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BACKGROUND DOCUMENT

REGARDING

IDENTIFICATION OF OPPORTUNITIES

FOR

AFRO-ASIAN COOPERATION

IN

FERTILIZER INDUSTRY

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GENERAL MANAGER(TECHNICAL)

NATIONAL FERTILIZER CORPORATION OF PAKISTAN(PVT.) LIMITED  
1ST FLOOR, ALFALAH BUILDING, SHARAH-E-QUAID-E-AZAM,  
LAHORE, PAKISTAN.

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1. F O R E W O R D

1. This background document is prepared for the Asian Preparatory Meeting for the African Regional Consultation on Phosphatic Fertilizer & Pesticide Industries to be held in Lahore, Pakistan: October 17-20, 1988.
2. The Asian Preparatory Meeting is one of the Regional Consultation Meetings on the Fertilizer & Pesticide Industry. Four consultations have been convened so far. These meetings have, inter-alia, examined and drawn conclusions and formulated recommendations with respect to:
  - Contract procedures and arrangements intended to ensure the successful construction and operation of fertilizer plants;
  - Ways and means to reduce the high cost of fertilizer plants including their operational and maintenance requirements;
  - Continuous monitoring of the global pattern of fertilizer production and consumption in order to facilitate investment, procurement and other decision making in the sector;
  - The opportunities for co-operation between developing countries at the sub-regional, regional and inter-regional levels and the international support needed for that co-operation;
  - Strengthening technological capabilities in developing countries in the fertilizer sector;
  - Exploring technological alternatives more suitable to the conditions of developing countries. One such alternative is the mini-fertilizer plant.

In accordance with a recommendation of the Fourth General Conference, that special attention be given to industrial problems and co-operation between developing countries in Africa and with the decision taken at the second session of the Industrial Development Board, a regional consultation in Africa on phosphatic fertilizers and pesticides industries will be convened at Yamassoukro, Cote d'Ivoire 12-16 December, 1988.

3. A Global Preparatory Meeting for the regional Consultation was held in Lome, Togo, from 3 to 6 February, 1988.

The immediate aim of the Global Preparatory Meeting, attended by some 60 African and International experts, was to advise the UNIDO Secretariat on the selection of priority issues for consideration at the Regional Consultation.

4. The Preparatory Meeting for the Regional Consultation on Phosphatic Fertilizers and Pesticides Industry in Africa, recognizing the existence of serious constraints in the development of the fertilizer sector in Africa, adopted the following recommendations:

- 4.1 Given that no lasting and effective solution to the problems of the fertilizer industry and the development of fertilizer application can be found unless an agricultural policy is clearly defined and applied, the governments of the countries of the African continent should accord the highest priority to the formulation and implementation of their national agricultural policy;
- 4.2 Considering the importance of the wealth of information required to manage the fertilizer sector efficiently as well as the positive experience gained in other parts

of the world, it is recommended that an African centre for information on fertilizers be set up as soon as possible and that national systems for amassing the information should be improved and upgraded;

- 4.3 Considering that the choice of a fertilizer development strategy encompasses a large number of factors, it is recommended that the solution to the problems of the fertilizer industry in Africa should be tackled by decision-makers and sponsors of national and international funds within an integrated approach (industry, agriculture, trade, infrastructure, transport, finance, training and legislation);
- 4.4 In view of the opportunities for complementarity existing between African countries, it is advisable to encourage and facilitate the establishment and development of co-operation between the African countries which have already acquired a certain skill in dealing with problems relating to the production and distribution of fertilizers (Tunisia, Algeria, Morocco, Senegal) and other African countries wishing to develop their resources;
- 4.5 In view of the high cost of engineering and its impact on the profitability of fertilizer plants and in order to allow for specific African features, the industrialized countries and the international organizations concerned are called upon to help with the development of national and/or regional engineering capabilities;
- 4.6 In view of the desire of African countries to develop their resources and to have access to a fertilizer industry that is profitable and suited to their needs, it is advisable to promote a subregional and regional approach to industrial projects so as to provide them with a sound basis;

- 4.7 That the competent multilateral organizations, such as UNIDO should support the mini-plant projects envisaged in certain countries until the stage of completion, in order to test the feasibility of such projects. Similarly, the industrialized countries are called upon to lend financial and technical support for the design and construction of these plants when the conditions are satisfactory;
5. Objectives of the Preparatory Meeting as laid down in the Aide-Memoire of January, 1988 are:
    - 5.1 To exchange information on and experience in, the planning, design, construction and operation of phosphate mines and phosphatic fertilizer plants in developing countries and particularly in Africa;
    - 5.2 To identify the problems confronting the phosphate and phosphatic fertilizers industry and examine possible solution in the light of regional co-operation between Asia and Africa;
    - 5.3 To encourage contacts with a view to co-operation on the basis of long-term arrangements covering joint ventures, technical assistance, the supply of raw materials and marketing;
    - 5.4 To identify in specific terms and in order of priority the key issues to be referred to the Regional Consultation on the Fertilizer Industry in Africa.
  6. Specifically the meeting should achieve the following results:
    - 6.1 An exchange of information and views on the problems and development of the phosphate-based industry in Africa;



- 6.2 A presentation of achievements and experience in the improvement of the technological and economic features of enterprises producing phosphatic fertilizers;
  - 6.3 The formulation of a framework and specific proposals for the promotion of technical and commercial co-operation between African and Asian countries with the assistance of the industrialized countries and specialized international organizations.
7. In this paper, efforts have been made to identify opportunities for Afro-Asian Co-operation in all stages of fertilizer industry.
  8. This paper has been prepared on the basis of the Terms of Reference attached as Annex-A.

2. I N T R O D U C T I O N

1. Most of the Asian as well as African countries fall among the Least Developed Countries (LDC's) or the developing countries. A list of these countries in African and Asian regions is attached at Annex-B.
  
2. Fertilizer use in African region is low and varies largely. Several factors, i.e. technical, economical, political and institutional are responsible for such low level use. The total fertilizer production in African region has seen very little growth in the eighties. Therefore the gap between production and consumption has increased with time and most of the African countries have become dependent on imports. Most of the production of fertilizer has concentrated in only a few countries, namely Algeria, Morocco, Senegal, Tanzania, Tunisia and Zimbabwe. The gap between production and consumption is expected to become larger unless decisions are made and implemented to promote economically and socially viable production facilities in African region at the earliest.

At the country level, however, the size of fertilizer market is very small. Therefore, the C.I.F. prices of fertilizer imports are 30 to 50% higher in African region than in Asia.

3. It appears appropriate here to make reference to the Seminar on Mini Fertilizer Plants held from 15-20 November, 1982 in Lahore, Pakistan. The concept of Mini Fertilizer Plants did not get importance on account of wide variety of factors but mainly because of the fact that excess fertilizer capacity was available world-wide. World supply situation is expected to be in deficit in year 1990-91/92. Hence it is necessary and timely to review the conclusions and recommendations made at the conclusion of the Seminar. For the sake of reference the recommendations have been attached at Annex-C.

4. It may be useful to review at this stage the phosphoric acid plant list (source: Report of the working group of World Bank FAO/UNIDO dated July 18, 1988). This list is placed at Annex-D and represents African and Asian countries. The cumulative total phosphoric acid plant capacity in the year 1987-88 has been provided.
5. Developing countries can overcome most of their economic problems by unity among themselves and it would go a long way in strengthening the world economy in a larger perspective. Developing countries can establish joint ventures on bilateral basis for which the competent country's know-how, machinery, raw materials and semi processed goods can be used. The capital exporting countries can finance these projects through grant and aid or low interest bearing loans as the long term solvency depends directly on the cost of loan.
6. Japan with huge trade surplus can play a very vital role in the development of both Asia and Africa. It is one of the most industrialized countries and can no doubt provide technical and economic assistance in all activities of fertilizer industry.
7. Due to better literacy rate, Asian region has developed itself into a technologically capable region and therefore can assist most of the African region countries in a much better way and at an economical cost.
8. Authors feel that this study cannot be a comprehensive study as neither the time frame allocated for this study nor information available can permit to complete the study. Authors would therefore like to recommend that a detailed study may be carried out after the Asian Preparatory Meeting for African Regional Consultation on Phosphatic Fertilizers and Pesticide Industries.

9. A list of the consultants in the Asian region is attached at Annex-E. This list is not very exhaustive but can be used as an indicative reference (Source: Directory of Sources of fertilizer related information with special reference to Asia. An ESCAP/FAO/UNIDO publication).
  
10. The subsequent chapters shall discuss capabilities in various areas, one by one.

3.           DISCUSSIONS OF TECHNOLOGICAL  
CAPABILTIES OF ASIAN COUNTRIES

### **3.1 Techno-Economic Feasibility and Investment Studies**

Asian regions possess good capabilities with respect to Techno-economic feasibility and investment studies. Japan and Korea are good example where such facilities are available. In addition facilities are also being developed in newly developing countries such as India and Pakistan. These countries therefore are in a good position to render services for feasibility and investment studies. As an example, India and China have highly developed research facilities and are actively engaged in research for the upgrading of low grade phosphatic ores. India can therefore, contribute effectively towards the development of phosphate rock based Fertilizer Projects. More recently, Pakistan has also established a Fertilizer Research and Development Centre for this purpose.

In Africa, Tunisia has developed its own process to utilize low grade phosphate rock for manufacture of phosphoric acid (SIAPE process). They are capable to supply basic engineering through their own design company. Many consultants from both regions are registered with such capabilities with financial institutions like Asian Development Bank, World Bank as well as with UN bodies like UNIDO for providing the above mentioned services.

In order to develop local expertise it is necessary that the feasibility and techno-economic studies be carried out in close association of local counter-parts. Pakistan has recently introduced a law making it mandatory for foreign consultants to associate local consultants to an extent of 30%. Similar laws could be framed by other developing countries.

**3.2 Process design, basic and detailed engineering**

Transfer of technical know-how cannot be completed without the knowledge of process design, basic and detailed engineering. Proper analysis of limitation of the plant capabilities can be made by thorough analysis only if expertise is available in these areas. India, China and Korea have developed expertise in this area to a large extent. These facilities have been developed with the assistance of industrialized countries such as Japan, Europe and United States and therefore the quality of process design, basic and detailed engineering available in these countries is comparable with those in the developed countries. China and India have made a big head-way in developing its own know-how because of their planning to create a technological base for the development of industry. Pakistan also has capabilities in this area but its development has been slow. There is a need to develop such facilities in African countries so that they can also achieve self-reliance as far as possible.

In order to achieve self-reliance in this area, the developing countries should make it a point to depute their experts in the office of the engineering licensors and engineering contractors where any projects has to be executed.



**3.3 Project Management, Procurement,  
Construction and Inspection Services**

During the past twenty years, large scale fertilizer projects have been established in China, India and Pakistan which has developed these countries in developing capabilities in Fertilizer Project Management such as procurement (under guidelines of various financing agencies) construction and erection, project cost control, production cost control, planned and preventive maintenance, manpower training, optimization etc. It is now within the capability of these countries to utilize their experience in promoting and establishing similar facilities in African countries. The capabilities in the inspection area however, cannot be categorised as of very good standard as those of international companies. This is because of the high cost of the testing equipment and their availability.

**3.4 Plant start-up, commissioning and operation.**

Because of much higher literacy rate in the Asian regions compared to African, the capabilities in this area are of course enormous. Korea, India and Pakistan have taken up various assignments in Gulf, Middle East and Saudi Arabia and it can be said without hesitation that the requirement of African region in this area can be easily met. It will be worth-while to state that many African countries are already enjoying the benefits of trained man-power from India, Pakistan and Korea.

Indian, Pakistani and Korean expatriates are working in African countries on individual basis as well as through government to government and through assignment from various consultants and contractors.

**3.5 Market Development, Marketing and Distribution**

In this area, Asian region has versatile experience. Most of the Asian countries are capable to provide assistance to the African region to their entire satisfaction.

It should however be borne in mind that market development, marketing and distribution system largely depends upon adequacy of the infrastructural facilities in each country.

Pakistan and India have developed this expertise and are now self dependent. They have attained this expertise from ab-initio; through research and development in marketing, training and field work.

This experience can be exchanged with African region where practically similar conditions exist.

**3.6 Maintenance, technical  
back-up and spare parts**

Asian countries have developed good expertise in the maintenance of the plant and equipment, although there is a lack of sense of preventive maintenance. Various parts are used many times after repair simply because of the high cost of the new spare parts.

It is important to develop resources to produce spare parts of general equipment and machinery, locally, in order to avoid high costs and assured availability. Because of the rapid advancement in technology, spare parts of many machines are either not available after some length of time or if available are at very high price.

It is proposed that the developing countries should obtain all the manufacturing drawings of spare parts at the time of purchase as well as agree with the supplier regarding local fabrication of spare parts.

There is also a need to undertake standardization as far as practicable within the country level if not at the regional level.

**3.7 Capabilities with respect to the Establishment of facilities for research and development, testing, inspection, quality control etc.**

Although some Asian countries possess capabilities in this area but they cannot match international standards due to lack of sophisticated equipment and techniques in this area. However, the basic training and orientation for establishment of such facilities can easily be undertaken by the Asian countries.

Apart from Japan and Korea, research facilities in newly developing countries are not highly organized. China and India have made considerable head way in developing their own research programmes. However, there is a need to develop such facilities within African countries where trouble shooting problem specific to each plant and country can be solved because such problems cannot be referred to other countries due to the urgency associated with their solution.

Before undertaking research projects, the developing countries should weigh the merits of purchase of a know-how or technology through licenses for modification and improvement to suit their needs rather than searching for already available developed processes and technologies.

3.8 Manpower training facilities

Most of the Asian countries have established many Technical Training Centres or Training Institutes. China, Korea, India and Pakistan could be the countries from where African region countries can get benefit in different fields specially in the phosphatic fertilizer industries. The operating plants could also be a good training ground. Asian countries can provide this service at very low rates compared to the developed countries.

Developing countries can also make use of UNIDO's publication: Guide to Training Opportunities for Industrial Development, 1988 (PI/101 October, 1987).

### 3.9 Joint Ventures

The joint ventures are one of the best ways to use each others capabilities. Many African region countries possess phosphate rock raw material which would be the potential source for setting up of phosphatic fertilizer plants in the Asian region. Middle income developing countries of the African and Asian regions can also make investments into low income countries. Countries deficient in the raw materials can set up plants where relevant raw material is available and arrange agreements to market their production in the consuming countries.

India has taken up steps to set up joint venture plants in Gulf and Middle East in order to cater for their own market demands.

Technical co-operation between Afro-Asian countries is also beneficial for the solution of each other's problems which can be achieved by exchange of personnel, holding of joint technical seminars and meetings.

Needless to say that without the assistance of developed countries and international financial institutions, many joint ventures cannot be materialized.

**3.10 Barter and counter trade agreements**

Many developed countries have made barter and counter trade agreements with the developing countries. There is need to undertake proper research so that each country can identify how they can utilize each others raw materials, resources and capabilities to the maximum. Following materials are suggested to promote counter trade among Afro-Asian region:

- ~ Setting up of joint commission by each country within Afro-Asian region.
- ° Setting up of Afro-Asian Chamber of Commerce and Industry.
- ° Utilization of international bodies like UNDP (United Nations Development Programme), TCDC (Technical Cooperation among Developing Countries), OIC (Organization of Islamic Countries etc.).
- ° Setting up of an organization to promote the cooperation for the development of phosphatic fertilizer in Afro-Asian region.
- ° Liberal aid and cheap credit facilities by developed countries with transfer of know-how.



### 3.11 Market Sharing

India is reportedly setting up plants in the gas rich countries (where cheap gas is available as raw material) and making necessary arrangements to share the market for India's consumption at international competitive prices. Similarly many industrially developed countries are making investments and making necessary agreements to lift the production for their own consumption or consumption of other markets in order to remain competitive in the international market. Since fertilizer consumption in the African countries is limited, sizable plants in these regions could be set up for their marketing in Asian countries where its demand is rising.

**3.12 Balancing, Modernization and Rehabilitation of Fertilizer Plants**

Many developing Asian countries have acquired vast experience of rehabilitation of fertilizer plants as they had to undertake rehabilitation of their own fertilizer plants in order to reduce the cost of production. They are therefore best suited to assist African countries in execution of rehabilitation projects.

It would be kept in view that from 1982 onwards, when no new fertilizer plants were set-up, emphasis shifted to balancing, modernization and rehabilitation of the existing fertilizer plants. This was done to reduce the cost of production, through energy conservation, optimization, inventory control and capacity expansion of the fertilizer projects.

4. INDIVIDUAL ASIAN COUNTRY DISCUSSION.

1. Peoples Republic of China:

Peoples Republic of China is a big producer of fertilizer. It produces all kinds of fertilizers, nitrogenous, phosphatic, potassic and other micro-nutrients.

China has developed its own processes, technologies for fertilizer, catalyst and other chemicals manufactured for fertilizer industry. A full range research, design, basic and detailed engineering, consulting, various types of equipment and machine design and manufacturing facilities are available in China. China has supplied complete fertilizer plants to a few developing countries including Pakistan. All research institutions, design, engineering and plant construction organizations are Government Agencies.

A list of China's Agencies dealing in the fertilizer field is given in Annex-E.

2. Hong Kong:

Hong Kong is basically a trade center. It does have a few fertilizer plants. There are a number of fertilizer process and plant supplier companies which operate in Hong Kong. There is no sizeable fertilizer plant manufacturing capacity/ capability of its own.

3. India:

Being a potential user of fertilizer, India has made great strides in the development of its fertilizer industry. There are a number of public and private companies which provide consultancy/technical advisory services. There are a large number of research institutions which provide extension services country-wide and to other developing countries.

India's capabilities of fertilizer plant manufacture are also worth mentioning. There are a few companies which now provide design, detailed engineering, procurement, project management, start-up, commissioning and operational assistance services related to the fertilizer industry. India is also producing catalysts for the ammonia plants. About 60% of fertilizer plant equipment is now being fabricated within India. Only the sophisticated equipments and instrumentation are being imported.

India could be a potential source for technology transfer and assistance to other under-developed countries.

4. Indonesia:

Indonesia is a country which produces and supplies fertilizers country-wide. There are a number of research organizations, laboratories and institutions which provide research facilities for agriculture and fertilizers. A number of foreign affiliated companies are operating in this country which provide/supplies processes and plants. These companies like their parent firms offer processes for fertilizer manufacture, basic and detail engineering, consulting services, procurement, construction, start-up, pre-commissioning and operation and management of fertilizer plants.

Indonesia is a country which could be considered for providing assistance in establishment of research and development centres.

5. Islamic Republic of Iran:

The major activity of the firms in Islamic Republic of Iran is limited to the production and supply of various fertilizers. A few foreign affiliated companies operate in Iran as process and plant suppliers.

Iran at present cannot be considered as a source for technical assistance to other countries in the field of fertilizers.

6. Japan:

Japan is a potential source of processes, technology, plants, equipment, machinery and all services needed from inception to completion of fertilizer projects. There are a number of world renowned companies which offer services on turn-key basis.

A detailed list of Japanese companies is given in Annex-E for reference.

7. Republic of Korea:

Korea is a cheaper source of plant, machinery, equipment and services compared with Japan for the fertilizer industry. It could therefore be considered as a potential source of supply of plant and machinery for under-developed and developing countries.

It has been experienced that prices of some of the equipment and machinery from Korea is 200 to 300% less than those supplied from Japan and European countries.

8. Nepal:

Nepal is an under-developed country and as such does not have sufficient technical capabilities in the field of fertilizer manufacture.

9. Pakistan:

Pakistan being an agricultural country, produces large volumes of various types of fertilizers. It has acquired various modern technologies for the fertilizer manufacture.

The process design, detailed engineering and other related service facilities are limited. Pakistan is however a good source of skilled man-power supply for the fertilizer industry. (The capabilities of Pakistan are further discussed in Section 5 separately).

10. Philippines:

Philippines have a number of fertilizer research and development institutions. It is a country which also produces fertilizer for its indigenous use.

11. Saudi Arabia/UAE and Qatar:

These countries are fertilizer producers and suppliers and do not possess sufficient technical capabilities for assistance to other countries in the field of fertilizers.

12. Singapore:

Singapore like Hong Kong is another trading center of Asia. There are few fertilizer producer/supplier companies operating in this country. In addition a number of foreign companies have their offices in Singapore from where they supply processes, plants and services.

13. Taiwan:

Taiwan does not have sufficient technical capability in the field of fertilizers for assistance to other countries.

14. Thailand:

There are only a few fertilizer plants in this country. However, a number of research and development institutions operate in this country which provide extension services for other countries in addition to their own demand.

5. PAKISTAN'S CAPABILITIES



Pakistan has the following capabilities, in broad terms:

- Techno-economic feasibility and investment studies.
- Limited basic and detailed engineering.
- Project Management, procurement and construction services.
- Plant start up, commissioning and operation.
- Maintenance, technical back up and spare parts.
- Market development, marketing and distribution.
- Capabilities with respect to establishment of facilities for research and development, testing, distribution and quality control etc.
- Man-power training facilities.
- Industrial maintenance and rehabilitation of fertilizer plants.

Pakistan's largest organization in fertilizer sector is the National Fertilizer Corporation of Pakistan(Pvt.) Limited (NFC). NFC is a public sector organization and is not committed to any interests of specific licensors, manufacturers or contractors. NFC is therefore free to impartially recommend the best possible solutions from purely technical and economical point of view, the most suitable technical and the best qualified Engineering Contractor for setting up of grass root fertilizer complex.

The staff of NFC has long experience that has evolved during the successful implementation of its large fertilizer units like Pakarab, Paksaudi and Pak China Fertilizers Limited.

Based on NFC's experience in the construction, commissioning and operation of modern fertilizer plants NFC can provide:

1. Project Monitoring and Advisory Services:

- Feasibility studies.
- Prequalification and engineering contractor selection.
- Bid evaluation.
- Preparation of contract drafts.
- Selection of Engineering Contractor.
- Contract negotiation assistance.

2. Project Progress Control:

Monitoring progress of projects during process design, engineering, procurement, erection, commissioning, spare parts recommendations and start up phase.

3. Procurement Supervision:

Reviewing of procurement procedures, inspection of critical equipment, securing of guarantee.

4. Construction Supervision:

- Planning and phasing of construction activities.  
Progress monitoring and quality control.
- Start up and acceptance supervision, phasing and monitoring of pre-commissioning and start up activities.

- Acceptance supervision and carrying of guarantee tests.

5. Operation Management

- NFC can assist in complete plant organization system.
- Provide management assistance for running of ammonia, urea and other fertilizer plants.
- Complete maintenance organization system covering preventive maintenance, scheduling and debottlenecking.
- Workshop organization (Mechanical, Electrical, Instrumentation).
- Formulate process control, quality control inspection and safety system.

6. Material Management:

Raw material and spare parts planning and handling.

7. Training and Training Management:

NFC has established a Technical Training Centre at Multan to meet the requirements of skilled and trained man-power in the areas of operation and maintenance of chemical industry. M/s. COSMO International Co. Limited, Japan were engaged as consultants.

The Centre started operation from 1st September, 1985. The training system and methodology adopted at the Centre imparts both knowledge and skill to the trainees. The purpose is achieved by delivering lectures followed by practical training in laboratories and workshops. In addition, a miniature plant has been installed which provides training on most of the unit operations used in chemical process industries.

The Centre has a capacity of training 90 operators/technicians which include 20 mechanical, 20 instrumentation, 10 electrical technicians and 40 operators.

In addition Industrial Management Courses for 60 front line supervisors and induction programmes for fresh graduate engineers and short term programmes for graduate engineers in different disciplines have been developed and are being conducted.

9. National Fertilizer Marketing:

National Fertilizer Marketing Limited (NFML), a subsidiary of the National Fertilizer Corporation of Pakistan, is the largest fertilizer marketing company in Pakistan. The company has by far the biggest dealer network of about 2600 dealers who ensure convenient and timely availability of fertilizers to the farmers. NFML pioneered in more than one way. It was the first company to operate in every region of the country, the only one to market indigenous phosphatic fertilizers in the country and the first to undertake export of locally produced nitrogenous fertilizer.

The company backs up its sales with agronomic services. Field Agronomists serve the farmers by rendering them practical advice on farm management and modern agricultural practices. It publishes a quarterly magazine in which recommendations on increasing crop production and proper use of fertilizers are made.

The experience in this field can be shared with friendly countries in Africa.

**NFMI. is fully capable of advising and managing on:**

- **The marketing and even distribution of fertilizer at the lowest cost.**
- **Providing technical and agronomical services to the farming community and to conduct technical research for increasing the use of fertilizer.**
- **Organizing market segments and regulate sales of products.**

**The NFML's experience can therefore be utilized by the African countries.**

6. CONCLUSIONS AND RECOMMENDATIONS

**6. Conclusions and Recommendations:**

- 6.1 A list of reliable consultants/contractors of Asia and Africa needs to be prepared.**
- 6.2 A list of companies which could provide man-power training and management may be developed.**
- 6.3 The committee should identify joint venture programme between Asian and African countries.**
- 6.4 Raw materials, their use, process development and assistance and co-operation available among various countries should also be identified.**
- 6.5 The committee may also define the cost of services from Asia and Africa.**
- 6.6 Measures to promote barter trade among the Afro-Asian countries should be identified.**
- 6.7 A roster of experts for both Asian and African regions need to be developed.**
- 6.8 A detailed study should be conducted under the auspices of UNIDO to identify all areas of co-operation among Afro-Asian countries in the fields of fertilizer and pesticides.**

A N N E X E S



**Asian Preparatory Meeting for the African  
Regional Consultation on Phosphatic Fertilizers  
and Pesticides Industries**

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**TERMS OF REFERENCE**

**An assessment of Asian technological and engineering capabilities related to fertilizer industry, viewed from the specific angle of its potential contribution to the development of the sector in Africa. The study should cover technical capacities available in Asia in respect to:**

- **techno-economic feasibility and investment studies;**
- **process design in addition to basic and detailed engineering;**
- **project management, procurement, construction and inspection services;**
- **plant start-up, commissioning and operation;**
- **maintenance, technical back-up and spare parts;**
- **market development, marketing and distribution;**
- **capabilities with respect to the establishment of facilities for research and development, testing, inspection, quality control, etc.;**
- **manpower training and facilities.**

**The study should be conceived to lead to conclusion and identification of opportunities for Afro-Asian co-operation in all stages and fertilizer activities.**

**In this effect topics such as joint-ventures, barter and counter trade agreement , market sharing, training programmes, industrial maintenance and rehabilitation of fertilizer plants, etc. should be given adequate exposure.**

LIST OF ASIAN COUNTRIES  
(Least developed or developing)

Afghanistan	Malaysia
Bangladesh	Nepal
Burma	Pakistan
China, P. Republic	Philippines
India	Sri Lanka
Indonesia	Taiwan
Iran	Thailand
Jordan	U.A.E.
Korea, Republic	

LIST OF AFRICAN COUNTRIES  
(Least developed or developing )

AFRICA:

Algeria  
Egypt  
Libya  
Morocco  
Tunisia

SUB-SAHARAN AFRICA

Angola	Mali
Benin	Mauritania
Botswana	Mauritius
Burkino Faso	Mozambique
Burundi	Niger
Cameroon	Nigeria
Central African R.	Reunion Islands
Chad	Senegal
Congo	Seychelles
Cote d'Ivoire	Sierra Leone
Ethiopia	Somalia
Gabon	Sudan
Gambia	Swaziland
Ghana	Tanzania
Guinea Bissau	Togo
Guinea	Uganda
Kenya	Zaire
Lesotho	Zambia
Liberia	Zimbabwe
Madagascar	
Malawi	

**CONCLUSIONS AND RECOMMENDATIONS OF  
SEMINAR ON MINI FERTILIZER PLANTS**

1. The Seminar recommended that UNIDO should examine the domestic fertilizer requirements of developing countries from the agronomic, economic and social conditions prevailing and to classify the countries into those which would require mini fertilizer plants either in the near future or within 10 years. The countries should also be classified, where possible, on the type of fertilizers required.
2. The Seminar recommended that UNIDO should collect and provide estimates of the cost of such plants and the finances which will be required for such purposes.
3. The Seminar recommended that in evaluating mini fertilizer plants and particularly when comparing them with large plants, UNIDO should not only consider the battery limits costs of manufacture but should also consider other relevant factors such as the availability of raw materials, the shorter construction period, the smaller infrastructure required, the possibility of longer on-stream days per annum and the local availability and training of personnel. In addition, the transport costs and difficulties of movement of raw materials and fertilizers should also be examined and the costs of fertilizers should be compared on a farm delivered price.
4. The Seminar noted that developing countries which now have an advanced fertilizer industry commenced with mini plants and in several of them mini plants still have a substantial share of their total capacity. The Seminar recommended that countries which are establishing plants for the first time should duly consider the possibilities of commencing production with mini fertilizer plants in order to be better prepared for the absorption of technology for further development.
5. The Seminar recommended that UNIDO should prepare a guide to mini fertilizer plants in order to enable planning and other organisations in developing countries to consider mini plants as a possible alternative for the development of the fertilizer industry.

**Ammonia**

6. The Seminar recommended that since ammonia is the base of all nitrogenous fertilizers and of NP fertilizers, UNIDO should carefully examine all available technologies for the production of ammonia. The Seminar suggested that UNIDO should confine its attention to plants of 100 tons/day and upto 250 tons/day as mini plants. In comparing technologies, both minimum-investment and minimum-energy evaluations should be considered.

7. The Seminar noted that acceptable modern technology was available for plants of 200-250 tons/day of ammonia, but technology for smaller plants (100 tons/day) may need further development. The Seminar recommended that UNIDO should study the newer designs of the latter size of plant and take appropriate action if found inadequate.
8. The Seminar suggested that the ammonia plants considered should be based upon natural gas, coal and residual fuel oil as feed stocks. The use of electrolytic hydrogen as a feed stock should also be studied.

#### Nitrogenous Fertilizers

9. The Seminar recommended that UNIDO should consider the production of urea, ammonium sulphate, ammonium nitrate calcium ammonium nitrate and ammonium bicarbonate for techno-economic appraisal and for comparison with large plants. The plant sizes to be considered should match the ammonia plant sizes given in 6 above, except for ammonium bicarbonate which should be based upon integration with a 60 tons/day ammonia plant.
10. The Seminar considered that sufficient technological developments had taken place on mini plants for nitrogenous fertilizers to make such plants economical for establishment in developing countries. No new process technology would be required for this purpose.
11. The Seminar recommended that UNIDO should study the storage and utilization of ammonium bicarbonate on soils outside China, as the product was a low cost fertilizer which had only been tried in China so far.

#### Phosphate Fertilizers

12. The Seminar recommended that UNIDO consider the following phosphatic mini plants for a techno-economic appraisal:
  - (a) Single superphosphate plants (300 tons/day).
  - (b) Triple superphosphate plants (100 tons/day).
  - (c) MAP and DAP plants (100 tons/day and 200 tons/day).
  - (d) Nitrophosphate plants(200 tons/day, 60% water soluble).
  - (e) Phosphoric acid plants to match the requirements of (b) and (c) above.
13. The Seminar considered that there was no particular need for any additional process design studies for phosphates, as economic processes were currently available for such plants.

14. The Seminar recommended that countries which had statutory regulations covering the strength of fertilizers should modify them in such a way that the strength stated on the bag should be sufficient.

Potash Fertilizers

15. The Seminar recommended that UNIDO study the techno-economic production of potash from sylvinite and carnallite in plants with a capacity of 50 tons/day. Processes for such plants were currently available but should be compared.
16. The Seminar suggested that UNIDO study the extraction of potash from biomass and other industrial by-products. The plant sizes to be considered should be flexible and based upon the availability of raw materials.

NPK granulations

17. The Seminar recommended that UNIDO should make a techno-economic study of NPK granulation plants with a capacity of 100 tons/day. Several processes are available for this purpose and the Seminar recommended that no new processes need to be considered.

PHOSPHORIC ACID PLANT LIST  
ASIA AND AFRICA

Plant Capacity  
('000 Tons P<sub>2</sub>O<sub>5</sub>)

Country/Company:

1987-88

JAPAN

◦ Asahi Glass	23
◦ Central Glass	131
◦ Chisso	25
◦ Co-op Chem.	111
◦ Mitsubishi Chem. Ind.	32
◦ Nippon Phosphoric Acid	84
◦ Nissan Chem. Ind.	29
◦ Toyo Rinsan	98
◦ Toyo Soda Mfg.	17

ALGERIA

◦ Alsoidal	165
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MOROCCO

◦ OCP-Maroc Chimie	297
◦ OCP-Maroc Phosphore	2475

SENEGAL

◦ ICS	253
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TANZANIA

◦ Tanzania Fertilizer	25
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TUNISIA

◦ ICG	150
◦ Ind. Chim. Maghrebines	412
◦ Ste Arbe d'Engrais Phos	330
◦ Ste Ind. Acid Phosphor	460

ZIMBABWE

- Ziambabwe Phosphate 20

CYPRUS

- Hellenic Mining/CCF Ind. 40

EGYPT

- Abu Zaabal Fert. & Chem. 65

IRAN

- Razi Chem. 215

IRAQ

- State Org. for Minerals 416

JORDAN

- JPMC 410

LEBANON

- Lebanon Chem. 99

SYRIA

- Syrina Government 160

TURKEY

- Akdeniz Gubre Sanayii 71
- Guebre Fabrikalari T.A.S. 148
- Iskur (Bagfas) 145
- Tugas 177

BANGLADESH

- BCIC 56



INDIA

◦ Coromandel Fert.	104
◦ Albright/Morarji & Pandit	16
◦ E.I.D. Parry	10
◦ Fert. Chem. Travancore	144
◦ Gujrat State Fert.	54
◦ Hindustan Zinc	26
◦ Hundistan Lever	42
◦ Rashtriya Chem. & Fert.	33
◦ Southern Petrochem	53

INDONESIA

◦ Petro Kimia	180
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KOREA

◦ Chin Hae Chemical	66
◦ Nam Hae Chemical	210
◦ Yong Nam Chemical	116

PHILIPPINES

◦ Atlas Fertilizer	12
◦ Philphos	360

CHINA P.R.

◦ Nanjing Complex	15
◦ Haikou	36
◦ Small Plants	5

TAIWAN

◦ China Phosph. Ind.	33
◦ Taiwan Fertilizer	10

Total(Asia & Africa)	<u>8664</u>
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**LIST OF CONSULTANTS WHICH CAN  
PROVIDE TECHNICAL ASSISTANCE**

<b><u>S.No.</u></b>	<b><u>Name of the Company</u></b>	<b><u>Major Activity</u></b>
	<b><u>CHINA</u></b> (People's Republic)	
1.	China Economic & Trade Consultants Corporation	Consulting Firm
2.	China National Complete Plant Export Corporation	Plant/Machinery Supplier.
	<b><u>INDIA</u></b>	
3.	Catalysts & Chemicals (West Asia) Limited. (Subsidiary of a Foreign Company).	Process and Plant Supplier.
4.	Haldor Topsoe International A/S (Subsidiary of a foreign company)	Process and Plant Supplier
5.	Kinetics Technology India Limited.	Process and Plant Supplier.
6.	Uhde India Limited (Subsidiary of a foreign company).	Process and Plant Supplier.
7.	Andhra Pradesh Industrial and Technical Consultancy Organization (APITCO).	Consulting Firm
8.	Atucom R&D Centre, Atul Consultants(P) Limited.	Consulting Firm/ Research Institution
9.	Central Fertilizer Quality Control & Training Institute	Governmental Agency University/Research Institution.
10.	Central Institute of Fertilizer Technology	University/Research Institution.
11.	Dharamsi Moraji Chemical Co. Limited.	Consulting Firm
12.	Engineers India Limited	Process and Plant Supplier.
13.	Fact Engineering & Design Organization (FEDO).	Consulting Firm/ Process and Plant Supplier.

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| 14. | Fertilizer Development & Consultation Organization (FDCO).   | Consulting Firm                         |
| 15. | Indian Council of Agriculture Research (ICAR)  | University/Research Institution         |
| 16. | Kerala Industrial & Technical Consultancy Orgazation(KITCO).   | Consulting Firm                         |
| 17. | Larsen + Tourbo Limited  | Process and Plant Supplier.             |
| 18. | Projects & Development India Limited. The Fertilizer (Planning & Development) India Limited(P&D).          | Consulting Firm                         |
| 19. | Steel Authority of India Ltd.  | Process and Plant Supplier.             |
| 20. | Tata Klochner Industrial Plants Limited.   | Process and Plant Supplier              |
|     | <u>INDONESIA</u>   |   |
| 21. | Gadjah Mada University Faculty of Agriculture(Gama).   | University/Research Institution.        |
| 22. | Institute for Research & Development Industry Agency for Industrial Research & Development.                | Research Institution/ Extension Service |
| 23. | Institute of Research & Development Industry Agency for Industrial Research & Development(BISB AIRD).      | Research Institution                    |
| 24. | Laboratory & Testing Institute for Industrial Products(BIBA).  | Research Institution.                   |
| 25. | Laboratory & Testing Institute for Incdustrial Products(BISM)  | Research Institution.                   |
| 26. | "Lemigas" Research & Development Centre for Oil & Gas Technology.  | Research Institution.                   |
| 27. | Regional Co-ord. Centre for R&D of Coarse Grains Pulses Roots & Tuber Corps. Humid Tropics of Asia(CGPRT). | Research Institution.                   |

JAPAN

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|-----|---|---|
| 28. | ASAHI Glass Co. Limited   | Process and Plant Supplier.   |
| 29. | Catalysts & Chemicals Industries Co. Limited.                   | Process and Plant Supplier  |
| 30. | Central Glass Co. Limited.                                      | Process and Plant Supplier. Also produces and supplies fertilizer.            |
| 31. | Central Engineering Co. Limited.                                | Consulting Firm/ Process and Plant Supplier.                                  |
| 32. | Chiyoda Chemical Engineering & Construction Co. Limited (CCEC). | Consulting Firm/ Process and Plant Supplier.                                  |
| 33. | Co-op Chemical Co. Limited                                      | Process and Plant Supplier. Also produces/supplier and distribute fertilizer. |
| 34. | Mitsui Toatsui Plant Services incorporated.                     | Consulting Firm.  |
| 35. | Denka Consultant & Engineering Co. Limited (DCE).               | Consulting Firm/ Process and Plant Supplier.                                  |
| 36. | Hitachi Zosen Corporation                                       | Process and Plant Supplier  |
| 37. | Ishi Kawajima-Harima Heavy Industries Co. Limited(IHI).         | Consulting Firm/ Process and Plant Supplier.                                  |
| 38. | Ishii Iron Works Co.Limited                                     | Process and Plant Supplier.   |
| 39. | Japan Consulting Institute (JCI).                               | Consulting Firm.  |
| 40. | Kawasaki Heavy Industries Limited (KHI)                         | Process and Plant Supplier.   |
| 41. | Kobe Steel Limited  | Consulting Firm/ Process and Plant Supplier.                                  |

42. Lurgi K.K. Consulting Firm/  
Process and Plant  
Supplier.
43. Mitsubishi Chemical Industries  
Limited. Process and Plant  
Supplier. Also  
produces and supplies  
fertilizers.
44. Mitsui Engineering &  
Shipbuilding Co. Limited Consulting Firm/  
Process and Plant  
Supplier.
45. Mitsui Toatsu Chemicals  
Inc. (MTC). Producer/Supplier/  
Process and Plant  
Supplier.
46. Nigata Engineering Co.  
Limited (Chemical Engineering  
& Construction Division). Consulting Firm/  
Process and Plant  
Supplier.
47. Nippon Kokan Kubashiki  
Kaisha (Japan Steel & Tube  
Corp). Process and Plant  
Supplier.
48. Nippon Shokubai Kagaku  
Kogyo Co. Limited. Process and Plant  
Supplier.
49. Nissan Girdler Catalyst Co.  
Limited. Process and Supplier.  
Also produces and  
supplies fertilizers.
50. Norton Japan Co. Limited. Process and Plant  
Supplier.
51. Showa Denko K.K. Process and Plant  
Supplier. Also produces  
and supplies fertilizers.
52. Toyo Engineering Corp.  
(TEC). Consulting Firm/Process  
and Plant Supplier.
53. Tsukishima Kikai Co.  
Limited. Process and Plant  
Supplier.
54. UBE Industries Limited. Process and Plant  
Supplier. Also produces  
and supplies fertilizers.
55. UNICO International  
Corporation. Consulting Firm.

KOREA

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| 56. | Agriculture Sciences Institute   | Research Institution/<br>Extension Service. |
| 57. | Association for Potash Research  | Research Institution.                       |
| 58. | Association of Industrial Research<br>Institution Federation of Korea. | Research Institution.                       |
| 59. | Korean Institute of Science &<br>Technology.                           | Research Institution.                       |

MALAYSIA

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| 60. | DDSA Management Consultants                  | Consulting Firm.                               |
| 61. | Jebsen & Jessen Engineering<br>(M) SDB. BHD. | Consulting Firm/Process<br>and Plant Supplier. |

PAKISTAN

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|-----|--|---|
| 62. | ENAR Petrotech(Pvt.)<br>Limited                              | Process, Design<br>Engineering and other<br>services.       |
| 63. | DESCON(Pvt.) Limited   | Design Engineering<br>and Consulting.                       |
| 64. | National Fertilizer Corporation<br>of Pakistan(Pvt.) Limited | Design Engineering,<br>Consulting, Research<br>Institution. |

PHILIPPINES

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|-----|---|---------------------------------------|
| 65. | Energy Research & Development<br>Centre Philippine National Oil<br>Company (ERDC & PNDC). | Research Institution/<br>Other        |
| 66. | Philippine Center for Appropriate<br>Technology & Trading (PCATT).                        | Research Institution/<br>Publication. |

SINGAPORE

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| 67. | Applied Research Corporation                 | Consulting Firm.                               |
| 68. | Felmar Private Limited                       | Process and Plant<br>Supplier.                 |
| 69. | Jebsen & Jessen Engineering<br>PTE. Limited. | Consulting Firm/Process<br>and Plant Supplier. |
| 70. | Metalcon (S) PTE Limited                     | Process and Plant<br>Supplier.                 |
| 71. | Sogep S.E. Asia                              | Process and Plant<br>Supplier.                 |