China

Wengfu Fertilizer Plant Construction Project (1)(2)

Report Date : March 2002
Field Survey : July 2001

1. Project Profile and Japan's ODA Loan

Site Map : Anning, Kunming, Yunnan Province

Site Photo : Wengfu Fertilizer Plant

1.1 Background

Annual food production of China in 1980s had changed in the range from 320 million tons to 410 million tons. In 2000, Chinese government set its food production target at 500 million tons based on the population of 1,250 million and per capita food requirement of 400 kg per annum. The government has realized that it is essential to increase the input of fertilizer to increase the volume of food production, which significantly contributes to the improvement in the productivity of food production. On the other hand, there is a considerable gap in the supply and demand of fertilizer in China and the nation is importing fertilizer in great volume every year. Volume of fertilizer imported in 1990[1] was 16.27 million tons (in weight[2]) and the amount of foreign currency paid for such import was as much as $2,610 million. Because of the situation, there is an urgent need of domestic fertilizer production for stable fertilizer supply and to save foreign currency. In particular, gap between supply and demand of phosphorus fertilizer in 1990 was 2.07 million tons and 33% of the consumption was covered by the import. Also, the ratio between nitrogenous fertilizer and phosphorus fertilizer in the total chemical fertilizer in 1990 was at a low level of 1:0.38, while the demand of agricultural department was 1:0.5. Since this unbalance with nitrogenous fertilizer was causing serious limitation on the agricultural production, it was an urgent task to construct phosphorus fertilizer plant to overcome the situation.

To solve this supply and demand gap problem in fertilizer, Chinese government has prepared a plan to construct 10 fertilizer plants in the whole nation with a total production capacity of 2.43 million tons (in net volume[3]) in its 8th Five-Year Plan (1991～1995). And, it was decided to construct a phosphorus fertilizer plant in Fuquan of Kueichou Province (120 km north from the center of Guiyang city) rich with its mineral phosphate reserve.

1.2 Objectives

To cope with the demand of phosphorus fertilizer and to improve the productivity in the food production for entire China through the construction of triple superphosphate[4] (TSP) fertilizer plant

[1] Chinese fiscal year is from January to December.
[2] Total of actual weight of all fertilizer types such as nitrogen, phosphate, potassium and complex type
[3] Total weight of active ingredients (nitrogen, phosphate and potassium) contained in the above fertilizers
[4] Phosphate fertilizer produced from phosphoric acid and phosphate rock contains 40 to 50% of water-soluble phosphoric acid portion.

with annual production capacity of 800,000 tons (or 368,000 tons in net volume).

1.3 Project Scope

Construction of production plants for sulfuric acid, phosphoric acid, TSP and fluoride aluminum. Japan's ODA loan covers total amount of foreign currency portion of the project.

1.4 Borrower/Executing Agency

External Trade Department[5], The People's Republic of China/Chemical Industry Department, The People's Republic of China

1.5 Outline of Loan Agreement

	First	Second	Total
Loan Amount Loan Disbursed Amount	8,820 Million Yen 8,820 Million Yen	3,466 Million Yen 3,370 Million Yen	12,286 Million Yen 12,190 Million Yen
Date of Exchange of Notes Date of Loan Agreement	August 1993 August 1993	January 1995 January 1995	- -
Terms and Conditions -Interest rate -Repayment period (Grace Period)	 2.6% : 30 years (10 years) General untied	 2.6% 30 years (10 years) General untied	- - - -
Final Disbursement Date	October 2000	February 2001	-

2. Results and Evaluation

2.1 Relevance

This project has a high priority, as it is in line with the basic policy of planned economy of China in its 8th Five-Year Plan to solve supply-demand gap in fertilizer and to save foreign currency that will be spent for the import of fertilizer. And also, the plan is relevant from a viewpoint of food production increase and foreign currency saving, as it aims to increase domestic fertilizer production. Furthermore, stable food production is a continuously important political issue for China, though a drastic change has occurred in the economic climate in the course of this project to introduce market economy system. Even today, relevance of this project does not change at all in view of the production and sales of fertilizer, which contributes to the improved productivity in food production.

On the other hand, this project operator, Wengfu Phosphorus Chemical Industry Group Limited Company, has started production and marketing of DAP by modifying a part of the plant using its own fund in 1999 when project has completed so that it can produce Nirinan (DAP) [6], which has a better marketability compared with TSP, because its final product of triple superphosphate (TSP) does not have reasonable marketability. There was a need for the study on the trend of the market for phosphorus fertilizer such as the movement in the fertilizer type in the international market at the time of planning and appraisal.

2.2 Efficiency

① Project Cost

Foreign currency portion in the project cost resulted in approximately 70% of the planned amount becausecontracted amount was lower than expected. On the other hand, actual RMB portion was

[5] Present External Economic Collaboration Department. Also, after 1999, borrower of Japan's ODA to China was changed to the government (Finance Department) of the People's Republic of China.

[6] A type of composite fertilizer produced from ammonia and phosphoric acid and includes 18% nitrogen and 46% phosphoric acid.

2,298 million RMB against that of planned amount of 1,267 million RMB, and thus, total project cost in Japanese Yen was 54% overran . If total project cost is recalculated in RMB, actual (3,100 million RMB) is larger than the plan (2,564 million RMB).
There was no problem in disbursement, however, delay in domestic currency infusion was one of the reasons for the delay in the construction period.

② Construction Period
This project was started in October 1991 with its preparatory work and the start of commercial production of TSP was April 1999, which was a 15 months delay from the plan. On the other hand, considerable time was spent to solve equipment trouble in the sulfuric acid plant, it was December 1999 when total trial run of all plants of sulfuric acid, phosphoric acid, TSP, and fluoride aluminum.[7] Project operator explained that the construction was delayed due to the delay in the civil engineering and installation works caused by the delay in domestic currency infusion.

2.3 Effect (Degree of Accomplishment)

① TSP Production Volume
Annual TSP production volumes of this project are as shown in Table 1. Percentage points of actual annual production against annual production capacity of 800,000 tons resulted in very low levels of 3.3% in 1999 and 1.1% in 2000. The situation is hardly an activity that is called TSP production and marketing.

Table 1：TSP and DAP Production (in weight)

		1999 (Year completed)	2000 (2nd year)	2001 (3rd year)
Actual Production (tons/year)	TSP	25,807	8,826	0
	DAP	---	107,833	115,432 (*)

Source: Obtained from project operator at the time of evaluation
(*) Result of Jan-Jun, 2001

Comprehensive trial run of this project started in February 1999. The poor sale of TSP was recognized, when the sale of TSP produced during this trial period started. The project operator realized the marketability of DAP, which is also a type of phosphorus fertilizer, is much better than TSP[8], it started plant modification in the beginning of 1999 using its own fund to produce not only TSP but also DAP to strengthen the ability to cover the risk of this project. The plant, which receive additional raw material ammonia, and ammonia blowing equipment were newly installed and the modification had completed in February 2000. As shown in Table 1, after March 2000, project operator has been carrying out production and sales of DAP instead of TSP.
This project operator is planning to improve DAP production capacity to 600,000 tons[9] by accumulating production technologies and marketing know-how while it is carrying out production and sales activities for DAP in the plant with the above modification and by introducing modification such as the introduction of pipe reactor into DAP plant to improve the operating factor of one system in two available systems of TSP plant. It is also planning to increase the production capacity up to 1.2 million tons in the future by modifying remaining another production system.

[7] TSP was produced and sold without waiting the completion of comprehensive trial run while coping with the trouble in the equipment of sulfuric acid plant.
[8] While TSP is a monolithic fertilizer that contains approximately 56～58% phosphoric acid content, DAP is a composite fertilizer that contains approximately 18% nitrogen content and approximately 46% phosphoric acid content. Generally speaking, trend in fertilizer type is shifting towards high component and complex type for more efficient agricultural work and high-added-value farm produce.
[9] When TSP production plant of 400,000 tons is modified, production capacity will become 600,000 tons of DAP.

② Supply and Demand Gap in Phosphorus Fertilizer in China

Objective of this project is to meet with the demand of phosphorus fertilizer in China. Though final product has been switched from TSP to DAP, original objective in a sense to produce and sell phosphorus fertilizer is unchanged. However, in the present situation where annual TSP production is extremely low as shown in Table 1 and also, DAP production has just started, it is difficult to say that this project is coping with the domestic demand for phosphorus fertilizer. Table 2 shows supply and demand balance in entire China. However, this supply and demand gap is still expanding further and much of the demand is filled by the import of large volume of fertilizer.

Table 2 Production/Consumption Balance in Phosphorus Fertilizer (Unit: 10,000 tons/year net)

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Production (*1)	412	416	455	417	497	619	575	560	663	636
Consumption (*2) (Note 1)	619	687	729	818	877	941	996	1,056	1,061	1,103
Assumed Import (*3) (Note 2)	207	271	274	401	380	322	421	496	398	467
Assumed Import Ratio (*4) (Note 3)	33%	39%	38%	49%	43%	34%	42%	47%	38%	42%

Source: China Almanac and Chinese Chemical Industry Almanac

Note 1: Compensated by assuming components of composite fertilizer as 18% nitrogen portion and 46% phosphorus portion.

Note 2: Since actual import data was not available, import was calculated by deducting production from consumption.

Note 3: Import ratio was calculated by dividing import volume by consumption.

③ Consumption of mineral phosphate

In China, a large reserve of mineral phosphate exists in the provinces of Kueichou and Yunnan. This was one of the reasons that Fuquan of Kueichou Province was selected as a construction site of this project. Wengfu mine that supplies mineral phosphate to this project started its production in July 1995 but it was forced to stop production at the level of one half capacity and produced only 500,000 to 700,000 tons of mineral phosphate to other regions as the completion of this project had delayed thereafter. However, as the operation of this project started in early 1999, the mine started its production intermittently to meet with the requirements. Actual consumption of mineral phosphate[10] in 2000 was approximately 170,000 tons and 180,000 tons in 2001 compared with planned annual requirement of approximately 1,230,000 tons in this project.

④ Recalculation of Internal Rate of Return (IRR)

At the time of appraisal, it was assumed that the financial internal rate of return (FIRR) will be 7.2% and economical internal rate of return (EIRR) will be 16.6%. However, since effectiveness of production and sales of TSP of this project was mostly not exhibited, internal rate of return resulted in negative figure.

2.4 Impact

① Ratio between nitrogenous fertilizer and phosphorus fertilizer in China

Ratio between nitrogenous fertilizer and phosphorus fertilizer was 1:0.38 in 1990 and this ratio had gradually risen to 1:0.47 in 1999 as shown in Table 3, which was close to the requirement of agricultural department. However, this rise in the ratio is not only caused by the increase in the production volume in China but also largely caused by the import of phosphorus fertilizer by spending foreign currency. Also, since production volume of this project is very limited, it seems

[10] For the calculation purpose, P_2O_5 component in the nitrogenous fertilizer was calculated as 30%.

that this project did not contribute for increase of this ratio.

Table 3 Ratio between Nitrogenous Fertilizer and Phosphorus Fertilizer

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Nitrogenous fertilizer (10,000 tons/year net)	1,700	1,799	1,839	1,930	1,990	2,143	2,277	2,316	2,381	2,339
Phosphorus fertilizer (10,000 tons/year net)	617	689	729	818	877	941	996	1,056	1,061	1,103
Ratio between nitrogenous fertilizer and phosphorus fertilizer	1:0.36	1:0.38	1:0.40	1:0.42	1:0.44	1:0.44	1:0.44	1:0.46	1:0.45	1:0.47

Source: China Almanac

Note: Compensated by assuming components of composite fertilizer as 18% nitrogen portion and 46% phosphorus portion.

② Improved Food Production and Productivity in China

A policy target, "to increase food production to 500 million tons in 2000 by setting food production target at 500 million tons based on the population of 1.25 billion and per capita food requirement of 400 kg per annum," which was established in 8th Five-Year Plan, high level plan of this project, was materialized as shown in the data of Table 4. However, production volume of this project was very limited, it is hard to say that this project has contributed to the materialization of the above higher-level target.

Table 4: Improved Food Production and Productivity in China

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Food Production (10,000 tons/year)	44,624	43,529	44,266	45,649	44,510	46,662	50,454	49,417	51,230	50,839
Population (x10,000)	114,333	115,823	117,171	118,517	119,850	121,121	122,389	123,626	124,810	125,909
Per Capita Food Production (kg)	390	376	378	385	371	385	412	400	410	404
Fertilizer applied acreage = Planted acreage (x1,000 ha)	113,466	112,314	110,560	110,509	108,544	110,060	112,548	112,912	113,787	113,161
Unit applied fertilizer (kg/ha) Net	228	250	265	285	306	326	340	353	359	364
Unit food production (kg/ha)	3,983	3,876	4,004	4,131	4,102	4,240	4,483	4,377	4,502	4,493

Source: China Almanac

③ Regional development and employment promotion in Kueichou Province

Since the plant and related plants were constructed by the project, a plot of ground in the size of approximately 397 hectares around the site was developed in Fuquan of Kueichou Province, which was originally an agricultural region, and a private railroad line in 6.3 km length and 10 km road were constructed.

Also, according to the Wengfu Phosphorus Chemical Industry Group Limited Company, a business operator of this project, a number of direct employees of this project including temporary workers are 2,873 (including 858 female employees) and a number of residents increased in the surrounding area of this project are approximately 13,000. It can be said that this project has contributed to the increase of employment opportunity.

④ Impact on Natural Environment

Project operator reported that the Environment Protection Bureau of Kueichou City, which is a

controlling government agency for environmental protection, has been implementing environmental inspection, but they have never received any instruction or recommendation on this project from the bureau.

⑤ Impact on Social Environment

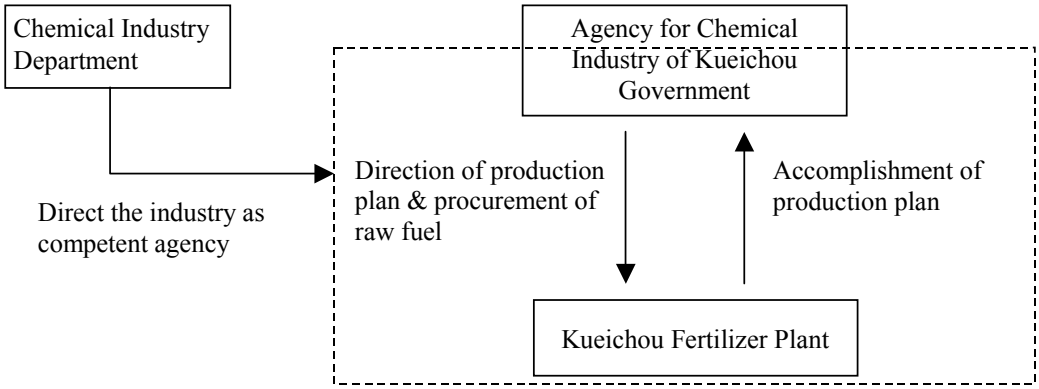
Business operator explained that no negative social impact has been reported on the construction of this project.

2.5 Sustainability

① Operation and Maintenance System

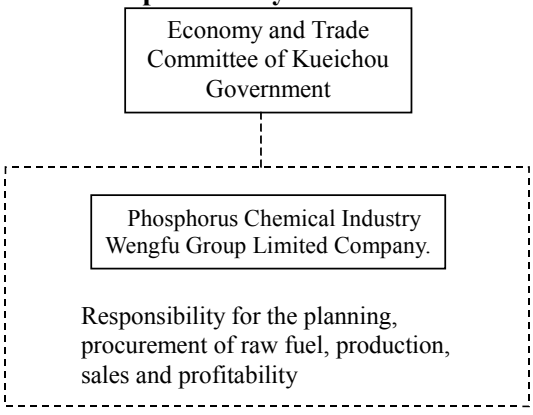
At the time of appraisal, it was agreed that the Chemical Industry Department of the Central Government directs the industry as a competent authority under the planned economy system as shown in Fig. 1 and Kueichou Fertilizer Plant carries out actual operation and maintenance based on the production plan prepared by the Agency for Chemical Industry of Kueichou Government who is also responsible for the procurement of raw fuel. However, in the course of this project, China has made a fundamental change in its economical principle and introduced socialism market economy and fertilizer field has also shifted into market economy around 1996 in the midst of such trend, and the shift is still continuing. According to the shift in the economic system, higher functions of central and provincial governments were abolished. And business operator itself started to carry out all necessary works such as planning, procurement of raw fuel, production, and marketing and assumed responsibility for the profitability of the project. Operation and maintenance system at the time of evaluation was changed as shown in Fig. 2.

Fig. 1: Control and Operation System at the time of Appraisal



Source: JBIC Data

Fig. 2: Control and Operation System at the time of Evaluation



Source: Data of Implemented Organization

Wengfu Phosphorus Chemical Industry Group Limited Company (hereafter referred to as Wengfu Phosphorus Fertilizer Plant), which was organized under Economy and Trade Committee of Kueichou Government in early 1998, is responsible for the management and maintenance of this project. Total number of employee of WENGFU Phosphorus Fertilizer Plant at the time of appraisal was 1,200, which consisted from 714 in production department and 486 in other departments including production control and sales department.

② Situation of Operation and Maintenance

Since TSP production started in April 1999, volume of TSP produced and sold up to the end of 2000 was only around 2% of plant capacity as explained in the above. And Wengfu Phosphorus Fertilizer Plant had stopped TSP production in early 2001, as the marketability of TSP was worse than expected. On the other hand, project operator realized that DAP had better opportunity. In order to strengthen the ability to cope with the risk of this project, project operator had newly installed ammonia receiving plant in early 1999 and temporarily modified one system of two TSP plants to the one for DAP production. Since March 2000, project operator has been producing and selling DAP in lieu of TSP. Wengfu Phosphorus Fertilizer Plant is planning to make full modification in one system of existing TSP production plants during the period of 2001 to revive the project through DAP production. In the future, full modification of remaining system of TSP plant to the one for DAP production and switching of raw material[11] for sulfuric acid production from sulfide mineral to element sulfur are also planned.[12]

The management of Wengfu Phosphorus Fertilizer Plant has already reduced number of employees from originally planned 2,400 to 1,200 and has let every employee realize the present condition by exhibiting cost items and values for every cost categories of organizational unit to which each employee belongs, and implement cost control. It has been keeping close relation with the agency of Kueichou Province Government (originally, Chemical Industry Agency of Kueichou Province) even after the shift into market economy system and by receiving various advices on the business management. Topnotch manager of Wengfu Phosphorus Fertilizer Plant is in mid-30s and has introduced new management techniques, which are new in China, in its own business management. We could observe enthusiasm and responsibility of the management at the time of the survey.

③ Financial Situation

It seemed that the profitability of this project in the TSP production and sales seemed extremely poor, however, we were unable to obtain the data that shows financial situation of the project unit.

Under such circumstances, Wengfu Phosphorus Fertilizer Plant, project operator of this project, has already been reconstructing its business system towards the one centered on DAP production as it could not see the sustainability and self-reliance in TSP production, and the sustainability of this project in view of TSP production has already been lost. On the other hand, if we take a look on the Chinese market from a viewpoint of production and marketing of DAP, volume of DAP import in whole China has been increasing lately[13] though insignificant and, therefore, marketability of DAP seems existing. As such, it must implement various measures in the future including acquisition of

[11] The modification is made in order to reduce production cost of sulfuric acid but it is not directly related to the modification for DAP production.

[12] TSP production facility introduced in this project consists from "Sulfuric Acid Plant (to produce sulfuric acid using sulfide mineral as raw material)," "Phosphorus Acid Plant (to produce phosphoric acid from phosphate rock and sulfuric acid)" and "TSP Plant (to produce TSP from phosphate rock and phosphoric acid)" and "Fluoride aluminum plant." To convert this plant for DAP manufacturing, new installation of receiving and storage facility for ammonia a new raw material and modification of TSP plant for DAP production would be required, however, plants for nitric acid, phosphoric acid and fluoride aluminum would be used as they are.

[13] Volumes of Chinese DAP import were 4.46 million tons in 1996, 4.64 million tons in 1997, 5.5 million tons in 1998 and 5.28 million tons in 1999. (Source: Chinese Chemical Industry Almanac).

production technology of DAP as project operator, development of the market and to ensure profitability in the production and sales of DAP. We must closely watch the future management situation of Wengfu Phosphorus Fertilizer Plant.

3. Lessons Learned

It is extremely difficult to forecast the risk of market fluctuation under the price-controlled-economy like in the case of this project. In particular, when relevancy of supply and demand analysis is reviewed in the manufacturing project, thorough study must be made in the planning and appraisal stages of the project on the direction of macro-economic policy, which may give grave impact on the feasibility or sustainability of the project or international market condition of the product. In some cases, study of concrete measure to alleviate the risk of market fluctuation would be necessary.

Comparison of Original Plan and Actual Scope

Item	Plan	Actual
① Project Scope		
Sulfuric acid plant	800,000 tons/year	Same as in the left
Phosphoric acid plant	300,000 tons/year (in P_2O_5)	Same as in the left
TSP plant	800,000 tons/year	Same as in the left
Fluoride aluminum plant	14,000 tons/year	Same as in the left
② Construction Period		
Work in preliminary stage	Oct 1991－Sep 1994	Oct 1991－Sep 1994
Process plant bidding	Apr 1993－Dec 1994	Apr 1993－Dec 1994
Basic design	Nov 1994－May 1995	Nov 1994－Oct 1995
Detailed design	May 1995－Mar 1996	Dec 1995－Mar 1997
Equipment procurement	Jul 1995－Dec 1996	Jul 1995－Dec 1997
Civil Eng'g & installation	Jan 1996－Sep 1997	Mar 1996－Dec 1998
Comprehensive trial run	Oct 1997－Dec 1997	Jan 1999－Dec 1999
Start of commercial run	Jan 1998	Apr 1999
③ Project Cost		
Foreign Currency	16,381 Million Yen	12,190 Million Yen
Local Currency	14,136 Million Yen	34,930 Million Yen
	(1,188 Million RMB)	(2,298 Million RMB)
Total	30,517 Million Yen	47,120 Million Yen
ODA loan portion included	16,381 Million Yen	12,190 Million Yen
Exchange Rate	1RMB = 11.9 Yen	1 RMB = 15.2 Yen (Note)

Source: JBIC Data and Data of Implemented Organization

Note: Actual exchange rate is a weighted average value.