STUDY ON PRIVATE-INITIATIVE INFRASTRUCTURE PROJECTS IN DEVELOPING COUNTRIES IN FY2011

STUDY ON THE UREA FERTILIZER COMPLEX PROJECT IN THE REPUBLIC OF MOZAMBIQUE

SUMMARY

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Prepared for:
The Ministry of Economy, Trade and Industry

Prepared by:
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1. Background and necessity of the project

Agriculture is the main industry of Mozambique, with 81% of the workforce engaged in agriculture, and accounts for 28.8% of the GDP. Mozambique’s agricultural products include cotton, cashew nuts, sugarcane, tea, cassava (tapioca), corn, coconuts, sisal, citrus fruits, tropical fruits, potatoes, sunflower, beef, and poultry.

Mozambican agriculture can be summarized as follows:

1. Dryland farming characterized by self-consumption and low productivity and production
2. Weak market-orientation
3. Primitive farming techniques involving environmentally inappropriate practices
4. Low quality and small-scale production

In Mozambique, there are only three fertilizer importers: Agrifocus, Agrochemical and Agrotech.

These importers import urea mainly from South Africa. They receive 3% of the import prices as a commission from the Government. Wholesalers buy the fertilizer at 70 to 80 US dollars per 50 kg and sell it to farmers at 100 US dollars per 50 kg. This is not necessary a competitive price from the perspective of the GDP of Mozambique. The fertilizer is sold at 10 US dollars per 5 kg in the market.

The Government of Mozambique seeks development in agriculture. While the potential annual fertilizer demand is 100,000t, the annual fertilizer consumption has increased from 18,000 to 51,000t over the last decade. If urea is produced domestically, the demand will expand and is expected to further increase. Fertilizer consumption in Mozambique is low compared to other African countries.

- Africa: 20 kg / ha
- Africa south of the Sahara: 8 kg / ha
- Mozambique: 5 kg / ha
- Abuja Declaration: 50 kg / ha (until 2015)

Southern African Development Community (SADC) countries, such as Zambia, Mallawi, Zimbabwe and Congo, are fertilizer importing countries and are expected to have a growing demand for urea as shown in the table below. This supports the need for the project.
Table 1 Comparison of current consumption and forecast for fertilizer for SADC countries (2007-2011 and 2011-2017)

<table>
<thead>
<tr>
<th>Year</th>
<th>Mozambique</th>
<th>Zambia</th>
<th>Malawi</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>28,000</td>
<td>180,000</td>
<td>270,000</td>
<td>478,000</td>
</tr>
<tr>
<td>2008</td>
<td>32,000</td>
<td>192,600</td>
<td>283,500</td>
<td>508,300</td>
</tr>
<tr>
<td>2009</td>
<td>33,000</td>
<td>206,100</td>
<td>297,700</td>
<td>540,800</td>
</tr>
<tr>
<td>2010</td>
<td>51,400</td>
<td>220,500</td>
<td>312,600</td>
<td>575,700</td>
</tr>
<tr>
<td>2011</td>
<td>50,000</td>
<td>235,900</td>
<td>328,200</td>
<td>613,100</td>
</tr>
<tr>
<td>2012</td>
<td>53,900</td>
<td>247,700</td>
<td>338,000</td>
<td>639,600</td>
</tr>
<tr>
<td>2013</td>
<td>59,300</td>
<td>260,000</td>
<td>348,200</td>
<td>667,500</td>
</tr>
<tr>
<td>2014</td>
<td>62,200</td>
<td>273,000</td>
<td>358,600</td>
<td>693,800</td>
</tr>
<tr>
<td>2015</td>
<td>71,700</td>
<td>286,700</td>
<td>369,400</td>
<td>727,800</td>
</tr>
<tr>
<td>2016</td>
<td>78,900</td>
<td>301,000</td>
<td>380,500</td>
<td>760,400</td>
</tr>
<tr>
<td>2017</td>
<td>86,800</td>
<td>316,000</td>
<td>391,900</td>
<td>794,700</td>
</tr>
</tbody>
</table>


The table above does not include an increase in fertilizer demand due to the increase in farmland and productivity brought by the Mozambique Tropical Savannah Agricultural Development Project “ProSavana” being developed by JICA under Japan-Brazil cooperation. Therefore, the demand is likely to be higher than the figure released by the Mozambican Ministry of Agriculture.

The Abuja Declaration aims to achieve a fertilizer consumption of 50 kg/ha, 10 times the current consumption in Mozambique, by 2015, and the demand is expected to further expand. Therefore, this justifies the necessity of implementing the project.

2. Basic policy on the contents determination of the project

The Government of Mozambique has been eager to have a domestic fertilizer project for 80 years, and we see no basic obstacles to its implementation. Respecting the plan of Mozambique, understanding its needs and reviewing the contents of the project, we will proceed with the survey.

1 Securing of natural gas
This investigation assumes that 33 million cubic feet/d of gas is secured out of increased production in Pande/Temane gas fields.

2 Construction site
Considering urea shipment and environment, Beira New Industry Area is the site for this investigation.

3 Determination of production quantity based on the urea demand
The Mozambique government plans to sell its urea not only to SADC countries, such as Mozambique at home, Malawi, Zambia and Zimbabwe, but also to South Africa where urea is traded with high prices. Actual demand that urea production quantity in Mozambique, Malawi and Zambia in 2011 is 613,000t. Potential production quantity is 33 million cubic feet/day, which is equivalent to nearly ten percent of the amount of gas production in Mozambique. Moreover, 1,725 MTPD, which is a global standard run quantity, will be the urea production capacity as a first step in the Sub-Sahara.
3. Outline of the project

The outline of the project is as follows.

<table>
<thead>
<tr>
<th>Construction site</th>
<th>Beira new industrial area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>Urea 1,725 MTPD</td>
</tr>
<tr>
<td>Destination</td>
<td>Mozambique at home, Zambia, Zimbabwe, Malawi, etc.</td>
</tr>
<tr>
<td>Raw material</td>
<td>33 mmscfd of production increase in Pande/Temane gas fields</td>
</tr>
<tr>
<td>Process</td>
<td>Ammonia is based on KBR’s technology. Urea is based on Toyo Engineering’s ACES21.</td>
</tr>
<tr>
<td>Utility facilities</td>
<td>The whole quantity of power is to be generated in-house. Industrial water is to be obtained from sea water.</td>
</tr>
<tr>
<td>Offsite facilities</td>
<td>Ammonia tank, urea tank, and 50 km bagging equipment</td>
</tr>
</tbody>
</table>

Figure 1 General view of the plant

Source: Made By the Study team
(1) Project costs estimation
Plant costs and the owner’s costs are as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount of money</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPC cost</td>
<td></td>
</tr>
<tr>
<td>- Ammonia/Urea plant</td>
<td>505 Million USD</td>
</tr>
<tr>
<td>- Utility/Offsite facilities</td>
<td>495 Million USD</td>
</tr>
<tr>
<td>- Total</td>
<td>1,000 Million USD</td>
</tr>
<tr>
<td>Owner’s costs</td>
<td></td>
</tr>
<tr>
<td>Operation start-up cost</td>
<td>67 Million USD</td>
</tr>
<tr>
<td>IDC</td>
<td>51 Million USD</td>
</tr>
<tr>
<td>Contingency costs, etc.</td>
<td>55 Million USD</td>
</tr>
<tr>
<td>- Total</td>
<td>173 Million USD</td>
</tr>
</tbody>
</table>

Made By the Study team

(2) Outline of the result of preliminary financial and economic analysis

The assumptions for preliminary financial and economic analysis are as follows:
- Revenues are calculated based on the urea revenue at the international market price as of December 2011; inflation is added to these prices only during the construction period.
- Urea production quantity is based on the calculation with 1,725t of urea production per day for 330 days/y. The total production of urea is 569,250t per year.
- Cash flows are discounted over a 20-year period.
- Interest rates: Base rate 4%, plus a CIRR (Commercial Interest Reference Rate) of 4.26%
- Depreciation is calculated under straight-line of at around 10% per year.
- Unit price for gas input is 3.16 USD per MMBTU.
- Income tax will be exempted for five years; however, after that the income tax of 32% per year is applied. Import duty and VAT are assumed to be exempted throughout the project period.
- The project site is leased as part of the national property. According to Beira state officials with jurisdiction over industrial complexes, one-time MZN 10 per 1 m² is required for land use. The amount for 20 ha of land is included in the estimation.
- The debt repayment period is assumed to be 8.5 years.

Financial analysis based on the above assumptions shows that FIRR is 15.31% with funds recovery period of six years.

i. Agricultural production increase due to urea supply
Mozambique’s GDP will be 10 billion USD and agriculture will represent 25% or 2.5 billion USD. Thanks to urea supply, agricultural GDP will increase by 5% (0.125 billion USD).

ii. Creation of job opportunities
600 persons will be employed by the operational companies of urea plants. Out of wages in Mozambique at home, 20% is taxed at source. Mozambique’s average wage is MZN 4,000 to 5,000 a month. The economic effect per year will be MZN 4,500 x 0.2 x 600 x 12 / 27 = nearly 240,000 dollars.

iii. Others
The economic effect of the technology transfer to Mozambique will be enormous.

iv. Economic effect
If this project is implemented, EIRR is estimated at 25.26% with a sufficient economic effect.
(3) Examination of environmental social dimension
EIA process, stage and period under Category A based on the Environmental Assessment Act (EIA Regulations 45/2004) in Mozambique are as follows:

Figure 2: EIA process, stage and period

Source: Made By the Study Team
4. Implementation schedule

The schedule negotiated between the investigation team and the Mozambique government is as follows. The detail design, bidding and project implementation are indicated below.

<table>
<thead>
<tr>
<th>Work Description</th>
<th>Year/Months</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feasibility Study (FS)</td>
<td></td>
<td>3</td>
<td></td>
<td>2/23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic and Front End Engineering Design (FEED) with EPC offer</td>
<td>7</td>
<td>6/1</td>
<td></td>
<td>2/31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPC Price Verification and Final Investment Decision</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>3/31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPC Price Verification and Final Investment Decision</td>
<td>12</td>
<td>5/1</td>
<td></td>
<td>4/30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finance Arrangement</td>
<td>6</td>
<td></td>
<td></td>
<td>2/4</td>
<td>7/31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPC Execution</td>
<td>32</td>
<td>6/1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial Operation (Operation &amp; Maintenance)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Made By the Study team

5. Feasibility study

Mozambique has a plenty of demand in urea as a means for promoting agriculture, and also a large amount of urea demand is expected to exist in the regions including the Southern African Development Community. FIRR and EIRR have also cleared the hurdle rate, thus showing potential economical efficiency. As a future measure to be taken in connection with the construction of pipeline, close consultation with the Government of Mozambique is required for realizing the necessary conditions as a joint project of gas allocation and site selection. Our study will also be made on the details of the project while respecting the intention of Mozambique, and also on collaboration with JICA’s ProSavana Project related to the development of fertilizer.

6. Technological superiority of Japanese enterprises

Fund procurement covers debt financing on one hand, and capital stock financing on the other hand. The former closely concerns plant construction and financial contribution by Japanese enterprises, which requires further investigation including the menu on accommodation loan by the Japan Bank for International Cooperation which occupies an important portion of this project.

In addition to the fund procurement of this project, there is a high possibility for Japanese enterprises to be participated in financing with an intention of being involved in the agricultural business and in the petrochemical business. In the first place, participation in the nitrogen-based fertilizer business is contemplated, where capital participation in the project with a view to exporting surplus nitrogen-based fertilizer to India, Australia, China and Japan having high demand recently will ensure preferential handling of products.
In addition to the transactions involving nitrogen-based fertilizer, Japanese enterprises have a chance for capital injection to ensure participation in the petrochemical business. Nitrogen-based fertilizer is made of natural gas, while basic chemical products such as ammonia and methanol can also be produced through similar processes. There remains also a high possibility for capital injection to supply urea as a raw material to high value-added chemical products made from these products. In such a case, however, the product configuration and plant configuration shall be reviewed.

Apart from business participation in the above-mentioned area and others for the purpose of handling exportation-based products, participation in agriculture-related business in the South African regions, where dramatic increase in fertilizer demand is expected will be attracting to Japanese enterprises. It is true that the consumption of fertilizer in this area at present is far smaller compared to that in other regions; a significant growth is expected in future, thus probably providing us with a big business chance.

As for plant construction, materials & equipment will be procured in China, Europe, Japan, Korea and the Southeast Asia. Equipment to be procured in Japan will include rotating machinery such as compressors, packaged equipment such as heat exchangers and boilers, chemicals units, gas turbines and compressors, material transporting equipments such as reclaimers, as well as pipe and special valves.

As for ACES 21 by Toyo Engineering, the sole urea license holder in Japan, the urea synthesis system is simplified with reduced plant construction cost, where operating conditions are optimized to minimize the operation cost, with the following features:

A. Cost saving (compact and equipment installed at a lower position)
   Reduction in construction cost. Installation of synthesis pipe on the ground due to forced liquid feed using a high pressure ejector, Vertical Submerged Carbamate Condenser (VSCC), simplification of synthesis loop, reduction of equipment cost, equipment downsizing by means of two-layer system, and decrease in the number of equipment in synthesis loop.

B. Energy saving (reduction of operation cost)
   Reduction of operation cost will be achieved by realizing low synthesis pressure with the adoption of optimum process conditions.

C. Ease in operation and stability
   Forced circulation within high pressure loop by means of high pressure ejector (no gravitational flow)

D. Reduction in maintenance cost
   Prevention of corrosion by adopting low synthesis system temperature and highly reliable materials.
7. Concrete Schedule Up to Project Realization and Risk to Hamper Realization

Since Mozambique has long desired to establish domestic fertilizer business, it is considered that there is no political and technical problem related to the implementation of the project. Each governmental organization has a fairly good understanding of the importance of domestic production of fertilizer for the purpose of promoting agriculture, and the necessity of enhanced agricultural production to follow. It is also said that the agriculture promotion program is already put in place to increase agricultural production.

After receiving an interest letter from the Ministry of Mineral Resources of Mozambique, Toyo Engineering Corporation and Sumitomo Corporation submitted to this Ministry in June 2011 an MoM (Memorandum of Understanding) focusing on the exclusive study of this project as a fertilizer project to make use of domestic natural gas to be supplied from Pande/Temane in the territory of Mozambique. In this connection, Toyo and Sumitomo are requesting the Minister to sign the MoM, but they are currently discussing in the Government of Mozambique on the pros and cons for signing it.

Securing gas supply is a key point for implementation of the project. The Pande/Temane gas fields are currently under exploration, while this study assumes that production in these gas fields will be increased in 2016. Thus, securing of gas constitutes a vital prerequisite for implementing the project.

Beira new industrial area located in the center of Mozambique is the No.1 candidate site for this project. This area has a commercial port and railways, thus providing easy access to neighboring countries. This commercial port allows importation of plant equipment, heavy machinery required for plant construction and chemicals as raw materials for producing fertilizer. Thus, exportation of products can also be facilitated. The Beira new industrial area is under the control of the government of Sofala Province, but requiring approach to both the central and the local governments. Close consultation with Mozambique is also necessary from the viewpoint of pipeline construction.

As a result of consultation between the Ministry of Mineral Resources and our survey mission, INP has been appointed as the responsible section in charge. However, INP is the organization for controlling the information on petroleum gas in this country, while National Enterprise of Hydrocarbon (ENH) is nominated a candidate as a responsible section in Mozambique in charge of promoting the urea production business in future. It is thus necessary to consult with various organizations concerned including the Ministry of Agriculture, the Ministry of Industry and Trade, and the Ministry of Industry and Commerce.

As Mozambique is regarded as a resource rich country because of the presence of a huge gas field in Rovuma in the north, future consultation with the Japan Bank for International Cooperation will be promoted on the basis of the result of this study to ensure financing. As for capital injection, future consultation will be necessary with National Enterprise of Hydrocarbon (ENH), Mozambican Hydrocarbon Company (CMH) that shows interest in fertilizer and the related government ministries of Mozambique (Ministry of Mineral Resources, Ministry of Agriculture, Ministry of Industry and Trade, as well as Ministry of Industry and Commerce).

As for the above issues, our survey mission will make approach to leaders of the Government of Mozambique, so as to proceed with the project execution.
8. Map indicating the project site in the surveyed country

Figure 3: Overall map of Mozambique

Source: Google
Figure 4: Proposed construction site

Source: Google