application during the last three years of the present Five-Year Plan period is also only 170,000 tons of P_2O_5 versus 890,000 tons of N representing a ratio of N:P_2O_5 of 1:0.2. Furthermore actual application of P_2O_5 has fallen considerably short of the yearly target so far. The target is well below a generally accepted minimum ratio of 2:1 (N:P_2O_5) which, as the agricultural program matures, normally would be expected to come closer to 1:1.

While in the first years of fertilizer application a high crop yield will be obtained with application of nitrogen nutrient alone, a yield will soon drop unless P_2O_5 is also applied in adequate volume. A lack of phosphatic fertilizer would have a definite retarding effect on the use of nitrogen fertilizer and in fact the recent economic IBRD mission to Pakistan has singled out the lack of application of phosphatic fertilizers as the most serious potential restraint to increased fertilizer usage in Pakistan and the attainment of the goal of food self-sufficiency by the end of this decade. IBRD/IFC have therefore asked the Pakistan Government--which has agreed--to make possible the importation of sufficient phosphatic fertilizers to complement the nitrogen fertilizer which is to be used in West Pakistan.

Potash consumption is so low (not over 100 tons per year) that it is ignored in most reports, and the Third Five-Year Plan has no targets for potash usage. The level of K_2O in West Pakistan soils is apparently high enough so that the crops now being grown show little or no response to applications of potash. With repeated cropping even these levels will eventually be depleted and the effectiveness of nitrogen and phosphate applications will diminish.

Pakistani agronomists will have to keep watch for signs of potash deficiency and warn the appropriate authorities in time to arrange for adequate importations of potash.

12. Expected Demand for Nitrogen Fertilizer in 1974/75

With all evidence now available we believe that it should be possible for West Pakistan to obtain a consumption of nitrogen for fertilizer of some 470,000 tons by 1974/75. The attainment of such a level of consumption would be a major achievement and would require a continuation of the Government's concerted efforts to increase agricultural output during the Fourth Plan and give priority to all areas supporting this aim. In particular it would mean for the Government to permit fertilizer imports of an adequate volume and type to match the other agricultural inputs in order to prepare the market for the substantial additional nitrogen fertilizer capacity now being planned.

While it is not inconceivable that nitrogen fertilizer consumption in 1974/75 could even be at or above 500,000 tons, it could reach also, say, only 400,000 tons. However, as will be discussed further below additional fertilizer capacity in West Pakistan can be economically planned and phased to cover such possible range.

13. Facilities to Meet Demand

Below is a summary of the existing fertilizer plants and those under construction and planned in West Pakistan. The dates shown for availability of production are estimates taken from several sources. On the assumption that the already available fertilizer capacity is fully utilized; that new facilities will take approximately 3 years to be implemented; that it will take a further 3 years till full capacity is reached from these new facilities and that the fertilizer requirements forecast by IBRD for 1974/75 are correct and are to be met by local supplies, additional fertilizer capacity equivalent to about 300,000 tons of nitrogen and about 227,000 tons of P_2O_5 need to be established.

Existing and Planned Fertilizer Plants in West Pakistan (tons)

Existing		Type of Fertilizer	Capacity in Fertilizers	Capacity in Nutrients N	Capacity in Nutrients P_2O_5
Daud Khel		Amm. Sulph.	50,000	10,500	-
Multan		Ca. Amm. Nitr.	103,000	26,780	-
Multan		Urea	59,000	27,140	-
Lyallpur		Superphos.	18,000	-	3,060
Sub-total			230,000	64,420	3,060
Under Construction					
Daud Khel	(1967)	Amm. Sulph.	40,000	8,400	-
Multan	(1968)	Ca. Amm. Nitr.	60,000	15,600	-
Multan	(1968)	Urea	15,000	6,900	-
Esso/Mari	(1968)	Urea	173,000	79,580	-
Lyallpur		Superphos.	32,000	-	5,440
Sub-total			320,000	110,480	5,440
Total				174,900	8,500
Planned					
Adamjee/Lahore	(1971/72)	Urea	330,000	152,000	
Dawood/Lahore	(1971/72)	Urea	330,000	152,000	
Hyesons/Mari	(1971/72)	Urea	350,000	160,000	
Sub-total			1,010,000	464,000	-
Grand Total				638,900	8,500
			Say	640,000	

The Government of Pakistan has authorized three new urea projects in addition to the Esso project now under construction. Each would have a nominal capacity of 1,000 tons per day of urea equivalent to 150,000 tons of nitrogen per annum. They are the Adamjee-Cyanamid and Dawood-Hercules projects in the Lahore area, and the Hyesons-Kaiser project at Mari, 350 miles southwest of Lahore.

Under consideration is also a T.S.P. plant to be erected in the Karachi area with an annual capacity of 150,000 tons. However, particularly since it is not clear when this plant would go ahead the Government has been asked by IBRD/IFC--as mentioned earlier--to permit the importation of sufficient phosphatic fertilizers to complement the new nitrogen capacity. Further urgent consideration should be given to the possibility of producing mixed fertilizers with part of the proposed ammonia capacity.

Hercules and Hyesons have informally indicated a willingness to consider the manufacture of phosphatic fertilizers at a future date after the presently proposed facilities are in operation. Meanwhile, Dawood Corporation, in its plans as Sales Agent, proposes to sell approximately 150,000 tons annually of ordinary superphosphate (or equivalent) in conjunction with sales of urea, both during the pre-production seeding period and after production begins.

14. Competition

The three proposed 1,000 metric ton per day urea plants, together with the small Multan expansion and the Esso 500 metric ton per day plant now under construction would increase urea production capacity in West Pakistan by 1,700% from 59,000 tons now to about 1.0 million tons per year, and nitrogen production capacity by 1,000% from about 64,000 tons now to about 640,000 tons per year over a period of three to four years.

Additionally, an ammonium sulphate nitrate plant at Daud Khel has been planned with a daily capacity of 600 tons of ammonia. This plant sponsored by WPIDC has been officially sanctioned but the Government has agreed to postpone construction. Presumably the Government would not proceed unless, after the private projects have come on stream, and the market would justify such an expansion of capacity.

However, even without the Daud Khel plant, proceeding with all three new urea plants more or less simultaneously would increase nitrogen capacity beyond the foreseeable market potential at the time of completion of these projects. Assuming that construction of the three plants was to begin before the end of 1968 they would be completed by late 1971. The following table shows plant utilization rate in 1974/75 (more than three years after assumed completion) for two and three projects if they were to proceed simultaneously and for a market in that year of respectively 400,000 and 470,000 tons of nitrogen.

Demand for Nitrogen in 1974/75 as Percent of Installed Capacity

Installed Capacity and Number of New Plants	Total W. Pakistan Demand		Demand Within 200 Miles of Shekhupura*	
	400,000 tons	470,000 tons	240,000 tons	280,000 tons
1. Capacity 640,000 tons (3 new plants)	62%	73%	-	-
2. Capacity 480,000 tons (2 new plants)	83%	98%	-	-
3. Capacity 300,000 tons (A/C and D/H only)	-	-	80%	93%

* Assuming A/C and D/H plants are located at Shekhupura and demand within 200 miles is 60% of total demand.

Since there is a possibility that nitrogen demand in 1974/75 will only reach about 400,000 tons there is room for not more than two of the three urea plants to go ahead immediately and still produce from the outset at a reasonable rate of capacity. If our projections are correct that demand will have increased to about 470,000 tons by 1974/75, full capacity utilization of two plants would only be reached more than three years after estimated start-up. On the other hand, should nitrogen fertilizer demand increase over the next couple of years beyond present expectations there will still be sufficient time to bring in additional nitrogen capacity.

We have calculated that about 60% of West Pakistan's fertilizer sales will be made within 200 miles of Shekhupura, where the Adamjee and Dawood plants would be located. Excepting a severe oversupply situation both sponsors are not overly concerned about competition from one or more plants at the Mari gas field, because of the high cost of transportation of fertilizer to their prime markets. It is estimated that these plants at Mari would have a production cost advantage of about $7 per ton of urea. Between Mari and Lahore, transportation and handling costs would be about $7 per ton by rail and $12 per ton by truck; these costs would appear to offset the cost advantage of cheaper gas. However, there is a sizeable proportion of the richest market area around Multan which is less than 200 miles from both Shekhupura and Mari, where transport costs would be about equal from both plant sites. A Mari plant would enjoy a $6 per ton cost advantage here. Esso certainly plans to sell urea in this Multan market area.

At the present time the price of imported urea, c.i.f. Karachi, is about $105 per ton or about $117 c.i.f. Lahore. This compares with an ex-plant selling price of about $93-95 per ton of urea that Adamjee and Dawood expect to charge. In five to ten years with a significant number of large low-cost ammonia/urea plants having come on stream it may be possible to purchase urea c.i.f. Karachi at $63 per ton and therefore in Lahore for about $75 per ton. However, imports of urea will probably not be a factor since the Government will not grant import licenses if there is adequate capacity in Pakistan.

15. Conclusions

While fertilizer consumption in West Pakistan is still relatively low it has rather steadily increased over the past decade at a rate of nearly 30% per annum. While this growth rate has been lower than is hoped for in the present Five-Year Plan it has nevertheless been impressive. The introduction of new varieties of wheat and rice seeds as part of the policy of the Pakistan Government to obtain self-sufficiency in food grains by 1970 has no doubt helped stimulate the demand for fertilizer which on the whole seems to be well accepted by the Pakistan farmer.

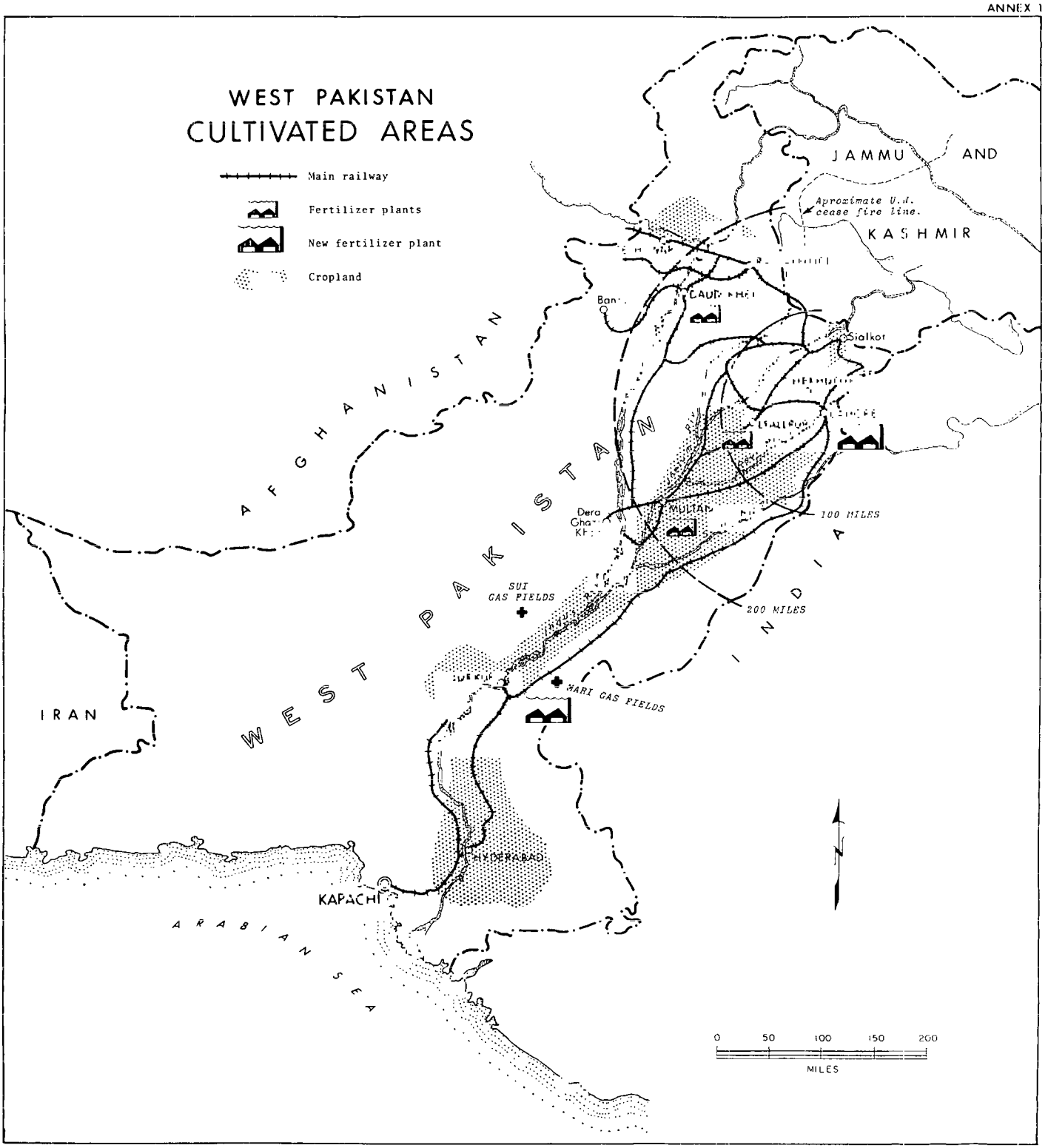
Provided that the Pakistan Government also in the Fourth Plan will pursue its determined policy of increasing agricultural output and give high priority to all factors that will foster this goal it is realistic to assume that consumption of nitrogen fertilizer will grow from about 125,000 to 150,000 tons in the current year (1967/68) to some 470,000 tons in 1974/75 or by an average annual rate of close to 20%.

This would allow two additional urea plants of together about 330,000 tons annual capacity in terms of N to be installed simultaneously at this time and be operated at reasonable rates of utilization from the outset, even if demand should increase at a somewhat lesser rate than now predicted.

Proceeding with a third nitrogen fertilizer plant of similar capacity now is not recommended. Such plant could, however, be embarked upon in good time should fertilizer demand over the next two years or so grow faster than now expected.

June 12, 1968
IFC - Engineering Department

ANNEX 1



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June 10, 1968

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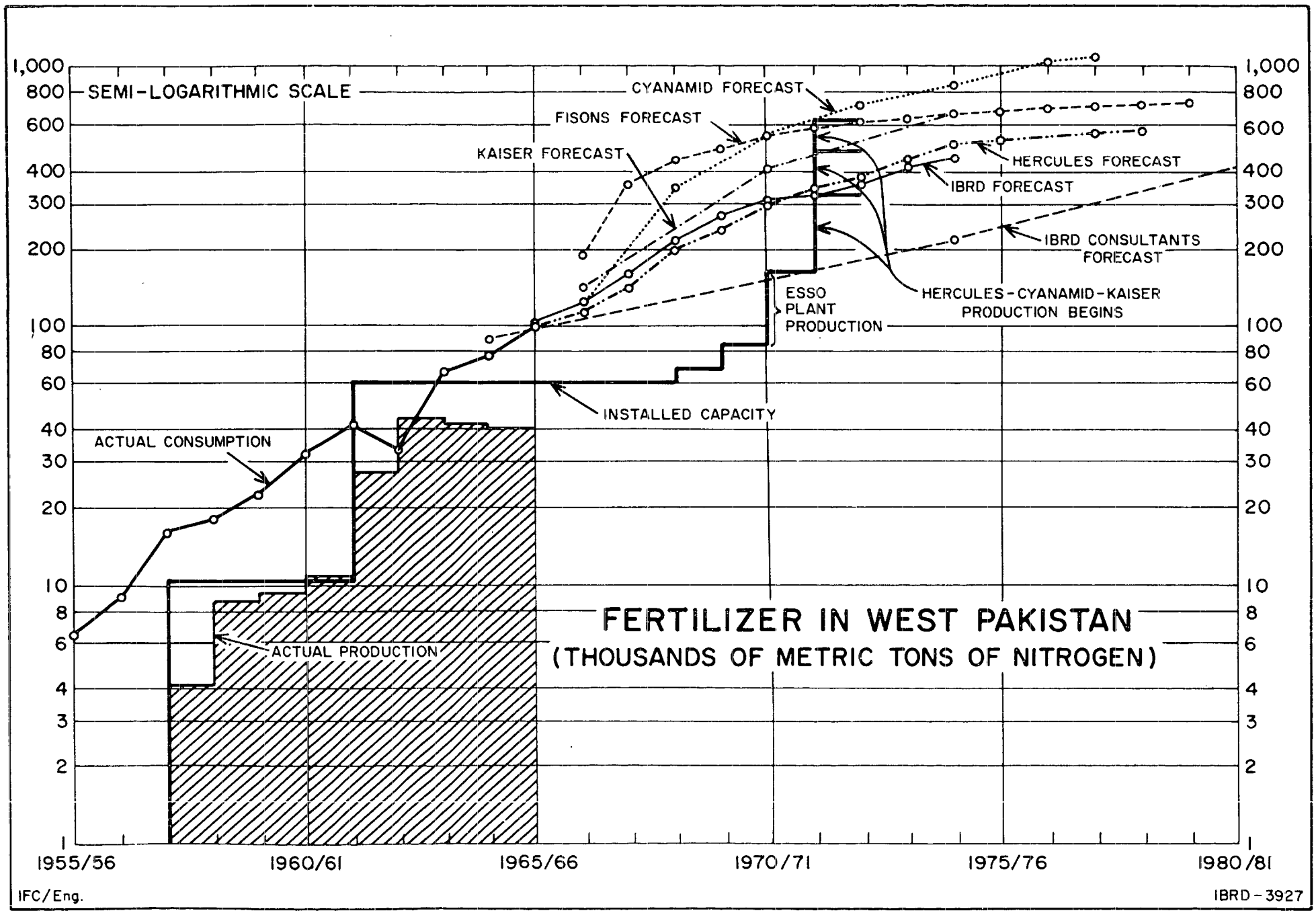
SEMI-LOGARITHMIC SCALE
CYANAMID FORECAST
FISONS FORECAST
KAISER FORECAST
HERCULES FORECAST
IBRD FORECAST
IBRD CONSULTANTS FORECAST
HERCULES-CYANAMID-KAISER PRODUCTION BEGINS
ESSO PLANT PRODUCTION
INSTALLED CAPACITY
ACTUAL CONSUMPTION
ACTUAL PRODUCTION
FERTILIZER IN WEST PAKISTAN
(THOUSANDS OF METRIC TONS OF NITROGEN)
1,000
800
600
400
300
200
100
80
60
40
30
20
10
8
6
4
3
2
1
1955/56
1960/61
1965/66
1970/71
1975/76
1980/81
IFC/Eng.
IBRD-3927

ANNEX 2

VARIOUS DATA ON WEST PAKISTAN CROPPED ACREAGE AND NITROGEN FERTILIZER APPLICATION RATES 1965-1985

	Actual	Projected		
	1965	1970	1975	1985
		(million acres)		
1. Cropped Acreage				
Irrigated areas				
Coarse Rice	2.84	2.78	2.88	2.32
Fine Rice	0.68	0.78	0.93	1.15
Cotton	3.72	4.23	4.73	6.11
Corn	1.08	1.29	1.49	2.33
Kharif fodder	2.24	2.73	3.21	3.98
Improved wheat (Mex.)	-	4.00	9.02	10.14
Present local wheat	7.72	5.07	1.40	-
Sugar cane	1.21	1.24	1.27	1.39
Fruit	0.30	0.35	0.43	0.73
Others	6.96	7.09	7.59	9.97
Total Irrigated Area	26.75	29.56	32.95	38.12
Non-irrigated Area	12.37	12.70	13.05	13.76
Total Cropped Acreage	39.12	42.26	46.00	51.18
2. Nitrogen Application				
Irrigated areas		(lbs/acre)		
Coarse Rice	4.1	10.2	19.4	29.1
Fine Rice	9.0	18.0	36.0	56.0
Cotton	12.2	18.8	37.8	38.6
Corn	-	10.6	22.2	29.0
Kharif fodder	-	12.0	24.0	37.5
Improved wheat (Mex.)	-	45.0	50.0	52.5
Present local wheat	4.2	15.6	10.6	-
Sugar cane	48.0	76.5	76.0	74.5
Fruit	3.3	24.0	48.0	48.0
Others	-	-	5.0	6.5
Average Irrigated Area	5.8	18.4	31.0	35.0
Non-irrigated Area	-	3.4	6.1	7.6

DESIRABLE APPLICATION OF NITROGEN AND PROJECTED APPLICATION AS % OF DESIRABLE

	Desirable lb/acre	Projected Application as % of Desirable 1965	1970	1975	1985
3. Crop					
Irrigated Areas					
Coarse Rice	60	6.9	17.0	32.4	48.6
Fine Rice	80	11.3	22.5	45.0	70.0
Cotton	60	20.4	31.4	63.0	64.5
Corn	80	-	13.3	27.8	36.2
Kharif fodder	60	-	20.0	40.0	60.5
Improved wheat (Mex.)	90	-	50.0	56.0	58.0
Present local wheat	30	14.0	52.0	35.4	-
Sugar cane	100	48.0	76.5	76.0	74.5
Fruit	75	4.4	32.2	44.4	44.4
Others	n.a.	n.a.	n.a.	n.a.	n.a.
Average irrigated	*	6.7	15.4	20.1	24.5
" non-irrigated	30	-	11.2	20.5	25.4

* Excluding application for "Others"

TOTAL FERTILIZER NITROGEN CONSUMPTION
(000 metric tons)

	Actual 1965	Projected 1970	1975	1985
4. Crop				
Irrigated Areas				
Coarse Rice	5.32	12.85	25.33	30.65
Fine Rice	2.78	6.33	14.22	29.27
Cotton	20.58	36.18	81.20	107.20
Corn	-	7.04	15.06	30.74
Kharif fodder	-	14.89	35.01	67.84
Improved wheat (Mex.)	-	81.78	205.00	241.98
Present local wheat	14.64	36.04	6.81	-
Sugar cane	26.39	43.13	43.90	47.06
Fruit	0.45	3.93	9.39	15.93
Others	-	-	17.13	29.33
Total Irrigated Area	70.16	241.40	454.05	599.58
Non-irrigated Area	-	13.60	24.00	31.00
Total Cropped Area	70.16	255.00	478.05	630.58

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