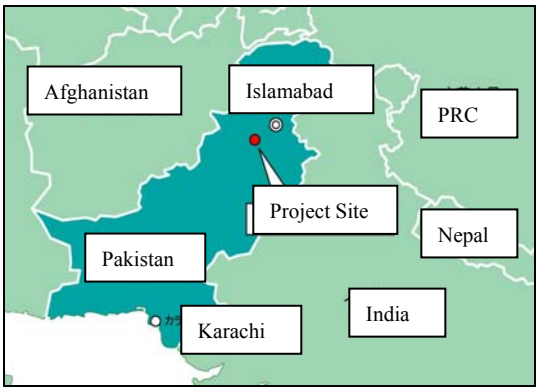
Pakistan

Daudkhel Fertilizer Plant Modernization Project(1)(2)

Field Survey: August 2003

1. Project Profile and Japan's ODA Loan



Map of Project Area

Daudkhel Fertilizer Plant

1.1 Background

In fiscal years 1987 and 1988, the agricultural sector in Pakistan was the largest economic sector, accounting for 24.5% of the gross domestic product (GDP)[1]. According to the national census of 1988, the number of workers employed in agriculture accounted for 49.2%, approximately half of all employed workers. Meanwhile, at the time this project was planned, the growth rate of agricultural production was low, at 1.2% (1980s) compared to the population growth rate of 2.6%, and so further promotion of the agricultural sector was considered necessary. However, according to FAO statistics, the percentage of irrigated farmland in Pakistan in 1984 was already high, at 60.6%, compared to the global average of 4.75%[2]. Since the cost of further increasing the percentage irrigated farmland was prohibitive, the government decided to place emphasis in its basic agricultural development policy on increasing the harvest per hectare through mechanization of agriculture and fertilizer usage, etc.

At the planning time of this project, there were nine fertilizer plants in Pakistan capable of producing 1.83 million tons/year of urea, 450,000 tons/year of lime nitrogen, 300,000 tons/year of compound and mixed fertilizer, and 90,000 tons/year each of ammonium sulfate and phosphoric fertilizer. However, even if one included the fertilizer plant expansion planned at that time as part of the government's plan to increase the amount of fertilizer used, there would still be a shortage of domestic fertilizer, and an annual shortage of 330,000 tons of nitrogen fertilizer[3] was forecast for 1993. Given this, the facilities of Daudkhel Fertilizer Plant (the plant which benefited from this project)

[1] In terms of source of foreign currency secured through export, agriculture was an important sector, accounting for 40% of the 3.68 billion dollars of total exports in FY86-87.

[2] The percentage of irrigated land in Japan was 60.23%.

[3] Types of fertilizer include nitrogen fertilizer (urea fertilizer, ammonia fertilizer, calcium cyanamide, and compound fertilizer), phosphoric fertilizer, and compound fertilizer (DAP), etc. Nitrogen is one component of fertilizer, and fertilizers that contain nitrogen are generally referred to as "nitrogen fertilizers." For example, urea fertilizer contains 46% nitrogen, and calcium cyanamide contains 26% nitrogen. Furthermore, since nitrogen is lacking in the soil of Pakistan and it is widely useful, urea fertilizer accounts for 71% of all fertilizer (FY2001,FY2002).

urgently required renewal and expansion because its production facilities, which had been in commercial operation since 1958, became too old for work and the production scale was small, resulting in low production efficiency and energy efficiency.

Moreover, air pollution measures were urgently needed since at the time of this project planning for Daudkhel Fertilizer Plant, a sulfuric acid plant was in operation and SOx and ammonia in excess of allowable standards were detected.

1.2 Objectives

The objectives are to conduct expansion and renewal of the facilities of the Pakistan Fertilizer Public Company's Daudkhel Plant located approximately 150 km southwest of Islamabad, in Punjab Province, Pakistan, and through this, to improve the productivity of the facilities and to reduce air pollution.

1.3 Output

The production facilities for producing 80 tons/day of ammonia and 300 tons/day of ammonium sulfate, which are not energy-efficient, will be abolished, and a plant to produce 600 tons/day of ammonia and 1,050 tons/day of urea will be constructed, based on maximum usage of current staff and utility facilities.

1.4 Borrower/Executing Agency

Borrower: President of the Islamic Republic of Pakistan

Executing Agency: PAFL（subsidiary company 100% owned by Pakistan Fertilizer Public Company）

1.5 Outline of Loan Agreement

	Project 1	Project 2	Total
Loan Amount/ Loan Disbursed Amount	18,598 million yen 18,558 million yen	5,107 million yen 4,886 million yen	23,705 million yen 23,443 million yen
Exchange of Notes/Loan Agreement	March 1989 March 1989	November 1994 November 1994	—
Terms and Conditions -Interest Rate -Repayment Period (Grace Period)	 2.5% 30 years （10 years） Partial Untied	 2.6% 30 years （10 years） General Untied	—
Final Disbursement Date	August 2000	August 2001	—

2. Results and Evaluation

2.1 Relevance

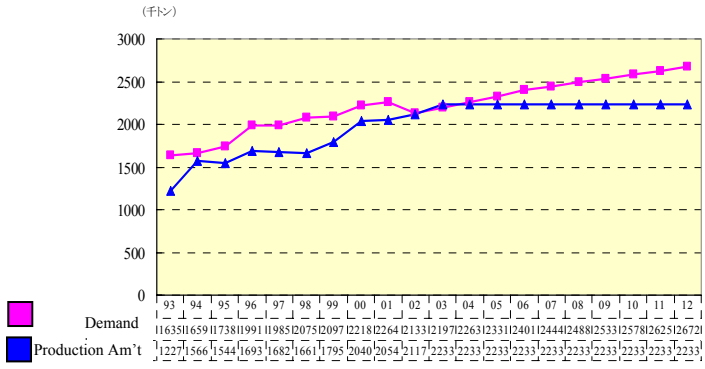
The Pakistan Government put emphasis on mechanization of agriculture and increased fertilizer usage to improve agricultural productivity as the basic agricultural development plan in the Seventh

5-Year Plan (1988/1989-1992/1993). The budget for agricultural development is calculated as 12.31 billion rupees, a 55.4% increase compared to gross expenditures during the Sixth 5-Year Plan. Because the domestic demand for nitrogen fertilizer increased as a result of the above-mentioned plan, a supply-demand gap occurred in 1988, with 1,282,000 tons in demand and only 1,097,000 tons produced domestically, and the shortfall had to be supplemented by imports. Given this, since this project was expected to improve fertilizer productivity by renewing and expanding facilities and to resolve by approximately 30% the supply-demand gap, it can be said that this project was consistent with the Pakistani Government's policy for the agriculture and fertilizer sector.

Also, in the Eighth 5-Year Plan (1993/1994-1997/1998) in effect at the time of the Project 2 part of this project, emphasis was placed on the fertilizer sector in the establishment of a policy to boost land productivity by increasing fertilizer consumption by 5.7% annually on average, in order to achieve the goal for agriculture sector growth (4.9% annual average). At that time, demand for nitrogen fertilizer was 1,635,000 tons, whereas domestic production was 1,227,000 tons, and so it was still as necessary as ever to boost domestic production of fertilizer (Figure 1).

Moreover, in the Ten Year Development Plan (2001-2011) [4] which was implemented at the time of evaluation, the importance of the industrial, infrastructure, and service sectors is increased, but the Pakistani Government still recognizes agriculture as an important sector in Pakistan, and it presents an agricultural development strategy for the coming 10 years. That plan states the increased investment in agriculture, including water, fertilizer, agricultural machinery, and seeds, etc., as its strategy to improve agricultural productivity. Particularly, the demand for nitrogen fertilizer was expected to increase by 4.0% per year from 2000/2001 through 2003/2004. Consequently, at the time of evaluation, because fertilizer was considered to have an important role in boosting agricultural production and because this project conserved foreign currency, which was in short supply in Pakistan, by providing an alternative to imported fertilizer through expanding and boosting efficiency of production, the relevance of the project remained high.

Figure 1 Domestic Supply and Demand for Nitrogen Fertilizer



Source Pakistan Fertilizer Related Statistics, National Fertilizer Development Center, Islamabad, 2002

Note: Figures for FY2003 and after are forecasts.

[4] Government of Pakistan, Planning Commission, Islamabad, September 2001.

2.2 Efficiency

2.2.1 Output

The start of the project was delayed by the time required for the Pakistan Government's approval processing and by the influence of the Gulf War. Because during that time (1) significant inflation occurred, (2) the terms and conditions for supply of natural gas changed[5], and (3) part of the existing facilities malfunctioned, it became necessary to change equipment specifications and conduct additional procurement.

2.2.2 Project Period

According to the plan, the loan agreement was scheduled for signing in March 1989 and the project was to be completed in January 1993. However, because (1) the project start was delayed due to the wait for approval processing and due to the influence of the Gulf War, and (2) procurement processing required extended time due to changes in specifications and additional procurement, this project was completed in September 1998.

2.2.3 Project Cost

Whereas the originally planned project cost was 28,989 million yen (loan portion: 23,750 million yen) total for the Phase 1 and Phase 2 of this project, the actual cost was 26,786 million yen (loan portion: 23,443 million yen).

2.3 Effectiveness

2.3.1 Increases in Fertilizer Production Amount and Fertilizer Sales Amount

Following the completion of this project, the amount of fertilizer produced daily has increased each year. In 2001/2002 both ammonia and urea had achieved over 95% of the planned level, and production was extremely favorable (Table 1). Also, the annual production amount has been growing annually since the completion of this project. In 2001/2002 it totaled 474,319 tons, which represents 90% of the planned level, and production was extremely favorable (Table 2).

[5] The terms and conditions for supply of natural gas were altered from a supply pressure of 19 kg/cm^2 to 7 kg/cm^2, and from a sulfur content of 10.2 ppm to 23 ppm, and so it was necessary to change the equipment specifications.

Table 1 Fertilizer Production Per Day (unit: tons/day)

		98/99 (Year of project completion)	99/00 (2nd year)	00/01 (3rd year)	01/02 (4th year)
Ammonia	Plan	510	570	600	600
	Actual	401	597	570	581
	Achievement of Plan (%)	78.6	104.7	95.0	96.8
Urea	Plan	893	998	1050	1050
	Actual	788	991	1017	1022
	Achievement of Plan (%)	88.2	99.3	96.9	97.3

Source: Material from executing agency

Source: Data concerning ammonia is from executing agency; data concerning urea is from Pakistan Fertilizer-Related Statistics, National Fertilizer Development Center, Islamabad, 2002

Table 2 Annual Fertilizer Production Amount

(unit: tons/year)

		98/99 (Year of project completion)	99/00 (2nd year)	00/01 (3rd year)	01/02 (4th year)
Ammonia	Plan	146,880	162,450	180,000	180,000
	Actual	77,794	115,818	135,660	173,719
	Achievement of Plan (%)	53.0	71.3	75.4	96.5
Urea	Plan注 1)	242,550	294,525	346,500	346,500
	Actual	124,604	200,124	233,838	300,600
	Achievement of Plan (%)	51.4	67.9	67.5	86.8

Note 1): The planned levels are based on the number of operation days in EIRR calculations which were prepared at planning time.

Furthermore, the executing agency maintains that it is possible to achieve further improvement in days of operation and annual production amount through resolving the following problems.

1) CO_2 Compressor[6] Problem Which has Existed Since Trial Operation of the Plant: The plant was often forced to halt operation due to this problem, but countermeasures have already been taken, including replacement of parts at the time of evaluation.
2) Stable Supply of Natural Gas: In addition to the fact that the natural gas companies' pipes have a small capacity, the plant is forced to stop operation during the peak gas-demand period in the winter since residents are given preference and the plant's gas supply is shut off. However, it is anticipated that the plant will achieve further increase of production amount in the near future because new natural gas fields are under development, and until they are developed, the Cabinet Economic Committee has notified the gas companies to maintain the gas supply.
3) Stable Quality of Natural Gas: Since the Daudkhel Plant is located at the end of the gas supply pipeline and must receive gas from multiple gas fields during periods when demand for gas

[6] The CO_2 compressor is a gas compressing machine that uses carbon dioxide as a cooling medium. Failure of the dry gas seal in the CO_2 compressor and failure of the low-pressure compressor, etc., caused a low rate of operation during the hot and humid summertime.

rises, the quality of the gas is not stable. This is a factor in the stoppage of the CO_2 compressor and forces the plant to halt operation. However, it is anticipated that the plant will achieve further increase of production amount in the near future because new natural gas fields are under development, and until they are developed, the Cabinet Economic Committee has notified the gas companies to maintain the gas supply.

Since the amount of urea fertilizer sold annually is steadily increasing (Table 3), the amount of fertilizer sold which is produced at the Daudkhel Plant is growing proportionally with the above-stated increase in fertilizer production amount. The actual annual sales amount is almost 100% of the production amount, and so performance is favorable.

Table 3 Annual Fertilizer Sales Amount (unit: tons/year)

	1998/1999 (Year of project completion)	1999/2000	2000/2001	2001/2002
Urea Fertilizer Sales (annual)	124,604	200,124	228,839	305,599

2.3.2 Improvement of the Quality of Fertilizers

In May 2003, Daudkhel Plant acquired ISO9001:2000 certification which guarantees its quality control system. Also, according to comparative data acquired by the executing agency concerning fertilizer quality at fertilizer production companies, the fertilizer produced at the Daudkhel Plant can be considered high quality since its numerical figures for active ingredient[7] content (nitrogen 46%), moisture content, hardness, roundness of fertilizer grains, and flow quality (no lumps) are similar to those of the private company FFC, which is well-known domestically for its quality.

Furthermore, at the time of the field survey, PAFL, which implemented this project, was preparing to apply for the ISO14000 series.

2.3.3 Effectiveness in Preventing Air Pollution

See "2.4.3 Environmental and Social Impact."

[7] Nitrogen and phosphates, which are the most important nutriments for plants.

BOX: Outline of Pakistan's Fertilizer Sector

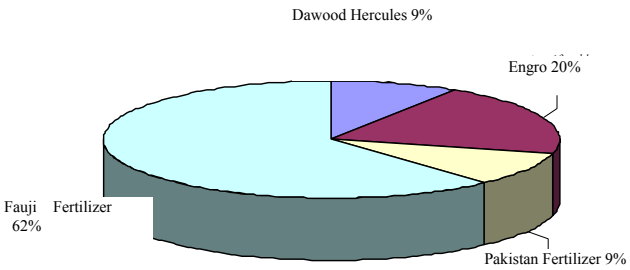
-Outline of Fertilizer Companies

As of August 2003, 5 main groups of fertilizer companies exists in Pakistan.

Company Name	Corporate Group Name（Abbrev.）	Fertilizer Produced
Dawood Hercules	□ D.H.	Urea
Lyapllpur Chemical	● NFC	Phosphoric Fertilizer
Hazara Phosphate Limited	● NFC	Phosphoric Fertilizer
PAFL（main business）	● NFC	Urea
Pak-Arab	● NFC	Urea、Compound and mixed Fertilizer、Calcium Cyanamide
FFC	■ FFC	Urea
Engro Chemistry Company	● ENGRO	Urea
Pak-Saudi Public Company	■ FFC	Urea
FFC Jordan	▲ FFC-JORDAN	DAP, Urea

-Outline of the Urea Fertilizer Sector

As of 2003, the corporate shares of the urea fertilizer sector were as follow. FFC has the top share in the country at 62%. Next is Engro at 20%, followed by Pakistan Fertilizer and Dawood Hercules at 9% each.



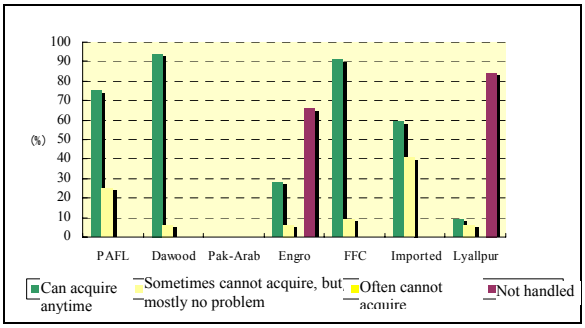
Effects of Project Shown by Study on Satisfaction of Retailers and Dealers with Fertilizer

A questionnaire concerning fertilizer was distributed to 32 retailers and dealers who handle urea fertilizer in the three areas of Mianwali, Khushab, and Rawalpindi in Punjab Province where the Daudkhel Plant is located. All of the respondents handle nitrogen fertilizers manufactured by PAFL, FFC, and Dawood Hercules Company, and they also all handle imported fertilizer (DAP). The largest selling fertilizer of the respondents was the fertilizer of Dawood Hercules Company, followed by that of FFC, then imported fertilizer, and finally PAFL fertilizer.

■ *Ease of Purchasing and Acquiring Fertilizer (production amount)*

Respondents were asked whether it was possible to purchase the fertilizer of each manufacturer whenever they wanted to purchase it. The supply condition of PAFL fertilizer was generally satisfactory, with 75% responding that they "can acquire it anytime," and 25% responding that they "sometimes cannot acquire it, but most of the time there is no problem."[8] However, over 90% of respondents said they could "acquire anytime" the fertilizers of Dawood Hercules and FFC, giving these companies higher ratings than PAFL.

Figure 2 Evaluation of Ease of Acquiring Fertilizer

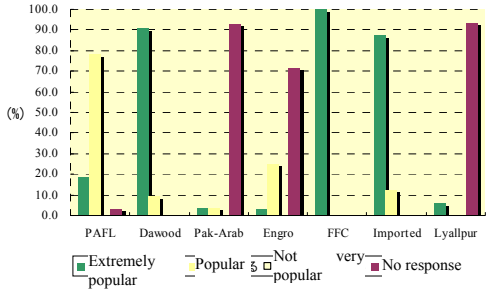


PAFL: Pak-American Fertilizer Public Company
Dawood: Dawood Hercules Fertilizer Public Company
Pak-Arab: Pak-Arab Fertilizer Public Company
Engro: Engro Company
FFC: FFC Fertilizer Company
Imported: Imported Fertilizer
Lyapllpur: Lyapllpur Chemical

■ *Fertilizer that Sells Well to Farmers*

Respondents were asked which fertilizers among those produced by the various manufacturers sell well to farmers. The result was that 18.8% replied that fertilizer manufactured by PAFL is "extremely popular," and 78.1% said it is "popular," so it can be said that this fertilizer has a solid reputation among farmers. Meanwhile, a popular fertilizer made by another manufacturer was that of FFC, which all respondents replied "extremely popular." Next was Dawood Hercules, which 96.0% replied "extremely popular." This shows that farmers very much favor these two brands. The reason for the popularity of these two companies' fertilizers is that farmers recognize that plants develop well when they are used.

Table 3 Evaluation of Popularity of Fertilizers



To sum up the ease of acquisition and the popularity among farmers of fertilizers in the area where the questionnaire was conducted, PAFL's fertilizer ranked third among seven companies (plants), following those of FFC and Dawood Hercules.

Note:) It should be noted that the above results were based on data from 32 retailers and dealers in a limited geographical area and represent only certain opinions in that area. Nationally, PAFL's parent company Pakistan Fertilizer has a network of 2,151 retailers/dealers, and FFC has a network of 3,220 retailers/dealers.

[8] According to dealers, the reason why it sometimes cannot be acquired is that the demand is actually larger than the amount supplied by the Daudkhel Plant.

2.3.4 Internal Rate of Return

(1) Financial Internal Rate of Return（FIRR）

The figure calculated for the Phase 2 of this project is used as the plan since the project life was altered from 15 years to 20 years due to the change in output. The FIRR at the time of the appraisal for the Phase 2 was 14.55%. However, when it was recalculated at evaluation time using the same items as for the Phase 2, the FIRR was 4.62% due to low fertilizer sales prices, in spite of the increase in project cost (on a local currency base) and rising materials costs.

	1994（Project 2 Appraisal）	Evaluation
Benefit	Sales income from urea fertilizer produced by the plant	
Cost	Initial investment Variable costs（material costs including natural gas, packing costs, etc.） Fixed costs（salaries、operation and maintenance expense, etc.）	
Project Life	20 years	
FIRR	14.55%	4.62%

(2) Economic Internal Rate of Return（EIRR）

The EIRR of this project which was assumed for the Phase 2 was 20.68% when calculated as shown below. When the EIRR was recalculated at evaluation time using the same items as for the Phase 2, it was 7.67% due to the delay in project implementation and the reduction in foreign currency saving effects (i.e. the price of imported fertilizer declined[9]).

	1994（Project 2）	Evaluation
Benefit	Foreign currency savings effects due to urea fertilizer produced by the plant (as a substitute for imported fertilizer)	
Cost	Initial investment Variable costs（material costs including natural gas, packing costs, etc.） Fixed costs（salaries、operation and maintenance expense, etc.）	
Project Life	20 years	
EIRR	20.68%	7.67%

2.4 Impact

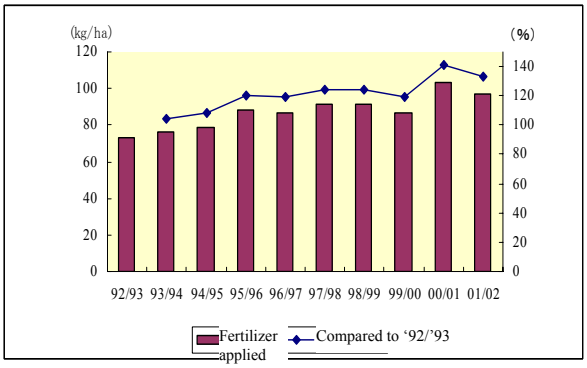
2.4.1 Improved Agricultural Productivity Accompanies Increase in Domestic Fertilizer Production

The amount of fertilizer produced by this project steadily increased from 1998/1999 (the year of

[9] Whereas the price of imported fertilizer was 6,356 rupees at the time of the Phase 2 calculation (1994), the price of imported fertilizer in 2001 after taking inflation into account as 5,385 rupees.

project completion) through 2001/2002 from approximately 200,000 tons to approximately 470,000 tons. The increase in production of 270,000 tons is equivalent to approximately 80% of the growth in domestic fertilizer production (330,000 tons) during the same period. Also, the domestic amount of nitrogen applied fertilizer increased from 1,795 kg/ha in 1998/1999 to 2,117 kg/ha in 2001/2002 (Figure 2). Agricultural productivity also rose during the same period by 6% for wheat and 11% for sugar cane (Table 4).

Figure 2 Amount of Nitrogen Applied Fertilizer (annual average)



Source:"Pakistan Fertilizer Related Statistics" National Fertilizer Development Center, 2002

Table 4 Total Yield of Main Crops and Yield per Hectare

Crop	Index	98/99	99/00	00/01	01/02
Wheat	Total Yield (1,000 tons)	17,858	21,079	19,024	18,475
	Yield/ha (kg/ha)	2,170	2,491	2,325	2,314
Cotton	Total Yield (1,000 tons)	55,191	46,333	43,608	48,082
	Yield/ha (kg/ha)	47,784	45,904	45,378	48,082
Sugar Cane	Total Yield (1,000 barrels)	8,790	11,240	10,732	10613*
	Yield/ha (kg/ha)	512	641	624	570*

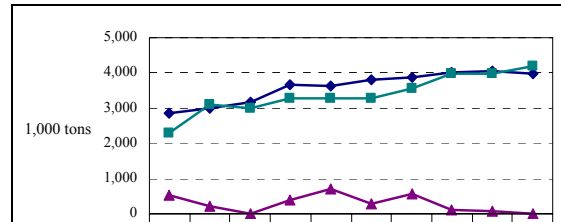
Source: Pakistan Ministry of Industries & Production

*tentative figures

2.4.2 Foreign Currency Savings Effect due to Substitutes for Imports

According to statistical materials, domestic production of urea fertilizer did not overtake demand, and imported fertilizers were relied upon to satisfy the shortfall until 1998/1999. However, from FY1999/2000 when this project was completed through FY2000/2001, the domestic supply and demand were nearly equal, and in FY2001/2002 domestic production exceeded demand (Figure 3). The amount of imported fertilizer decreased accompanying the above increase in domestic fertilizer production, with the amount of imported urea fertilizer reaching zero in FY2001/2002. Thus, at the time of evaluation, the supply and demand gap in urea fertilizer in Pakistan had been resolved.

Table 3 Supply/Demand of Urea Fertilizer and Amount Imported



	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02
Demand	2,849	2,978	3,152	3,648	3,643	3,802	3,887	3,999	4,047	3,986
Domestic Production	2,306	3,104	3,000	3,258	3,258	3,284	3,550	3,968	3,983	4,190
Imports	525	206	0.40	389	704	264	574	114	86	0

Source:"Pakistan Fertilizer Related Statistics"
National Fertilizer Development Center, 2002

Moreover, accompanying the resolution of the gap due to increased domestic fertilizer production, trial calculations by the executing agency for FY2001 show the foreign currency savings effect to be approximately 37 million dollars annually, and so it can be said that the foreign currency savings effect is being realized as anticipated.

2.4.3 Environmental and Social Impact

The objectives of this project, in addition to improving productivity at the Daudkhel Fertilizer Plant, included mitigation of air pollution. In the latest field study, actual figures of SOx and ammonia emission could not be obtained, but according to the executing agency, the decrease in SOx and ammonia hypothesized at the time of project planning was visible due to the switch from ammonium sulfate production to urea production. Also, each indicator of the ammonium and urea plant newly constructed reached Pakistan's National Environmental Quality Standards in the table below. So, it appears that this project produced no negative effect on the environment. Furthermore, according to the questionnaire distributed to 32 retailers and dealers, 91% replied that no negative effect on the environment due to fertilizer usage has been visible.

Also, no land was acquired and no residents were relocated in the project.

Table 5 Environmental Indexes

	Parameters	Units	Nat'l Environmental Standards	Standards Agreed to by Contractor	Measured Levels (Averages)
A	Discharge				
	Temperature	℃	40	-	30
	pH		6-10	6-9	8.1
	NH_3	mg/l	40	40	33
	Oils and Fats	mg/l	10	10	5.6
	Biochemical Oxygen Demand (BOD)	mg/l	80	80	46
	Suspended Particles (quality)	mg/l	150	200	77
	Urea	mg/l	-	10	3.5
	Chromium	mg/l	1.0	0.5	Not Detectable
	Zinc	mg/l	5.0	5.0	1.9
B	Exhaust				
	Urea Content of Exhaust	mg/Nm3	-	50	35
C	Noise (measured with a sound-level meter 7.5 meters from the source)	dB	85	-	70

Source: Material from the executing agency

2.5 Sustainability

2.5.1 Executing Agency

(1) Technical Capacity

The operation and maintenance work at the Daudkhel Fertilizer Plant is classified as shown below.

- Daily Work: Checking of pressure level at each plant (pressure changes), temperature level, and gas level, etc.
- Periodic Work on an Annual or Shorter Cycle: Inspection, replacement, and cleaning of parts such as filters, etc., and checking emergency stopping valves.
- Work Implemented Every 3 Years: Large-scale facilities overhauls, etc.

In addition to periodically implementing the above work, the Daudkhel Fertilizer Plant not only store back-up copies of monitoring data results in multiple forms, but also has established a system in case of any problem wherein it can receive support from the Japanese consultants, contractors, and suppliers who were involved in this project, at its reference center where equipment and material manuals as well as files for operation and maintenance are gathered[10].

Moreover, there are currently approximately 150 staff members in the Technical and Laboratory Division who are in charge of operation and maintenance. Their technological level is satisfactory overall because they are provided with opportunities to acquire up-to-date technology and skills through the various training programs for the staff varying in length from 1 week to 2 months[11].

(2) Operation and Maintenance System

1) Pakistan Fertilizer Public Company

Pakistan Fertilizer Public Company is a holding company with a total of 5 subsidiaries (at the time of evaluation), and PAFL is one of its subsidiaries. National Fertilizer Marketing Limited, which is part of the same group, handles marketing of fertilizer produced by companies in the corporate group. The above three companies (Pakistan Fertilizer, National Fertilizer Marketing Limited, and PAFL) are in constant close contact, and the organizational structure of the group companies is established.

2) Organization of PAFL

At the time of evaluation, PAFL had 558 employees. From 1994 to 2001, the number of employees was in a downtrend (from 651 in 1994 to 479 in 2001), which is resulted from natural attrition due to retirement and no new hiring in order to reach an appropriate number of employees. The executing agency believes that the present number of employees is the appropriate number for conducting the efficient operation and maintenance of the plant.

(3) Financial Status

First, to analyze the Profit and Loss Statement, operating profit posted a smaller loss due to annual

[10] This operation and maintenance system is the result of technology transfer from Japanese contractors to the staff during the implementation of the project (according to an interview with the executing agency).、

[11] There are also overseas training programs in Japan and Indonesia.

increases in sales accompanying the increase in fertilizer production and the positive tendencies in the cost of sales to net sales ratio, starting in 2000[12]. However, the company continues to post a deficit at the operating profit stage. Due to this, it seems that improvement of profitability will be an issue for the time being. The situation is that the amount of fertilizer produced was already 90% of facility capacity in FY2001, meaning that large increases in production and sales cannot be expected (see 2.3.1), and in addition, while a high price is charged domestically for natural gas[13], which is a raw material in fertilizer, the price of fertilizer is depressed. Thus, further improvement in management efficiency is required, including adjustment of the number of employees to a suitable level as mentioned in the preceding section.

Looking at the Balance Sheet next, because a large deficit was posted in current net profit starting in 2000, the owned capital ratio declined from 30.4% in 1999 to 14.3% in 2002. So, it must be said that as long as improvement in profitability is not achieved, the plant's chances of sustainability in financial terms will be weak.

Table 6 PAFL's Profit and Loss Statement (unit: 1,000 rupees)

Item	1999	2000	2001	2002
Sales	12,803	646,441	1,512,751	1,971,051
Cost of Sales	12,546	979,643	1,745,183	1,940,718
Gross Sales	257	△333,202	△232,432	30,333
General Administrative Expense	776	59,338	56,408	61,927
Operating Profit	△519	△392,540	△288,840	△31,594
Non-Operating Profit	6,880	43,491	35,714	23,238
Non-Operating Expenditure	318	244,227	433,523	490,344
Recurring Profit	6,042	△593,276	△686,649	△498,700
Corporate Tax, etc.	5,680	2,793	8,146	7,938
Current Net Profit	361	△596,069	△694,796	△506,638

Source: Material from the executing agency

[12] Since 1999 was the year following the start of operation and the scale of operation was small, analysis of the Profit and Loss Statement starts from FY2000 so that the figures can be compared with other fiscal years.
[13] There are limits to cost reduction since the cost of natural gas used as fuel for fertilizer production rose by approximately 48%, and the cost of natural gas used as a raw material for fertilizer rose by approximately 8% from 2000 through 2001

Table 7 PAFL's Balance Sheet （unit: 1,000 rupees）

Item	1999	2000	2001	2002
Fixed Assets	9,421,475	8,639,186	7,971,385	7,103,363
Current Assets	947,931	1,342,136	1,152,845	1,236,813
Other Assets	16,846	12,964	12,628	16,747
Total Assets	10,386,255	9,994,289	9,136,860	8,356,926
Long-term Liabilities	5,837,542	5,815,801	5,687,397	5,898,471
Current Liabilities	1,389,854	1,615,699	1,581,470	1,259,297
Total Liabilities	7,227,396	7,431,500	7,268,868	7,157,768
Capital	3,158,856	2,562,786	1,867,990	1,199,155
Total Liabilities and Capital	10,386,253	9,994,287	9,136,858	8,356,924

Source: Material from executing agency

2.5.2 Operation and Maintenance Status

It was confirmed in the latest field survey that the majority of the facilities are operating normally. There was a problem with the operation of the CO_2 compressor following the 1998 operation test and trouble occurred due to the falling off of the reformer tube in 2000. However, no major trouble has occurred since then. Still, even though measures had already been taken at the time of evaluation, the following minor issues remain. These issues should be resolved, to improve the rate of operation and to increase the production amount of the Daudkhel Fertilizer Plant

1) Replacement of coil tube of reformer (vapor quality improvement device in the ammonia plant)[14]
2) Replacement of the pump valve in the ammonia plant
3) Spot check of the damper on the reserve boiler
4) Improvement of the CO_2 compressor

2.5.3 Others

(1) Possibility of Privatization

There has been a trend toward privatization in the fertilizer sector since the 1990s, and Daudkhel Fertilizer Plant which benefited from this project was a candidate for privatization. However, privatization was shelved due to the plant's profitability at the time. According to the Ministry of Industries and Production and Pakistan Fertilizer, in the study by the privatization committee implemented in 2003, PAFL is once again a candidate for privatization[15], but at the time of evaluation, the timing of privatization and future trends were undecided.

[14] Since trouble occurred in 2000, there has been no effect on daily work, but after consulting with the contractor on how to effect complete repairs, tubes were replaced over several months in 2003, and agreement was made that if further trouble occurs, the contractor will send welding equipment and engineers (according to and interview at executing agency).
[15] In 2002, Pak-Saudi which was owned by Pakistan Fertilizer was purchased by the private company FFC.

(2) Securing a Stable Supply of Natural Gas

Stable supply of natural gas is a necessary requirement for the maintenance and improvement of fertilizer production amounts at the Daudkhel Fertilizer Plant. As pointed out since the time of appraisal, both the quality and the quantity of the supply of natural gas are currently susceptible to the effects of the seasons. In 2001 due to the action of the Ministry of Industries and Production, the Ministry of Oil and Natural Resources directed gas companies to supply gas to this plant without setting a maximum limit (on supply amount) [16]. It is expected that the further increase of production amount can be achieved in the near future because new gas fields were discovered in 2002 are now under development, and until then the Cabinet Economic Committee notified gas companies to maintain the supply.

3. Feedback

3.1 Lessons Learned

None

3.2 Recommendations

None

[16] JBIC sent a letter to the Ministry of Industries and Production requesting that concrete measures be taken, and the Ministry of Industries and Production sent a request to the Ministry of Oil and Natural Resources. The reaction to that request is in the result of the hearing when the interview was conducted at the Ministry of Industries and Production during evaluation.

Comparison of Original and Actual Scope

Item	Plan	Actual Performance
Output	(1) Plant Construction • Ammonia Plant; Urea Plant Designed capacity 600 tons/day; 1,050 tons/day, respectively (2) Rehabilitation • Coolant Unit Renewal of cooling tower 15,000 M.T/hr circulation • Water Processing Unit Renewal of water processing unit（150 tons/day） • Nitrogen Generator Unit Introduction of emergency generator 400 Nm^3/hr of Nitrogen • Urea Storehouse Expansion of urea storehouse Capacity: 15,000 tons • Liquid Ammonia Storehouse 3520NM3/hr (3) Procurement • Equipment, materials, workshop lab, workshop • Other equipment and materials (4) Consulting Service -Overseas: 56M/M -Domestic: 153 M/M -3rd party inspection	• Ammonia Plant; Urea Plant As planned • Coolant Unit As planned • Water Processing Unit As planned • Nitrogen Generator Unit As planned • Urea Storehouse As planned • Liquid Ammonia Storehouse As planned • Equipment, materials, workshop lab, workshop As planned • Other equipment and materials As planned As planned
Project Period	(1) Consulting Services ・Selection of Consultants: February-April 1989 ・Engineering: July 1994-December 1995 (2) Bidding/Evaluation: April 1989-February 1990 (3) Procurement/Shipping: August 1994-July 1996 (4) Engineering work/Installation work: February 1995-January 1997 (5) Test Operation February 1997-June 1997	・April-December 1989 ・As planned February 1990-November 1991 July 1994- May 1997 August 1994- August 1998 May 1998-September 1998
Project Cost Foreign Currency Local Currency Total ODA Loan Portion Exchange Rate	19,521 million yen 9,468 million yen (local currency：2,552 million rupees) 28,989 million yen 23,705 million yen 1 rupees ＝ 3.71 yen （addition loan: foreign currency 5,107 million yen）	19,260 million yen 7,526 million yen （local currency: 2,773 million rupees） 26,786 million rupees 23,444 million rupees 1 rupees ＝ 2.71 yen （presented by executing agency: average levels during project）

Third Party Evaluator's Opinion on
Daudkhel Fertilizer Plant Modernization Project (1)(2)

Dr Zafar Mueen Nasir
Chief of Research and Head, Human Resource Development Division
Pakistan Institute of Development Economics (PIDE)

Daudkhel Fertilizer Plant Modernization Project (1)

Relevance

Like most of the developing countries the economic base of pakistan is dominated by agriculture and livelihood of majority of the people depends on the farm output. While the agriculture sector has been growing over time at a respectable growth rate, the proportion of people living below poverty line especially in rural areas has risen during 1990s. In its different policy documents government of pakistan has given priority to agriculture sector to improve the farm output and reduce poverty in the country. The policy was directed towards mechanization of agriculture sector along with the increase in fertilizer use to improve farm productivity. It was planned to enhance the domestic production capacity of fertilizer to provide regular supply at affordable rates to farmers as well as to save foreign exchange. It is in this context that the renewal and expansion of daudkhel fertilizer project is very relevant for pakistan's agriculture sector. The project is expected to resolve the gap in demand and supply of fertilizer and increasing its availability which is essential for increase in agricultural productivity and reducing poverty in the rural areas. The project will directly benefit the country by reducing its import bill and increasing farm output. The project is in line with the national development plan and priorities set by the government for the promotion of agriculture sector. The project will also benefit the country by reducing the pollution level in the project area and having no adverse impact on the soil quality. Thus renewal and expansion of daudkhel project is a step towards self sufficiency in fertilizer production and resolving the gap in supply and demand.

Impact

The project was expected to increase availability of fertilizer, reduce pollution and improve agriculture productivity in the country. The increase in agriculture output is expected to raise income level of farmers and reduce poverty in rural areas. At macro level the project was expected to save foreign exchange which is in short supply in pakistan. The project has apparently good impact on the economy and income level of rural population. The production data of the project shows a steady increase in the output of fertilizer right from 1998-99 (the year of completion of the project) through 2001-02 (year of evaluation) from approximately 200,000 tons to approximately 470,000 tons. Although there is still room for improvement and production can increase to another 13, 0000 tons annually but due to host of factors this was not achieved till the time of evaluation. The main reason is the quality and quantity of natural gas which is the main input in the fertilizer production. Due to the government's policy of priority to domestic use of gas over industry in peak hours, the gas supply to the industrial facilities is interrupted frequently. The fertilizer production which depends on the gas supply is the hard hit due to the interruption of gas supply. The gas has to be in regular supply to achieve maximum production level.

The increase in fertilizer production has increased the fertilizer use in the country and the data shows that the fertilizer use in the country has increased from 1795 kg/ha in 1998-99 to 2117 kg/ha in 2001-02. The statistics further reveals that the better usage of fertilizer has increased the agricultural productivity of different crops raising income level of the rural farm households. The domestic demand of urea was almost equal to the domestic production with the production of this project in fy 2000-01 and in the subsequent year it exceeded demand. This was important improvement in the pursuit of self sufficiency and saving of foreign exchange. The calculation shows that pakistan saved about 37 million dollar annually because of the increase of domestic production mainly due to the renewal and expansion of daudkhel fertilizer project. The project contributed positively in raising the standard of living of the rural

population by enhancing agricultural output and their income level. The project has no negative impact on the environment and on soil quality which is another positive outcome of the project.

Daudkhel Fertilizer Plant Modernization Project(2)

Effectiveness

The agriculture is the mainstay of majority of the population in pakistan. Presently the agriculture sector contributes about 23 percent towards the overall gdp and provides jobs to 42 percent of the country's total labor force. Pakistan has plenty of irrigated land but supply of inputs like fertilizer, pesticides and good quality seeds remains lowers than the demand. Due to the importance of the agriculture sector, government of pakistan has given priority to this sector in the development plans and adopted a policy of easy availability of inputs to farmers for increasing farm productivity and raising their income level. The renewal and expansion of daudkhel fertilizer project is envisaged to increase the domestic production of fertilizer to resolve the demand and supply gap. The data shows that the project helped in enhancing the production of both urea and ammonia in the country. The project had achieved 95% of the planned production in fy 2001-02.in fy 2001-02 the production was at 90% of the planned level which is by all standard a remarkable achievement. If the quality and quantity problem of the natural gas is resolved the production can increase further. The company has also success in selling all its output which is important for the sustainability of the project. As far as quality of the fertilizer is concerned, the company has already acquired the iso 9001-2000 certification which is major achievement for a pakistani production facility. The fertilizer produced by the daudkhel project is of high quality as for as its ingredient contents are concerned. The quality of the daudkhel fertilizer project is comparable with any other high quality fertilizer (especially ffc) available in the country. The quality is also recognized by the users as well. The project is also good for the environment because it helped reduce population in the production and it has no adverse impact on the soil quality. The financial internal rate of return of the project is calculated as 4.62% and economic rate of return is calculated as 7.67%. Both are positive and higher than the market interest rates. This shows that the project is viable by this standard.

Sustainability

The profit and loss statement of the daudkhel renewal and expansion project shows net loss from the day of its operation. The improvement in the situation was seen during fy2002 but the overall situation did not change. The plant is already operating at its more than 90% of its capacity therefore there is not much room for improvement through increase in production. The situation however can improve by lowering the recurring expenditure with some management efficiency and rightsizing the employment level. Government is divesting from the major state own enterprises but the daudkhel fertilizer company stands no chance for privatization due to the its loss making operation. If operation cost is brought down by some restructuring measures the expenditure can be controlled and then chances of its profit earnings will increase. In this way it will contribute positively to the national exchequer.