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19361

DP/ID/SER.C/37
8 January 1992
ORIGINAL: ENGLISH

FERTILIZER RESEARCH AND DEVELOPMENT INSTITUTE AT FAISALABAD

DP/PAK/83/010

PAKISTAN

Report of the evaluation mission*

Prepared in cooperation with
The Islamic Republic of Pakistan,
The United Nations Development Programme, and the
United Nations Industrial Development Organization

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* This document has not been edited.

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I. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Project Title:	Fertilizer Research and Development Institute at Faisalabad
Project Number:	DP/PAK/83/010/A/01/37
Executing Agency:	United Nations Industrial Development Organization (UNIDO) UNDP Budget: US$ 1,011,000
Government Implementing Agency:	National Fertilizer Corporation Govt.Budget: Pak Rs.20 m
Project Approved:	October 1983 Date of Evaluation: June 1991
Date of Operation started:	March 1987 or December 1989

A. Objectives and output

Objectives and output statement are as reflected in the latest revision of the project document and PPERs. The outputs and objectives are reproduced in total, in the terms of reference (Annex I) and also in various forms in the body of the report. The review and analysis of the outputs as well as the objectives are addressed in chapters II and III of the evaluation report.

B. Purpose of the evaluation mission

The mandate of the evaluation mission is as contained in the terms of reference. The latter required the usual assessments that are typical of ex-post evaluation exercises. This includes assessment of the project design, effectiveness, relevance, sustainability, impact and lessons learned. The specific issues are as defined in the terms of reference.

At the initial meetings with the Government representatives and NFC, the mission was intimated that the Government was particularly interested in the issues outlined in the terms of reference, although in carrying out this exercise the team placed particular emphasis on the changes in the external environment in which the Institute operates, outreach services to the fertilizer sector, conclusions and recommendations on the future scope of FRDI.

C. Summary view

In summary, the view of the mission is that the Institute is well established considering that it has had only four years "operational experience" and bearing in mind that it will probably take at least ten years to reach maturity. The project of assistance has been implemented successfully even though there have been opportunities missed. Its design was too narrow and the overall project somewhat overambitious. There have been some areas which were not fully considered in respect to associating and integrating the Institute into the total fertilizer system of the country and

not merely making it an instrument of NFC. Furthermore, the institutional development has been neglected.

The above weaknesses call for reflection on and the need for corrective measures in Government policies to better clarify and define the future of fertilizer production and use.

The results achieved to date are satisfactory but their impact is of course limited as would be expected from such a young institution.

D. Findings of the evaluation mission

The major findings are:

Project efficiency was assessed as satisfactory. Considering external factors, the use of the various inputs was satisfactory. Due to slippages and omissions, the overall project experienced a delay of over one year.

Results at the output level, given the external constraints implied, were as planned and reasonably good. Success at the purpose level is fair. Therefore, effectiveness under the present situation is assessed as good. However, projections into the future, considering the present policy environment, created some degree of doubts.

Sustainability, as defined by the team, was made difficult to assess in view of the unforeseen elements relevant to this assessment that were not addressed by the project document. Operating strictly on the conditions defined in the project document, it could be said to be sustainable. However, considering the current trend in policies and priorities, some radical changes in objective, approach, management and other innovations, particularly in reference to outreach services, are necessary.

The significance and relevance of the project to current Government policy and priorities, in view of emphasis on deregulation and privatization, have changed.

FRDI is doing a commendable job in executing its public mandatory functions concerning testing and "research" in the fertilizer sector. Too much time and effort, however, is devoted to addressing issues of relevance only to NFC and very little to the private sector fertilizer industry.

If the service provided by the FRDI is clientele-oriented, industry is willing and able to pay the costs for quality services. The identification of needs of the clients is, however, still not being adequately undertaken.

The integrated approach of the development and utilization of the fertilizer sector is marginalized. In addition, institutional coordination, particularly with respect to those institutes that are engaged in activities similar in full or part to those of the FRDI, as well as those that could compliment those activities, is also neglected. Duplication and wastage of much needed resources is therefore apparent. This is through no fault of the Institute but are in fact problems that are built-in in the project design.

E. Recommendations of the evaluation mission

In view of its findings, the mission recommends to the Government, UNDP and UNIDO to take the necessary actions covering the implementation of the following recommendations:

1. The need to make available immediately to the Government through the UNDP Office, the Industrial Research and Service Institute (IRSI) evaluation report which highlights the experience of UNIDO/UNDP on institution-building projects. This detailed document should be used as reference point for all future activities pertaining to the development of the Institute.

2. Action should be taken to facilitate, within a period of one year, the adequate integration of the Institute into the international network of relevant institutions in the fertilizer and related sectors. The purpose is to provide opportunities for appropriate technology transfer, information exchange and sharing of relevant experience. In addition, the information base of the Institute should be expanded.

3. As a matter of urgency, actions should be taken to enable the Director of the Institute and at least two of his senior staff to embark on study tour to research institutions of internationally recognized standing as well as those operating as centers of excellence. Such study tour should include visit to the International Fertilizer Development Centre (USA), developed countries' institutions, as well as to other developing countries within the framework of TCDC. At the end of the study tours, the staff should prepare detailed reports with recommendations on measures to improve on the operations, work programme and general integration of the Institution.

4. The concerned parties should review the mechanism for proper integration of the Institute into the sector-wide activities of the fertilizer industry and related sectors. The main purpose is to create an enabling environment for the Institution to operate with a view to enhancing its impact and relevance to the development aspirations of the country. Emphasis should be on integration at the working level with the needs and programmes of pertinent Government entities, including Division of Planning, Ministry of Agriculture, Fertilizer Marketing Organization, the private sector involved with fertilizer production and development as well as those institutions engaged in similar or in particular activities complementary to FRDI, especially the National Centre for Fertilizer Development (NCFD).

5. With regard to institutional development of FRDI, the following actions for implementation within the next two years are recommended:

   - o Better integration of the Institute into the total system for fertilizer development and utilization;
   - o Review and possible restructuring of the Board of the Institute;

- o Redefinition of the role and functions of the Technical Advisory Committee so as to make it more relevant to the Institute;

- o Elaboration of a career development programme for the staff of the Institute on the basis of continuous reviewing of its structure and outreach programme.

6. Actions should be taken to revamp the approach and mechanism for the development of FRDI's work programme so as to make it more needs-oriented.

7. Action should be taken to enhance the Institute's capacities in developing a well-structured approach in undertaking economic assessment of the planned activities (in the form of opportunity studies) to provide justification for embarking on the particular line of action and ascertaining the economic viability of the results.

F. Lessons learned

The events to date demonstrate how an original project design can be rendered obsolete or marginal by external events, unless they are monitored on a regular basis and due consideration of changes in policy included at the drafting and consequential stages.

The highlights of the lessons learned are :

(a) The need to make use of past experience in other countries as reflected in the UNDP/UNIDO report on Industrial Research and Service Institute.

(b) The advisability of utilizing preparatory assistance to adequately define the needs and work including the necessary requisites required.

(c) Careful attention needs to be given to the sustainability of the Institute, particularly with regards to financing for the long term.

(d) It is important to have the active participation of beneficiaries and end users.

(e) The UNDP/CEO evaluation guidelines need further clarification.

G. Evaluation team

1. Arturo Chavez-J. Consultant and Team Leader representing UNDP.

2. David Tommy, Evaluation Officer representing UNIDO.

3. Sarwar Zahid, Deputy Chief, Planning Wing, Ministry of Production and representing the Government of Pakistan.

II. PROJECT CONCEPT AND DESIGN

A. Context of the project

The development of this project was influenced by the state of the fertilizer production industry in the country at the time, the needs of the National Fertilizer Corporation (NFC) and actions by a set of key individuals in Pakistan. This eventually led to the Government seeking the assistance of UNDP in 1982 to establish the Fertilizer Research and Development Institute. The project was defined and its design finalized over a period starting in 1975 to 1983.

The production of fertilizers in Pakistan started under Government initiative in 1957/1958 with the establishment by the NFC of two companies, the Lyallpur Chemical and Fertilizer in Faisalabad and the Pak-American in Iskandarab, and for the production of single superphosphate and ammonium sulfate respectively. The capacities established were equivalent to 5,000 tons/year of P_2O_5 and 19,000 tons/year of N respectively. These investments were followed shortly in 1962 with the establishment of PAK-Arab in Multan with units to produce calcium ammonium nitrate and urea with capacities of 117,000 tons/year and 46,000 tons/year of N. These initiatives represented the first period of investments which established the basic elements for national fertilizer production.

The second period of investment came in 1968-1971 when private industry as distinct from NFC, established two major urea plants. EXXON Chemical Pak. Ltd. set up a production capacity of 118,000 tons of N in Dharki in 1968 while Dawood Hercules (DH) in 1971 set up capacity of 160,000 tons/year of N. In this second period, NFC increased its equivalent P_2O_5 production from approximately 4,000 tons/year by the addition of 15,000 tons/year in 1967 with two units at LC & FL in Faisalabad for single superphosphate.

The total actual production of fertilizers in 1975 from the above investments were of 296,000 tons/year of N and 10,600 tons/year of P_2O_5; representing about 75% of the N and nearly 30% of the P_2O_5 utilized, while the remainder was imported. It is apparent that by 1975, the NFC was already concerned with the need for appropriate technical capacities to assist in the operation of its three companies, taking into account that none of them could independently financially support such needs. In addition, further investment by NFC was foreseen, particularly in the phosphatic fertilizers subsector, hence bringing the problem of training of new staff into focus. As a result, NFC took the initiative of sending Dr. M. Ishaque, then Managing Director at Pak-Arab in Multan, to the United States to visit the Centre for Fertilizer Development at Muscle Shoals, Alabama and the International Centre for Fertilizer Development which had also been established in Alabama. From this visit, Dr. Ishaque, who later became Managing Director of LC & FL, elaborated a proposal to NFC to establish a Fertilizer Technology Centre at Multan, the site of the largest production unit of NFC.

The NFC approved the proposal in December 1977 but was not forwarded to the Government until October 1979, a period dedicated to the sorting out of budgetary matters related to the financing of the proposal The proposal was seen more than anything as a needed new investment. The formula for financing was as outlined in Annex II. This formula was established on the basis of having each NFC production company pay a percentage of investment costs as

well as annual operating costs on the basis of production of each company. In this context, the largest investment items were new buildings and the equipment most of which needed to be imported. Therefore, the proposal as submitted to the Government indicated total financial requirements of 24.3 million rupees, of which about 25% were for foreign imported materials.

In January 1980, the Government requested the assistance of NORAD which was declined by July. Subsequently, consideration was made by the Government for submission to UNDP but the resources available from the latter were already fully programmed. It was only in December 1982 that the proposal was approved for UNDP assistance. In January 1983, Mr. Panfil (UNIDO Interregional Adviser) reviewed the Government proposal in Pakistan on behalf of UNIDO and assisted in its reformulation for UNDP consideration. Formal approval was given in October 1983.

As evidenced above, the submission was fundamentally based on obtaining financial support for the foreign exchange requirements associated with the establishment by NFC of what was then called the Fertilizer Research & Development Institute at Faisalabad located next to LC & FL operating facilities. Dr. Ishaque retired as General Manager of LC & FL in June 1983 and became adviser to NFC with responsibility to oversee the Institute's establishment, bearing in mind that the Institute was designed to serve the five NFC companies then established.

By this time, the country had experienced its third period of investments in fertilizer production which occurred between 1979-1982. NFC during this phase, made further investments in three of its companies: Pak-Arab in Multan with 70,000 tons/year N + 70,000 tons/year P_2O_5 (NP), and the new companies Pak-Saudi in Pirkur-Mathelo with 256,000 tons/year N (urea) and Pak-China in Haripur-Hazara with 43,000 tons/year of N (urea). The private-owned Fauji Fertilizer Company also established 262,000 tons/year capacity of N (urea) in 1982. Thus, the production of fertilizer in 1983/1984 was of 1 million tons N/year, making the country almost self-sufficient, and 89,900 tons/year P_2O_5, about 30% of requirements, the remainder being still imported.

The project concept was to basically provide technical services to the five NFC companies. This was to be through a new institution carefully designed to avoid duplication, particularly of scientific equipment in operating plants or contiguous institutions in Faisalabad. The primary function of the project was institution-building and restricted to an organizational set-up responsive exclusively to NFC. In this narrow sense, the arrangements for the project were appropriate. However, there is no evidence that NFC was responding to a national macro-economic policy framework. The new institution fitted well into NFC plans, but it remained as an open question whether it would be directly related to a larger total system of fertilizer production and utilization in the whole country with appropriate participation by the eventual beneficiaries, particularly the agricultural sector.

Thus, the broader coordination of the new institution with other relevant institutions in the country does not seem to have been explicitly considered, even though there are implicit elements of some degree of thought having been given, particularly in respect to consultation with scientific research institutions in order to avoid duplication of scientific equipment capacities.

UNDP's consideration of the project seems to have been cursory. No evidence was found of any effort to tie the project to any other projects of related assistance. Thus, the relationship of the new institute to an existing National Fertilizer Development Centre (NDFC) under the Planning and Development Division of the Ministry of Planning was not apparently considered. This Centre came into operation in 1977-78 with FAO assistance and financial support from Norway in its first phase and Netherlands in phases II and III.

B. Project document

The project document was essentially prepared by the Government over a considerable long period of time (1975-1983). UNIDO's involvement in the preparation of the document was marginal and seems to have been restricted to the formal drafting so as to conform with internal logic of project design.

1. The problem and technical approach

The problem is barely described in the project document and is given as "satisfying all the needs of NFC companies as far as applied individual research is concerned." No definition is provided as to the nature of the needs or research activity, except to indicate that the technical subjects to be initially covered should "promise early attainment of tangible results" and set a basis for continued work on selected subjects.

In addressing the problem(s) to be encountered by the project, the document failed to consider what institutions are directly related to the institution in question in terms of policy guidance, supervision, supporting functions etc; policy issues related to basic institutional mandates, overlapping organizational roles, coordination issues, deficiencies in the support provided by one institution to the other; and, what other organizations in the environment have programmes that deal with the same problem or parts of the same problem as the institution under study.

The technical approach chosen was to establish a new technical institute under the NFC. The need of the project and the real justification for assistance hinges on the provision of common-service facilities in the form of "sophisticated, expensive, analytical instrumentation presently utilized for this type of research". It is also argued that no company of NFC would be in a position to acquire these inputs in order to engage in research for solving specific problems. Furthermore, indication is provided that the equipment required could not "economically be utilized if located in a single company". The approach also recognizes the need for foreign expertise which no single company could economically afford.

The project document does not indicate any real consideration of alternative approaches, except to unify and centralize capacities for research in fertilizers as required by NFC in one institution. At the same time, there is no recognition of any risk involved. On the contrary, the assumption is explicitly made that the project "will improve the productivity of the fertilizer industry and in the long run make the country fully self-sufficient in fertilizer supplies." No indication is given as to how changes in Government policies or operating environment could affect the Institution, how research results alone would achieve such lofty goals taking note that no benchmarks are given for productivity nor is information given on,

particularly, the availability of phospharic resources based on geological data. Import dependency amounted to 2/3 of phosphatic requirements.

2. Objectives, indicators and major assumptions

(a) Objectives

The development objective of the project is given as:

> "To achieve self-reliance of the fertilizer industry in Pakistan. To promote and continuously enhance indigenous technological capabilities to support the expanding fertilizer industry in Pakistan."

The immediate objectives are given as:

> To establish a specialized fertilizer research and development institute of NFC capable of:
>
> (i) Testing domestic and imported raw materials and proposing ways and means of their economic use;
>
> (ii) Testing of chemicals lubricants, catalysts and other auxiliary materials used in the fertilizer industry and proposing means for gradual development of local production;
>
> (iii) Testing, checking and evaluation of NFC products and assessing their suitabilities for local climatic conditions and applications;
>
> (iv) Suggesting technological improvements to be made in the manufacturing units and working towards adopting advanced technologies for the production of straight, compound and blended fertilizers to suit conditions and specific requirements in Pakistan;
>
> (v) To gradually develop the local manufacture/regeneration of catalysts used in fertilizer plants.
>
> To acquire in-depth knowledge of latest developments in the afore-mentioned areas of specialization.
>
> To provide technical advisory services to the existing fertilizer production units of NFC.
>
> To establish technical information and documentation services at FR&D Institute.

(b) Indicators

The project document provides indicators for project progress and achievement but does not explicitly give any indicators for impact assessment.

The indicators for progress are provided in a prior obligation by the Government of supplying the investment and working capital in an amount of 18

million rupees before the project could start. Subsequently as prerequisites, it called for the elaboration of the fundamental design for the new building required. Furthermore, it called for the appointment of the project national director and the critical nucleus of professional and technical personnel of 6 persons. Lastly, it limited the equipment contribution from UNDP to a financial amount of US$ 485,000 (established in the document) based on a preliminary equipment list which needed to be subsequently reviewed and established on the basis of a detailed research programme which was to be recommended by a contractor together with the proposed final list of equipment. Thus, the equipment indicator was left open ended for the Government and strictly limited to financial contribution from UNDP.

The achievement indicators were provided in the definition of project outputs. There are stipulated commitments concerning the formal establishment of facilities that would include five specific laboratories dealing with raw material testing, catalyst testing and regeneration, product testing unit operations with semi-pilot scale equipment and analytical capacities into physical and chemical characteristics. A library was also included. These indicators however are not explicitly defined as to what each unit is to contain so as to be considered acceptable. A second set of achievement indicators are specified to be technical reports on R&D work on 3 general topics which included local and imported phosphate ores and procedures for their use, treatment of cooling and boiler water in fertilizer plants and recommendations for blends of lubricating oils including pertinent regeneration techniques. Technical reports were also required on the ad hoc technical advisory services that would be provided to NFC fertilizer plants without providing quantifiable targets for such services.

Indicators for technology transfer are not specifically provided, except for the delivery of nine training fellowships on four fields of specialization.

From an operational viewpoint, the project is well structured with the indicators as indicated above to permit oversight which is complemented through the mandatory semi-annual progress reports. However, the document does not specify any particular specific monitoring system that would permit the use of the indicators, apart from the standard monitoring procedures for all projects including tripartite reviews and quarterly reports. In the case of this project with a three-year duration, such monitoring would be inadequate bearing in mind that two years were planned for construction and delivery and commissioning of inputs and one year for actual research activity.

However, the above monitoring system was to be complemented by two technical evaluations as distinct from project evaluation. These evaluations were scheduled at mid term when buildings have to have been completed and three months before project completion. These technical evaluations might provide some insight as to the value or quality of the project activities but as designed they could not be seen as practical monitoring tools since they were more operational in character.

(c) Assumptions

The document does not explicitly provide the assumptions for the project. However, these assumptions can be implicitly derived from the project design.

The most fundamental assumption is that through the delivery of the inputs stipulated from the Government and UNDP, a specialized Fertilizer Research and Development Institute would be fully established taking into consideration that it would have only one year of operational experience.

A second fundamental assumption is that the physical establishment of the Institute in two years plus the results arising from the stipulated outputs would contribute towards achievement of the development objective when no linkages of any sort are indicated between the Institute and these objectives. These development objectives are much too general and imprecisely written to be seriously taken for any reasonable period of time (ten years); for three years they are meaningless. The third implicit assumption is that the prevailing Government policy will remain unchanged.

On the other hand, there are three further important assumptions that are explicitly provided.

(i) Improvement of productivity of national fertilizer industry;

(ii) Self-sufficiency in fertilizer supplies;

(iii) Capability for the Institute to provide regional services to other countries under ECDC/TCDC programmes.

It is necessary to question the validity of these explicit assumptions when no linkages are provided to show how the Institute and its activities would enhance productivity at plant level nor increase fertilizer production which is a derivative of new investments. Whether one year of operational experience would provide the competency to provide services to other countries on a regional basis becomes also highly questionable.

The document does not even provide a general indication of how NFC would translate research reports into eventual reality at company and plant level.

3. Beneficiaries

The beneficiaries of the project are clearly identified to be the five operating companies of NFC:

Lyallpur Chemical and Fertilizer, Faisalabad
Pak-American, Iskandarabad
Pak-Arab, Multan
Pak-Saudi, Mirpur, Marthelo
Pak-China, Haripur

On the other hand, the document makes no recognition of the fact that the end users of fertilizers is the agricultural sector where the cost/benefit

of their utilization must be realigned to responding to specific crop needs. In this respect, many problems of fertilizer utilization arise from its techniques for application back to the distribution system to farmers. The policy implications of overall planning for fertilizer use are critical in any programme of technical fertilizer development, but no meaningful linkages are contained in the document that would indicate the use of research results at such level.

4. Work plan

The document does not contain neither a work plan nor research programme for the new institution. However, provision is made that a work programme is to be elaborated at project start. Furthermore, provision is also made for the preparation of a detailed research programme based on proposals by a sub-contractor of project implementation.

However, the provision of these tools per se, do not provide assurance for realistic expectations unless such work plans are reviewed and continuously updated and the detailed research programme is subject to careful scrutiny and review before formal acceptance. The document makes no specific provision for the utilization of the instruments.

III. PROJECT IMPLEMENTATION

A. Inputs

1. UNDP/UNIDO

The total external inputs initially provided for in the project document was US$ 943,400. Subsequently however, this was revised to US$ 1,011,000. The justification was that it was to be used to "purchase certain essential equipment". This sum was utilized to finance the services of short-term consultants, fellowships/study tours, sub-contract and the purchase of equipment. The breakdown is as follows:

Short-term consultants	US$ 13,000
Fellowship/study tours	US$ 84,000
Equipment	US$ 553,000
Sub-contract	US$ 343,000
Summaries	US$ 18,000
Total	US$ 1,011,000

2. Government inputs

This is valued at Rs. 20 million. The inputs were utilized for the provision of land, building and utilities, furniture, workshop facilities, library furnishing, air-conditioning, chemicals, and staffing of the Institute. (The detailed breakdown is provided in Annex III).

3. Analysis of inputs provided

In the supply of short-term experts there were the usual delays. The bulk of the assignment of the project, however, was carried out by the sub-contractor. This approach met a delay of almost one year due mainly to the administrative processes of UNDP/UNIDO. The justification for sub-contract is given as "the scope of the work envisaged requires a great deal of flexibility in the services to be rendered in the field. This may require numerous split missions depending on the project's actual performance at certain moments as well as extensive home office support which is a real problem in case of individual experts. In addition, training of 27m/m is required for nine candidates in a company having facilities in certain narrow specialization". Whilst the first part of the explanation could be accepted, the latter part, pertaining to training could not be understood by the evaluation team. In addition, there was an apparent conflict of interest as a result of the sub-contractor being included on the list of bidders for the supply of equipment for the same project.

The procurement and delivery of equipment also met with considerable delay. The magnitude and nature of such delay is detailed in Annex IV (Project Implementation Details). This delay could be attributed to two main causes. The first is said to be in-built in the project document in the form of discrepancies arising from the comparison between the inputs delivered and the actual inputs outlined in the project document; the project document did not initially require to supply so much equipment as was later recommended by the

sub-contractor. Secondly, considerable budget reappropriation was called for during the implementation as a result of currency fluctuation. The expertise supplied was adequately qualified. The implementation of fellowship and delivery of equipment suffered usual delays which did not affect the project, except in time frame. All equipment have been installed and are being properly used. The training and equipment provided by UNIDO are considered applicable but not totally adequate. As a result of the Government inputs and the resultant activities, the outputs produced included:

> *Physical facilities which are rated as appropriate. This consist of a building on land acquired for 99 years on lease. The building consists of 4 laboratories, a library, office facilities for the management and secretarial staff, a pilot plant, laboratories and a workshop. In addition, there is a conference/lecture room with seating provision for 105 people. The land is, however, bounded on two sides by private residence and on the third by a small industrial plant.*
>
> *The Institute is provided with reasonable number of vehicles as Government inputs. One vehicle was purchased using UNDP funds. Ownership is still an issue for settlement between the Institute and the UNDP. This issue, as is the case with the transfer of ownership for the other equipment provided by the project, should be urgently finalized.*
>
> *Government inputs also resulted in the staffing of the Institute. The quantity and quality of staff are considered to be acceptable for the time being with the exception of the urgent need for a librarian. The exact staffing is detailed out in the organogram in Annex VIII.*

The Government contribution to the project in the form of personnel was adequate in quantity and was in keeping with the numbers indicated in the project document. Due cognizance should, however, be taken of the fact that the majority have had no previous experience in working in R&D institutes. Delays in implementation were experienced due to late construction of the building - due to the need for redesigning. The delay in Government nomination of fellows also caused constraints in implementation of study tours/ fellowships.

Operational level - engineers and scientists - the level of industrial experience and academic advancement was found to be sometimes deficient. For instance, the computer programme development and training is carried out by an instrument engineer. This task is undertaken in conjunction with his substantive assignment as head of the instrument room/workshop. In addition, there is no qualified librarian - the task is carried out on ad hoc bases by the chemist at the physical chemistry laboratory.

At its present location, there is very little room for further expansion of the FRDI (physical construction) if the need arises. This could pose serious problems. In addition, provision of certain essential inputs have been delayed/prevented as a results of Government budgetary constraints.

B. Activities

A rather elaborate list of activities related to the outputs is incorporated in the project document. The project document also indicated that a detailed workplan as well as the list of equipment was to be prepared by the sub-contractors. However, an indicative workplan was provided in the form of bar chart in the project document. These activities, as could be seen from Annex V, were by and large undertaken successfully although with slippages. The project implementation was launched in January 1984 and was initially scheduled for three years but in fact terminated about two years later. The qualified indicators, which were rated as reasonable, were reached in the majority of cases.

Two particular items included in the project document were considered to be highly optimistic, i.e. could not be reached, and, on the suggestion of the short term consultant, were deleted from the project. It was recommended that they should be undertaken at a later date, when the Institute is considered mature enough. These were:

- o "Testing of catalysts and the means for gradual local production of catalysts"; and
- o "Lubricant testing services".

Contrary to the recommendation of the consultant, the Institute embarked on the latter activity and progress is reported as significant.

A list of 21 activities related to the 3 outputs was included in the project document. A bar chart for such activities is included but as stated earlier the preparation of the detailed workplan was assigned to the sub-contractor. An analysis of these activities show that they were, in the main, undertaken in their totality, with the exception of those pertaining to:

- o Testing of catalysts - deleted;
- o Lubricant testing services only partially achieved.

In conclusion, the implementation of the project's activities progressed satisfactorily, given the external conditions and the operating environment.

In view of the fact that this evaluation is an ex-post evaluation, it requires that a fuller analysis of the activities beyond the life of the project be undertaken, so as to better assess the impact and relevance of the project. The activities of the Institute beyond the project life are outlined in the planned work programme of the Institute provided in Annex VI. (That of research activities undertaken thus far is provided in Annex VII.)

One of the major issues with the work programme of the Institute is that pertaining to the selection of topics to be addressed. In principle, the role of the "Technical Advisory Committee" should ensure the relevance of these topics with immediate and short-term needs of the operating companies of NFC as well as ensuring that duplication with the activities of other R&D Institutions is minimized. The effectiveness of the Advisory Committee as presently constituted is doubtful.

A second important issue is the application of the results of research work into actions at the processing plant level. This would require the carrying out of cost estimates for putting into use these research results. It is observed by the mission that only the simplest components of this important sector are followed up upon by the Institute. The economic assessment is carried out by other sections of NFC such as the technical and marketing divisions.

It is apparent that the majority of the activities of the Institute are concentrated on the phosphatic fertilizer sector, especially the raw material research and analysis. Pakistan does not have good-quality phosphate rock and has to import from Jordan and Morocco. The private fertilizer sector's production is concentrated on the Nitrogenous fertilizers due to current Government policies.

One of the activities carried out, albeit to a very limited extent, by the Institute is the provision of services to the private non-fertilizer sector. The nature of such activities is defined in Annex X. Whilst this may be relevant in view of the sustainability of the Institute, it gives the impression that the Institute is not 100% occupied with provision of services to the fertilizer sector.

C. Quality of monitoring and backstopping

1. Assessment of project management

The quality of monitoring and backstopping was rated by the mission as only just satisfactory. For the majority of the implementation, the project management and the sub-contractor were given a free hand. A great deal of uncertainty still remains around the issue of the role of the Government in the final selection of the sub-contractor, the finalization of the list of equipment and the selection of possible placement for fellows. Some of these shortcomings, particularly with regard to finalization of the list of equipment, could be attributed to the fact that the counterpart staff were not adequately trained at the time when the list was being prepared and as such had very little knowledge of the equipment required. On the issue of the selection of the location/hosts for the study tours, the limitation to only one institute is not fully acceptable to the mission.

2. Planning, backstopping, monitoring and review

(a) UNIDO

The project document was signed on 23 October 1983. A revised project document was submitted for approval in November 1983 and implementation was launched in 1984. An assessment of project design is undertaken in chapter II. As mentioned earlier, no detailed work plan was available at the start of the project. Backstopping was assessed to be initially weak until the mid-point of the project life and, subsequently, it improved remarkably.

Monitoring of the project was essentially by the sub-contractor. There were a number of reviews undertaken as is detailed out in Annex IV. Major revisions of the document were limited to activities pertaining civil engineering works as directed by the short-term consultant as well as budgetary changes.

(b) UNDP - Management of the tripartite review process and coordination

In all, three tripartite reviews were held during the life of the project. These tripartite reviews were held regularly, as stipulated in the project document and as was mandatory, except for that originally scheduled for 1988 which, for logistic reasons, never took place. The three parties were adequately represented in all such reviews. The chair was normally occupied by a senior official of NFC, Lahore. Project progress reports were prepared for the tripartite reviews by the responsible management officials using the format then in force. Two of the tripartite reviews tended to concentrate on delivery of inputs in the carrying out of activities.

The final tripartite review which took place in June 1989 witnessed a shift of attention from inputs and activities to management problems which by then had become transparently inadequate. No specific mention was made of delays on equipment, customs clearance, experts' and fellowships' fielding and matters relating to UNDP jurisdiction, which were manually delegated to the SIDFA, except for participation in tripartite review meetings.

(c) Pakistan Government support

From the outset, the Chairman of NFC identified himself as the National Project Director (NPD). However, in view of his busy schedule, the day-to-day monitoring was delegated initially to Dr. Ishaque up to May 1985 and subsequently Mr. M.A. Fazali. Mr. Khan became the first Director of the Institute and was replaced in mid 1989 by Dr. Haq.

The support of the Government to the project was reported satisfactory. However, budget appropriations to the project in view of the overall prevailing economic situation met with limited constraints. Delays (detail in Annex IV) were often encountered with the submission of candidates for study tours and fellowships. The majority of the posts in the project were appropriately filled, even in the face of budgetary constraints. The recent Government policy of privatization could have substantial implications on the operations and future funding of the project. The issue of funding could pose serious problems for the Institute in the future.

IV. PROJECT RESULTS

A. Outputs of outputs produced

In its totality and in accordance with the project document, four laboratories, one pilot plant and a library/documentation unit were established. The primary function of the project is institution-building, the outputs or results of project activities are therefore expressed in terms of new capacity to perform the services or functions planned for the organizational units responsible.

In keeping with project design module for institution-building projects, hereunder are the descriptive statement of each output and sub-output, current status, accomplishments, and the assessments made by the evaluation team. It must be noted that the smooth operations are affected by external factors, particularly Government budgetary constraints and staff movement.

1. Output No.1 - Fertilizer Raw Material Development Laboratory

Status

(a)

(i) A functioning fertilizer development laboratory equipped to carry out studies on local phosphate rock bonification, phosphoric acid and various phosphatic grades fertilizer manufacturing, reduction of harmful impurities by bonification. The testing and development are being carried out at bench scale and pilot plant scale. In addition, research work on TSP, MAP and DAP is in progress.

(ii) An officer has been trained in the sub-contractor's laboratory the other officers lack the experience and exposure required for adequate functioning of the laboratory. The staffing in accordance with the organogram is in the main complete.

(b)

(i) One of the main and impressive activities appears to be that of the development and preparation of various micronutrient blends, bearing in mind the nature of the soil type/corp needs.

(ii) Specialized research and measuring instruments were ordained for the laboratory as per list attached as Annex III. A few of the laboratory fittings including fume cupboards etc. were locally produced at a much reduced cost.

(c)

(i) A qualified and trained core of national staff of engineers/researchers within the laboratory of which are capable of carrying out independent research work and the rest are support staff.

(ii) The accomplishment of the laboratory, which is rather impressive considering the limited experience of the staff, is as per Annex IV (details of research projects completed). There is no indication of whether and when additional staff will be supplied nor an elaboration of a structured future work programme. In addition, it is not quite clear if the subjects of research are needs-oriented or purely academic, in some cases.

(iii) The research activities carried out by the laboratory as well as these in progress are as per tables and "Research activities undertaken by Fertilizer Development Lab". These are listed as 54. In addition, the status of each research activity is provided on the said tables.

Accomplishments

The Fertilizer Development Laboratory has completed a total of 29 research reports. These are included in the above-cited table. The marketing of the activities and services to the outside is, however, very limited. This is said to be the responsibility of the Marketing Section of the NFC. There is no clear indication as to how the research results are utilized. The specific research activities that are on-going are as in Annex VII (On-going Research Projects).

2. Output 2 - Special Chemicals Development Laboratory

Status

A functioning laboratory capable of evaluating and developing "economical" substitute of such chemicals as are consumed by the fertilizer industry. The basic objective is to save on much needed foreign exchange that is now utilized for the importation of these chemicals. Such chemicals include: water treatment chemicals, anti-foaming chemicals, anti-caking agents and corrosion inhibitors.

The laboratory is equipped with a sophisticated computer controlled corrosion measurement system, as well as computer controller, IR speetnophotometer, microbiological evaluation unit, etc.

The laboratory is reported to be operating satisfactorily. There is, however, some doubts as to if it is being fully utilized. In addition, there is doubt as to whether the laboratory has sufficient capacity to carry out the planned tasks.

Accomplishments

The accomplishments of this laboratory are summarized in Annex V. The list of on-going activities are, on the other hand, provided in Annex VII.

3. Output No.3 - Analytical Laboratory

Status

(i) A functioning analytical laboratory capable of analyzing different raw materials, intermediate products and finished and experimental products coming from other sections of the Institute, NFC and other industries of the country.

(ii) The laboratory is fully equipped with modern and sophisticated instruments. In some cases, the optional utilizations of these instruments is in doubt.

(iii) This unit is comprised of 2 subunits:

Chemical laboratory: Equipped with Atomic Absorption Spectrophotometer, Automatic Nutrient Analyzer, Gas Chonomatograph, High Pressure Liquid Chromatograph, Karl Fisher Titrator, Memotittator, Specific Ion Analyzer and other routine laboratory equipment. It has the potential for undertaking a broad spectrum of analyses.

Physical laboratory: Equipped with instruments for measurement of Angle of Repose, Drillability, Dust Contents, Abrasion, Sieve, Roundness, Granule Hardness, Caking & Shooting testing apparatus. In addition, microprocessor based on Bomb Calornetry, Viscometers and other physical laboratory analysis are undertaken, especially on rocks, finished products and lubricating oils.

Accomplishments

The accomplishments which are claimed to be substantial are contained in the table in Annex V. The on-going activities are likewise contained in Annex VII.

4. Output No. 4 - Pilot Plant

Status

(i) A functioning pilot plant unit capable of translating the research bench results to reflect the reality of difficulties to be faced at the full-scale plant level. The unit attempts to produce engineering design data for the full-scale plant.

(ii) The pilot plant unit is equipped with workshop facilities which help in the fabrication of required equipment and components.

(iii) The majority of the main equipment of this unit are locally produced. At the time of the evaluation, some of

these were assessed as requiring urgent repairs or replacement.

(iv) Staff working in this unit as well as in the fertilizer Development Laboratory have no due regard for protection at work.

Accomplishments

The accomplishment report includes that it should however be reiterated that no clear "benchmarks" were provided in the project document:

- Studies on fertilizer process for various NFIC blending/granulation as per requirement of Pakistan soil types;
- Improvement on SSP granulation plant;
- Phosphoric acid concentration using local rock;
- Bonification of local low grade ores;
- Improvement of quality of zinc sulphate.

5. Output No. 5 - Documentation and Technical Information Section/Library services

Status

A functioning unit consisting of a documentation and technical information section/library service. Resources for the books, documentation and furnishing of the section were provided by the Government. Overall status in terms of physical facilities, information material, data collection, analysis and dissemination are far from adequate.

Staff is limited to one officer with general education background who works under the supervision of the chemist in the Physical Chemical Laboratory. This supervisory function is carried out on ad hoc basis.

Accomplishments

This includes the acquisition of:

- 1,000 volumes of technical books/proceedings/seminar on science, chemical processes, agriculture, fertilizer technology and engineering;
- 25 volumes of current journals on fertilizer technology and processes.

Technical reports on quarterly activities produced locally and annual reports.

6. Output No. 6 - Instrument Section

Status

(i) The equipment and instruments installed at the Institute are rather sophisticated and require adequate servicing, as well as preventive maintenance. In view of the above-mentioned, a functioning instrument section was established.

(ii) This section is equipped with repair kits and tools required for maintenance of all equipment, instruments, air-conditioning plants, electric power, generator, electronic PABX exchange, computer, etc.

(iii) Staff is rather inadequate. It is manned by one instrument engineer with seven years experience and he is assisted by a technician. However, as a stop-gap arrangement, agreements or understandings with other laboratories, universities, etc. have been reached so that exchanges of various forms can take place at the shortest possible notice.

Accomplishments

Instruments repairs and maintenance have been introduced. The management so far has been adequate but as the equipment ages, there may be the need for more hands and greater expertise. A structured preventive maintenance scheme is obviously absent.

7. Overall assessment of outputs

Operating strictly on the use of the project document as the baseline, it could be concluded that, apparent delays in implementation notwithstanding, all outputs were satisfactorily attained. This assessment is based on systematic analysis. This is, however, not totally scientific as complete objective data is not available or was created after the fact. Nevertheless, it seems very clear that overall project accomplishments are as planned and the magnitude set out originally by project completion was over-exceeded. There is, however, evidence that the components that have been established through the project may encounter serious difficulties in carrying out their mission and effectively reaching the targeted end users in the future, without significant changes in the internal (fertilizer industry) and external (Government - Ministries of Industry, Productivity, Agriculture, Planning and Finance) project priority, policies, institutional arrangement, operating environment, etc.

Considering the background of the staff of the Institute and their level of exposure as well as internal experience attained, not to mention the very short life so far of the Institute, the achievement, at least in numerical terms, is rather impressive. It is reported that 29 publications and reports have thus far been produced. The organizational structure and management of the Institute needs urgent reexamination, particularly in view of recent Government policy of privatization.

One important issue requiring urgent attention is the relevance of these outputs to serve as inputs to the operations of the beneficiaries. It is apparent that for this Institute as an R&D entity to survive, it must be of direct service or relevance to the fertilizer industries. One planned approach was through the Technical Advisory Committee as a control mechanism to ensure that the research activities selected are attractive and are of direct relevance to the needs of those industries. In addition, the results should be in useable form. The linkage with other sections of the economy, particularly with the Ministries of Planning and Agriculture, should be given due cognizance in this process.

B. Immediate objective(s)

The purpose of the project which is contained in the project document is "To establish a specialized Fertilizer Research Development Institute of NFC capable of: testing domestic and imported raw materials and proposing ways and means of their economic use; testing of chemical lubricants, catalysts and other auxiliary materials used in fertilizer, etc; testing, checking and evaluation of NFC products and assessing their suitabilities etc; suggesting technological improvements to be made in manufacturing units etc.; to gradually develop to local manufacture/regeneration of catalysts used in the fertilizer plants, etc." Comments on the project design have been made in chapter II. As it is appreciated that end-of-project-status indicators were fairly well established, it is fairly straightforward to determine if the change intended by the project has taken place. Important issues such as uncertainties, risks etc. which are imperative for consideration of projects in developing countries like Pakistan are not addressed. The final tripartite review meeting concluded that, in the main, the objectives of the project were attained. The evaluation team could only make a subjective assessment of the achievement of the project's purpose based on interviews with the staff, selected end users, the NFC, and observation of the operations of the laboratories. There is no doubt that the Institute's capabilities in the areas mentioned were established through the production of the project's outputs. The only areas where there were noticeable deviations from the project document (as mentioned earlier) are with respect to the catalyst development capabilities - this issue was totally deleted from the project activities, the work on lubricants was only partially achieved and technological improvement addresses processes and not the fertilizer manufacturing plants.

The afore-mentioned notwithstanding, it is not quite clear how the analyses of the cost-effectiveness of the various activities of the Institute are undertaken. It is apparent that this exercise as well as the marketing of the result of research are not been addressed by the Institute but rather by other sections within NFC. It is apparent that the issues for consideration by the Institute are pre-determined by the Technical Advisory Committee and the Board, with significant inputs from the technical department of NFC.

In recent months, it has become quite apparent that the sophisticated equipment provided to the Institute will not be optimally utilized if its services are limited to the fertilizer sector only. This issue links closely with issue of sustainability and Government recent privatization policies. Hence, far reaching moves have been made to provided services to the chemical and allied industries in Pakistan as well. These services rendered thus far, are enlightened in the table entitled "R&D services provided to private

industries". The advantages and disadvantages os such an action have been addressed earlier.

On a more detailed basis, the comments that can be offered in respect of achievement of the objectives are provided in a summarized form in Annex IV. "Detail of the research projects completed" and "Research activities carried out at FRDI, Faisalabad".

The project's function was clearly institution-building and the evaluation is satisfied that FRDI was established with capabilities in fields identified in the project document. Certain minor redundancies, however, can be detected which were as a result of the project design and later approaches which tended to concentrate on a high instrument/equipment component at the expense of adequate training and exposure of the staff. In addition, very little attention was paid to the organizational and management aspects. On the whole, however, the project purpose is clearly defined.

C. Development objective

The development objective in the document, even though assessed in chapter II as rather broad, is well defined and could be used as an impact target. The mission was therefore in a position to make an assessment of impact. Certain marginal inroads can be claimed by the project but significant development changes caused by the project cannot be ascertained. Prior to the launching of the implementation of the project in 1984, total installed capacity was recorded as 1,028,001 nutrient tons of nitrogenous fertilizer and 86,235 nutrient tons of phosphatic fertilizer. This capacity has almost double according to figures of 1990. It is impossible to attribute the change to the impact of the project. This could be as a result of the fact that the Institute is still at an embryonic stage to make proper impact or as a result of the fact that the Institute is many stages detached from the actual fertilizer industries. The way in which the results trickles down to the industries is still not clear.

D. Unforeseen effects

While there have been unforeseen events and delays caused by factors external to the project itself, it is evident that FRDI staff did not anticipate or fully appreciate the changes already made in Government policy concerning privatization and its potential impact on FRDI's mission, approach and tasks. The inadequacies originate from the project design where uncertainties and risks were not appropriately addressed. At the conceptual stage, it was anticipated that NFC will continue to finance the activities of the Institute. It may be recalled that at the launching of the implementation of the project of the nine operating fertilizer plants, only three belonged to the private sector. It has been reported that in as much as there is Government regulations requiring the private plants to contribute to the financing of the Institute, this has not been forthcoming. It is therefore not clear what the attitude will be after full privatization of the industry. It is, however, a common position that the attitude of the private sector will depend on the quality and relevance of the result or services provided by the institution.

As to project effects on end users there do not appear to have been any significant unforeseen effects - negative or positive. One exception might be the expectation that project activities, particularly those concerning

training and promotion/marketing would have included coordination with other public organizations/private sector enterprises essentially in the same line of business. This has not been the case. Another unforeseen negative effective might be the continuing lack of organization and overall direction networking to make the Institute more oriented to the needs of the end users.

It should be emphasized at this juncture that, there is connection between critical assumptions and unforeseen effects at the project purpose and output levels. If explicitly stated at the beginning, they could have been observed during the life of the project. While they can often not be prevented, changes in the opportunities could be adequately noted.

E. Sustainability

Sustainability is defined as "the ability of the project to continue its positive results once the external support is removed". The effect of external unforseen factors on the sustainability is closely related to the issues addressed in the proceeding section. In addition to those issues, the project design does not adequately address the issue of sustainability.

Sustainability is indeed related to the continuing achievement of the project purpose and function. In the case of institution-building projects, it refers to institutional maturity and viability, i.e. ability to exist in a changing external environment.

It should be stated from the outset that the Institute is at an early stage of its establishment. Hence, there are difficulties in proper assessment of its sustainability.

The team used criteria contained in the checklist provided by UNDP/CEO to assess the sustainability.

At present, adequate resources are apparently provided by the Government (NFC) for the project to continue. This status quo is expected to continue in the near future. The duration, however, can not be precisely determined. The problem is with Government current economic policies, particularly the drive towards privatization. These are factors outside the control of current FRDI management but presumably short-range in nature and could be overcome by a well-structured organization and well defined work programme with a systematic approach that is end users needs-oriented.

During the course of the interviews and analysis it was evident that, whilst ideas for future work programme have been floating around the Institute and NFC, this has not been elaborated. In fact, an outline of future programme plan had been prepared. It contains the main elements but requires further elaboration. The FRDI appears to be more pre-occupied with operational management questions, e.g. budget approvals, staff recruitment and promotion and is not yet able to provide needs guidance and inputs. Contacts with end users and the private sector is of an ad hoc nature, and the Advisory Committee and their role in the planning process and reviewing of needs, etc. is largely marginal and ineffective and not binding on the Institute.

The project was initiated in January 1984 and became functionally operational in 1988; it is therefore not matured by definition. In its present form, its viability and ability to recognize changes and develop appropriate responses to meet them is more appropriate to a centrally planned

economy rather than the provision of demand-related services to increase competitiveness. In its present shape, management cannot be expected to do more than hold the ship together. The overall present and future sustainability of the Institute, without the major changes recommended herein, is doubtful.

F. Follow-up

Prior to the consideration of a new phase, "strategic planning advice" should be provided with due cognizance of the current Government policies. Management and financing advice on IRSIs in an open market economy with particular attention to flexibility, authorities and other changes is required to transform FRDI into a more self-reliant, demand or client-responsive outreach institution. In addition, due consideration should be accorded to the human resources development component, particularly in respect to international exposure of the staff and management at credible institutions as well as networking arrangements and technology transfer aspects. It is strongly believed that the approach is vital to the future of the Institute.

V. FINDINGS

On the basis of its work which included briefings, review of files and reports, visits to the Institute, discussions and visits to relevant organizations and its own assessment, the mission has established the following findings related to the project and its impact.

A. Findings on the project

The findings on the project have been made on the basis of assessments made in regard to efficiency, effectiveness, significance and relevance.

1. Efficiency

In accordance with UNDP briefing kit, efficiency is defined as:

> *"... the productivity of the activity implementation process of an activity - how well inputs are converted into outputs. An efficiency analysis usually compares a variety of ways of conducting an activity to find the one which requires minimum inputs to achieve some fixed goals or produces maximum outputs from a fixed quantity of inputs."*

In chapter III, the evaluation team undertook assessments regarding inputs and activities to the extent possible. Whilst it may be safely stated that the use of inputs was reasonably efficient and satisfactory, due cognizance should be taken of slippages resulting from delays caused by external factors. The afore-mentioned notwithstanding, the team also observed that it was impossible to address the latter part of the definition. This is due to deficiency in the project design. The project document failed to address various other alternatives when solution of the "problem" addressed by the project. In addition as stated in chapter III, the modalities adopted in converting the inputs to outputs, e.g. the training/fellowships and their timings, the issue of sub-contracting, the procurement procedures, are in some cases found not to be totally acceptable, or, under the given conditions, not considered to be the most realistic or cost-effective approaches.

2. Effectiveness

The glossary of terms included in the UNDP briefing kit states that:

> *"Effectiveness is a measure of the extent to which an activity achieves its objectives."*

On further analysis of the above unclear definition, the team concluded that it calls for an address of the economic (in resources and time) use or transformation of inputs into work programme or activities. Effectiveness on the one hand deals with the production of the outputs (planned project results) and an assessment of their contribution to achieving the project purpose as measured by end-of-project-status indicators.

The individual assessments by outputs are given in chapter IV. In reality, it was difficult or impossible to assess the achievement of outputs reported by the project management since "no benchmark" was provided. The overall rating, however based on non-scientific observations, was reported by the team as according to planned and good to satisfactory. Some of the

problems encountered included delays in the provision of inputs. Given the external constraints imposed on the project, accomplished achievements, i.e. established capabilities, are rated as impressive.

Given the afore-mentioned analysis, however, there is compelling evidence to conclude that the purpose of increased and demand-related services is rather diffused. In addition, the continued achievement of this end, as disinvestment financing by Government are launched, could be in doubt. The work programme of the Institute is all embracing - routine analyses, bench work, research activities and pilot plant. The mechanism for approval of the work programme also needs urgent revamping for it to be service-oriented. The current role of the Board, the technical department of NFC, the individual fertilizer institutes that constitute the shareholders, and the Institute, as well as the Chairman and the Ministry of Production is not the most ideal and in its present form could not survive the current direction of Government policy and changing political-economic-industrial environment.

This is not entirely the fault of the project per se (although it was short-sighted, not to speculate on the possibility), but is very pertinent to assessing the relevance, significance and impact of the period.

While the overall effectiveness is rated as good, the future prospect would have been better addressed if the issue of the future fertilizer situation, demand and the Government deregulation policies were addressed.

In addition, effectiveness could have further been enhanced if due cognizance was taken of the role of existing institutions such as NFDC (organizational chart, for easy reference attached as Annex IX), especially since these two institutions could compliment each other and duplication could be minimized.

3. Significance and relevance

The project in as much as it has been "fully" operational for over two years is still not sufficiently tied into the current trend of Government economic policies and objectives as they pertain to the fertilizer subsector specifically, and, the food and agriculture and industrial sectors in general. It was and it still continues to focus entirely on Government-owned industries. The private sector is only brought in through their participating role in the "Technical Advisory Committee". This committee has a purely advisory function and its recommendations are not binding on the Institute or could not on their own, alter the work programme of the Institute. It should be borne in mind that the most influential entities in this respect are the Chairman and the Technical Department of NFC in as much as they provide required technical advise to the Chairman.

In the normal testing and laboratory activities carried out by the Institute, it has been doing a credible job, given the constraints and the "newness" of its operations. It is in the "outreach" services to the fertilizer plants that the Institute can be most helpful. Unfortunately, in the research sector, the work is only partially carried out. Currently, the economic analysis of the cost of developing the results of research undertaken by the Institute itself concentrates, at the most, only the very preliminary analysis. This is one of the weakest areas, excluding training, exposure of research staff, data/informatics, transfer of technology network. Additional and urgent attention is therefore called for. Without a strategic plan,

innovative and forceful leadership by the Managing director. Chairman. Board and Ministry of Production. and the provision of the continued staff motivation. the Institute is unlikely to meet its future challenge.

In conclusion. the FR & DI was established vide this project whose implementation was launched in January 1984. which became operational in 1989. two years behind schedule. During these formative years. it was quite obvious that Government economic policies were public sector involvement driven. Despite the recent drive towards active deregulation. the past status quo continued within the organ and objectives of the Institute. The Institute continued to operate within a public-dominated protected investrial environment. Lately. the effects of the deregulation have begun to be felt. public enterprises have started to be sold to the private sector. A future industrial sector which is essentially private and exposed to eternal competition. demanding higher level of quality cannot be ruled-out. The Institute should be flexible enough to respond adequately to the needs of industry by being service-oriented. It is currently not fully objective driven in its work programme. uncoordinated with the structure of NFC and the interlinkaged between MOP and other relevant ministries. and the outreach services business. The conditions are symptomatic of inadequate central management capabilities and a lack of adequate policy direction. Unless the FR & DI is fundamentally structured to increase the effectiveness of its services. the Institution will become severely constrained and will not be able to adequately respond to the needs of the end users. The mission feels that there is need for urgent action to Institution will become severely constrained and will not be able to adequately respond to the needs of the end users. The mission feels that there is need for urgent action to institute changes in the organizational and strategic outlook of FRDI.

The Institution itself recognizes the need for improvement in its outreach and organizational relationships with the Holding Company. the MOP. Ministry of Planning. Ministry of Agriculture. Ministry of Industry (which in its present mandate handles only private sector. is unable to react by planning and implementing the necessary changes in the current managerial vacuum and the decision hierarchy).

The financing of the FRDI merits some attention. particularly in view of its future viability. In its present mandate and structure. while it is a public company which carries out voluntary services to the private sector. the FRDI is unable to generate additional income from the activity. While this venture could be an important marketing policy that could be capitalized upon in the future. it presently leaves the team to wonder if this act is not an expression of the under-utilization of the time and capabilities of FRDI with respect to the fertilizer subsector for which it was specificallv created. The present financing arrangements were the weighing factor for contribution with budget of FRDI having no bearing to the quality and quantity of service received.

The need for a clearer policy and general direction for FRDI operational management has been repeatedly expressed in this report. The same is expressed regarding the composition and functions of the Board of the FRDI and the Technical Advisory Committee. The frequency and duration of each session leaves one to wonder if technical and managerial issues are seriously addressed or if major decision-making is delegated to the Chairman and indirectly to the technical department of FNC.

4. Impact

The project is a typical institution-building one and therefore, as stated earlier it is impossible for it after just two and a half years of operation, to make an impact on the macro-economic or development objective level. It should, however, be reiterated that, bearing in mind the relative short life-span of the Institution, the potential for a great impact on the fertilizer sector is evident. The provision, however, is that due cognizance be taken of evolving Government policies and the necessary adjustments made. Greater flexibility in the management and programme development should also be made to ensure that the adjustments are properly defined and the proper marketing drive be instituted to attract the continuous attention of the target groups.

B. Conclusions

1. Institute's operation

The mission has ascertained that the Fertilizer Research and Development Institute has been established through the implementation of this project which started in 1984. The Institute's establishment required a period of 5 years under the project until its completion in 1989, two years later than originally envisaged. This period was taken up essentially as one year for preparation, two years for construction, delivery of equipments inputs, and training, and one year of operational experience under the project. This experience has increased with another 2.5 years of further operation, one of them before project completion in December 1989. The immediate objectives of the project for the Institutes establishment has thus been essentially achieved as defined in the project document, to serve the needs of the five companies under the aegis of the NFC. However, the purpose for which the Institute was established raises certain questions in regards to the fundamental premise for the Institute services and the project design. This premise, which was accepted through project approval, assumed that the services of the Institute were needed and that the principal element of assistance was the provision of financial means to purchase sophisticated equipment which are required as the tools for research and development activity concerning the development and utilization of fertilizers.

In reality, the R & D needs of the NFC were not been really established at the time of project design and approval. Thus, the survey to establish such needs was left as an activity within the context of the project which was carried out by Kemira, a sub-contractor for UNIDO. On the basis of such a survey an R & D programme was prepared and a list of the equipment required was established and recommended by end of 1985. This list was subsequently split into equipment to be purchased within the projects budget allocation and equipment left for future consideration.

It is not apparent to the mission if the R & D topics where in fact significant enough to assume that positive results that would significantly increase fertilizer production.

The choice of the R & D programme did not purposely orient the Institutes capabilities to principally raw material utilization, or process improvement, or product quality, or product development nor was consideration given as to the agricultural effectiveness that any such fertilizer potential

improvements would have to justify actual production application. In actual fact the work programme covered a little bit of everything. It should be borne in mind that raw materials are essentially natural gas locally available for nitrogenous fertilizer and phosphate rock which is mainly imported, since local ores are of low grade and limited quantity. In view of the aforementioned, the economic utilization of the local ores is questionable because of processing problems, low efficiency of recovery and low solubility. On the other hand, all processes for fertilizer production in use in the country are standard commercial processes which were acquired through investments which bought the processes and engineering know how from foreign competent international companies. Thus, the expectation of productivity improvement related to urea or phosphatic fertilizer production can be surmised to be marginal considering that no productivity benchmarks have been established for R & D improvements and bearing in mind that all plants of NFC are operating at or above rated capacities.

The increases in fertilizer production in the country have occurred as a result of investments in new production capacities for principally urea in the private sector while NFC and its companies are more oriented to phosphatic fertilizers. These increases in production have been justified on the basis of 5% average annual growth rate in the utilization of fertilizers by the agricultural sector which results principally from the Governments planning actions.

The Government orients the extent of growth of fertilizer through control of prices of the basic 12 agricultural crops which utilize the major amount of fertilizer (inter alia wheat, rice, maize, cotton, sugarcane and tobacco); agricultural credit in fertilizer purchases, subsidy payments on fertilizers and the amount of imported fertilizer purchased by the Government to supply the total needs not served through national production. In this context, subsidy on nitrogenous fertilizer were only discontinued in 1988 while those on phosphatic still apply ranging from 10% to as high as 60%. These subsidies are about to be removed this year responding to conditionalities of World Bank and Asian Development Bank.

It is evident that Government action based on planning considerations is the important instrument that establish the parameters for fertilizer production. Ample evidence exists that points to the fact that urea production is being carried out with significant profitability margins while phosphatic production has a marginal profitability or even a significant loss which arise from the fundamentals of using imported phosphate rock and the related transportation costs, particularly within the country. Furthermore, further investments in phosphatics have to be considered in the context of the port capacity of the harbour facilities in Karachi which are nearly operating at capacity thus requiring investments for enlargement if greater amounts of phosphate rock are to be imported.

These broad policy considerations have overriding effect on fertilizer production and utilization. The potential benefit of R & D activities and the work programme of the Institute needs to be carried within the framework of such broad policy parameters, which is not necessarily the case up to now. It is evident that the Institute's current work programme and R & D results are of marginal value to the country and may be so also to NFC.

2. Institute's capacity

The Institute as established under the project consists of a number of laboratories and facilities previously described, which are suitable for R & D and testing work, having thus created a certain operational capability which is suitable and perhaps amply comfortable for the present level of endeavors.

Under the project, which is institution building, no consideration was given to the institutional development of the FRDI. No definitions or parameters have been provided to ascertain what institutional organization and capability should be developed nor provision has been made to provide the necessary measures for career development for the technical staff and growth of the Institute with corresponding budgetary provision for such growth both in terms of infrastructure and staff. This void is a serious omission from the project which endangers the Institute's viability and future development.

The operational parameters which were defined in the project and achieved are of a static nature which may be ample in terms of equipment service capacity today. Unless further thought and plans are made for the near term (one year), medium term (5 years) and long term there is a distinct danger for the institution to stagnate.

This fact is particularly important when it is appreciated that the inputs for the Institute's technical and scientific capacity came from one source; Kemira, the UNIDO sub-contractor. In fact practically the whole project implementation was given to Kemira including sub-contract obligations, and outside of it provision of training and equipment supply. It was UNIDO who introduced this modality for implementation. In the view of the mission opportunities have been missed to provide the Institute with a some what broader base of expertise by having access to other centers of expertise such as the International Fertilizer Research Institute in Alabama USA. It is evident that such a narrow base for technology transfer limits the Institute capacity and exposes it to the danger that it might try to repeat work that has been done elsewhere and which is easily accessible and shared since fertilizer producers have distinct marketing areas heavily based on national requirements of where their plants are located.

The Institute should be a center of total technical information on fertilizers. This is not the case at the moment since the information base is very modest. Through network arrangements, it could obtain any information required without necessarily incurring the expense of duplicating basic data sources. Thus, its ability to serve industrial needs based on information data sources should be expanded.

The Institute's system to develop its research work programme has been well established. The original research programme proposed by the UNIDO sub-contractor, Kemira, around of 1985 consisted of 27 topics of which 19 only were approved by NFC. These items became the basis for the work activity starting in July 1986 through March 1987 with the help of Kemira staff at site and continuing thereafter till the end of 1987 when nominally, the project was due to be completed. The Institute continued to review and update its research activities on an annual basis on its own starting June 1988 through approval of its work plan by the Institute's Board. Thus, the workplan of 1989 was fully established under the Institute's full responsibility even though the project was only finally completed in December 1989. The real delivery of technical assistance by UNIDO really terminated by early 1988.

The system for research programme definition now rests on the initiative of the Institute based on discussions with each one of the 5 NFC companies and the final approval by the Board every June of each year. The Board is made up of the five Managing Directors, one from each company plus the Technical Manager of NFC and its Chairman.

This system to generate the research work programme seems too constrained to the internal interests of NFC and may result in too narrow approach to the total needs in the country in respect to fertilizer development. The role of the technical advisory committee appears to be insufficiently strong to make significant impact on work programme definition, and the Board is too much of an NFC instrument to guarantee wider aspects of Government policy and interest. Thus, approval system seems to perfunctory and it seems to be more designed to justify the annual operating budget of approximately 6.5 million rupees.

Changes to the system of work programme development may well seem advisable. Nevertheless, the work activities carried out in the four-year operational period are quite credible for a new institution when a total of 29 research reports have been produced, and 54 technical projects have been completed.

The information on follow-up to the work is not too clear, and it seems as if the technical results are not immediately implemented and, in some cases, not even followed through as a research activity that are considered appropriate for implementation.

3. Institute's structure

The Institute's structure was defined by the project document for UNDP assistance. The Institute currently answers to such a design. In this context, it has been well established and has the necessary capabilities to do serious work even though in terms of staff, it has a minimal critical mass of about 30 persons distributed among the many functional activities. This situation makes the institution critically vulnerable if any one staff member is absent or leaves.

In this respect, it is regrettable that the original Institute design, the formulation of the project document and its final preparation by UNIDO do not seem to have the benefit of experience as reflected in the UNDP/UNIDO evaluation of Industrial Research and Service Institutes (IRSI). The project appraisal process by UNDP does not reflect the use of its Programme Advisory Note on the subject, and the further monitoring mechanism of the project implementation did not make use of it. This serious omission should be corrected, particularly taking into account the fact neither the Director nor any of the Institute staff took advantage of fellowships designed for the purpose when the project started and the offer was reiterated at the last tripartite review in June 1989.

Thus, the Institute suffers from lack of experience in the setting up of such institutions and, therefore, is likely to make the same mistakes as many others have made.

The Institute's structure is currently static without benefit of forward planning in regards to institutional development. This shortfall should be corrected. The operational functions established are suitable for its present

initial operative stage at which it finds itself. However, this structure needs to be continuously reviewed on the basis of annual assessment of needs to make sure that the Institute's services answer to practical problems of its end users.

The operational functions which the Institute has established include laboratories, bench-scale units, pilot plants, workshops, and information services. From the very beginning, there were differences of views on the emphasis for the functional activities. Whereas the consultant at project start suggested that it be laboratory and information services, UNIDO emphasized the bench scale & pilot plant development. The emphasis should respond to the need for services. Thus far, however, it is not evident at what scale the industrial services are more needed. It would appear, however, that the information services would be the most critical area where appropriate network arrangements with other institution of competency elsewhere in the world would be beneficial.

Concerning the other functions, part of the problem rests with the fact that the Institute does not provide sufficient emphasis to the economic assessment of the results or even to assess the economic benefits of investigatory work. It is not being suggested that the Institute should be competent to carry full feasibility studies, but it certainly should elaborate opportunity studies as a means to give proper balance to its results and thereby justify the appropriate functional level for the work to be done. Pilot plant work is expensive and should be undertaken only when proper justification is demonstrated. Yet, there is a lot of work to be done which does not require research but mainly technical investigation and solution. There would appear to be greater need for this type of work which lends itself to immediate practical solutions at the production level.

4. Institute's future

The Institute finds itself at a crossroads which is not of its own doing. The relationship of the Institute to the total system that deals with fertilizers must be strengthened. This system includes agricultural production and research, marketing and production of fertilizers, policy planning at a central Government level, universities, and financial institution and organizations that deal with investments.

The Institute recently has been opened to serve private industry, i.e. not merely fertilizer private industry, which is essentially urea production and for which R & D certainly is not very needed to merit high priority. But to all other industry shifting the Institute from being a sector-oriented to a multi-disciplinary one. Such a shift must be carefully assessed because it will need significant increase in infrastructure and staff.

For the moment, the Institute should limit its general services to industry to testing work and not entering into R & D unless there is a comparative advantage to do so.

Privatization is also a new policy orientation of the Government which is just beginning. It is understood that the Asian Development Bank has under way a study for the privatization of NFC. If such a study proves viable, and the NFC companies are privatized, life for the Institute is likely to become more difficult since private industry expects results to concrete problems

quickly and on time within the scope of some confidentiality. The Institute must prepare itself for this eventuality.

The financial sustainability of the Institute under present circumstances can be seen with some uncertainty. If NFC and its companies are not going to be in a position to finance the current budget which is currently at an operating level of 6.5 million rupees, then the Government will need to make arrangements to finance the institution from its own resources. Financing from private industry should be encouraged and services to industry must be paid. However, experience has shown that such services will at best meet 50% of the financing requirements.

Against these policy changes, the Institute is in a period of reflection and preparation. The urgent important actions to take are to review past experience on dealing with industry and defining work programmes, strengthen its information databases through International networking arrangements, develop closer liaison with pertinent national institutions, particularly the Center for National Fertilizer Development.

It should also study the experience of others by referring to the report of the evaluations's study of IRSI and undertaking fellowship tours and training for the Institute Director and senior staff to other similar institutions in the industrialized and developing countries that are dealing with fertilizers. Opportunities for TCDC/ECDC should not be overlooked.

VI. RECOMMENDATIONS

On the basis of its findings the mission has the following recommendations to the Government, UNDP and UNIDO:

1. The Institute should be exposed immediately to the experience gained by UNDP/UNIDO with the provision of assistance in institution-building by particularly making them aware of the UNDP/UNIDO report on the Evaluation of Industrial Research and Service Institute (IRSI). UNIDO should make greater use of this report in its activities of providing advice to developing countries on this subject. UNDP should make full use of the Programme Advisory Note on IRSI in the exercise of its functions of appraisal of any further need for assistance as well as in the monitoring of the implementation of institution building projects.

2. Action should be taken within this year, to develop and integrate the Institute within an international network of similar institutions in order to improve opportunities for technology transfer, information exchange and sharing of relevant experience. In particular, the technical information database of the Institute should be expanded in terms of:

   - o Implementation-oriented systems providing practical answers to nut-and-bolts questions to design engineers, managers, entrepreneurs etc.;
   - o Research-oriented systems providing purely scientific and technical information inputs to research scientists, engineers and technologists.

3. The Director of the Institute and at least two of its senior staff be provided, not later than a year from now, the opportunity to tour similar research institutions of recognized standing in the field of fertilizer development for the purpose of general orientation on institutional development, work programme development and seeking of appropriate information data sources. It should include developing network exchange arrangements with such institutions. In particular, such tours should include a visit to the International Fertilizer Development Center in the United States (an institution assisted by the UNDP and the World Bank) as well as TCDC/ECDC opportunities. The visits to each institution should be of a duration that not only permits exposure to, but also acquiring of the relevant features of experience on the basis of which the Institute's staff should prepare reports with proposals for action and further consideration by the Institute's Board and the Government as required. This should serve the purpose of improvement of the Institute's operations in providing of services to the end users in the country.

4. The Government should review within two years the system for coordination of activities dealing with the fertilizer utilization and development with particular emphasize on the better integration of the Institute at the working level, with the needs and programmes of pertinent Government entities such as the Division of the Plan, the Ministry of Agriculture, the Ministry of Industry, agricultural research institutions, fertilizer marketing organizations, fertilizer production units in the private sector, universities, and financing

institutions, to complement the direct relationships of the Institute with the NFC and the Ministry of Production. The objective of such action is to improve the working-level relationships of the Institute with the totality of the potential users of its capabilities to assure the maximum and optimal utilization of the technical resources available at the Institute. In particular, and before the end of 1991, the relationship at the working level between the National Center for Fertilizer Development and the Institute should be significantly increased, so that these two institutions can better serve their respective mandates and obligations though a closer influence in each other's activities.

5. The Institute should be assisted to develop a plan in institutional development to be achieved within the next two years, that should include:

   (a) The better integration of the Institute into the total system for fertilizer utilization and development;

   (b) The review and possible restructuring of the Board of the Institute to include a more representative spectrum of interest;

   (c) The redefinition of the role and functions of the Technical Advisory Committee so as to make it a more representative body of expertise, covering the widest spectrum of interest and participation, to support and help orient the work activities of the Institute, with the objective of making the Committee's advice more relevant and more influential in the elaboration of the Institute's work programme.

   (d) Elaboration of a career development programme for the staff of the Institute on the basis of continuous review of its present organizational structure to assure that it serves the changing needs of the Institute clients. Such a programme should aim at making sure that there is backstopping for each function and that situations where individual staff absence voids a particular functional capacity be avoided. In this regard, the position of a designated Deputy Director would be highly useful.

6. The development of the work programme of the Institute should have the benefit of a needs assessment to be carried out periodically, at least once per year, and an assessment of client satisfaction. Such programmes should be based on work activities with quantified benchmarks and targets for achievements so that the adequacy of the work can be properly assessed. In such programmes, efforts should be made to recognize opportunities for investments leading to quick practical solutions as distinct from exclusively research programmes.

7. The Institute be encouraged to develop a more structured approach in making economic assessment for the utilization of its results as well as using such technique as a tool to assess the justification for initiating work in terms of preliminary opportunity studies. The Institute should not develop a capacity to undertake full feasibility studies but it ought to be able to offer services and interpret its research results in the context of such preliminary opportunity studies.

Suggestions

In light of the above recommendations, the mission considers that assistance to strengthen or expand the Institute's infrastructure should wait until the effect of the implementation of the above recommendation is observed. On the other hand, the mission considers the ways and means be found to assist the Government, if required, in the implementation of the above recommendations.

VII. LESSONS LEARNED

This evaluation has pointed out the following issues as meriting attention in future programming for such kind of projects:

1. There is evident importance to utilizing the past experience of UNDP/UNIDO to advise Governments on the critical policy questions related to the establishment or strengthening of such institutions. The use of the IRSI study by UNDP/UNIDO should be a mandatory tool in the review and assessment for any request for assistance on this subject matter.

2. The preparation and design of a project on this subject requires considerable thought and organization. Therefore, the use of extended preparatory assistance of one or two years should be utilized to permit for the adequate definition of needs and working out the necessary requisites required including:

   (a) Measures for institutional development;

   (b) Operational work activities;

   (c) Actions taking with the construction and the organization of the institution;

   (d) Framework of the national system of institutions and organizations who will make use or influence the work of the institute to be established.

   The preparatory activities should include as minimum:

   - The definition of need on the basis survey of needs assessment;
   - The definition of the administrative and legal arrangements for the establishment of the institution;
   - The design of the necessary infrastructure;
   - The recruitment of key staff and the advance orientation study tours to similar institutions and formal training which might be required;
   - Institutional development plan.

3. Careful attention must be paid to the sustainability of the proposed institution by ensuring a long-term financial commitment for operation. Efforts should be made from the start to charge for services rendered so as to reach a 50% financing arrangement, preferably with the Government.

4. Once the a project is operational, the work programme is the next important element for action. The elaboration of this programme should have the active participation of participants and end users.

5. The UNDP/CEO Evaluation kit's glossary of terms and checklist is ambiguous in many areas and is not a clear guidance for the preparation of reports. The briefing kit needs clarification, particularly with respect to the content of final reports.

Annex I

TERMS OF REFERENCE

8 March 1990

Joint In depth Evaluation Mission of the Government of Pakistan, UNIDO and UNDP

DP/PAK/83/010

Fertilizer Research and Development Institute, Faisalabad

I. BACKGROUND

Fertilizer production in Pakistan started in early 1958 on a modest scale at Pak-American Fertilizers Limited, Iskanderabad. Production facilities have grown since then and today the nitrogenous fertilizer industry in the country is approaching self-sufficiency. At the time this project was being considered, there were eight companies (nine plants) producing different fertilizers, three of them in the private sector and the rest in the public sector under the management of the National Fertilizer Corporation of Pakistan Limited (NFC). The installed capacities of the plants at that time were:

Public Sector

Name of Company	Product	Annual Capacity
i) Pak-American Fertilizers Limited, Iskanderabad	A.S.	90,000 Tonnes
ii) Lyallpur Chemicals & Fertilizers Limited, Faisalabad and Jaranwala	SSP	90,000 Tonnes
iii) Pakarab-Fertilizers Limited, Multan	NP	304,500 Tonnes
	CAN	450,000 Tonnes
	UREA	59,400 Tonnes
iv) Pak-saudi Fertilizers Limited, Mirpur Mathelo	UREA	557,000 Tonnes
v) Pak-China Fertilizers Limited, Haripur Hazara	UREA	95,700 Tonnes

Private Sector

i) Dawood Hercules Chemicals Limited, Chichoki Mallian	UREA	345,000 Tonnes
ii) EXXON Chemicals (Pakistan) Limited, Daharki	UREA	173,000 Tonnes
iii) Fauji Fertilizer Company, Sadiqabad	UREA	557,000 Tonnes

A project to establish a Fertilizer Research and Development Institute to promote and support the industry was conceived. The project, although relatively comprehensive, concentrated on a limited number of technical subjects which promised early attainment of tangible results and accumulation of experience to form a basis for continued work on selected subjects. The intention of NFC was to pursue this scheme in a consistent way, leading to steady expansion of the Institute so that it ultimately will become fully self-reliant and capable of satisfying all the needs of NFC's companies, particularly in the field of applied industrial research.

Because of the sophisticated, expensive analytical instrumentation presently applied for this type of research, each particular company would not be in a position to establish the required facilities on their own and engage in research for solving their specific problems. On the other hand, foreign expertise and a large number of imported equipment is needed, which could not economically be utilized if located at a single company. For this reason, the companies agreed to join hands and to provide every local financial support which is at their disposal and within the reach of their financial authority to establish the Institute. The support of UNDP/UNIDO was nevertheless required.

Project objectives

The development objective of the project is the achievement of self-reliance of the fertilizer industry of Pakistan in its efforts to satisfy the increasing fertilizer demand of the country through the introduction of the results of R + D in production; utilization of local know-how and raw materials; and the development of methodologies to suit local environment.

The establishment of fertilizer plants in Pakistan was higherto based on imported technologies recommended by foreign consultants and contractors. Unfortunately, some of these technologies turned out to be inappropriate and caused considerable consequential losses to the economy.

In view of the growing demand for fertilizer in the country, Pakistan needs to develop to an economically feasible extent its own chemical process technologies for the fertilizer industry and thus become more independent of imported know-how and techniques. The existing R + D facilities at various Production Units of the National Fertilizer Corporation of Pakistan Limited (NFC) were considered far too inadequate to undertake this challenging task.

The project (immediate) objective was to establish a specialized Fertilizer Research and Development Institute at NFC capable of providing the following services to the national fertilizer industry:

A. Testing services, specifically

   1. Testing of domestic and imported raw materials;
   2. Testing of catalysts, chemicals, lubricants and other auxiliary materials used in the fertilizer industry; and
   3. Testing and quality control of NFC fertilizer products.

B. Advisory services to existing fertilizer production units with the aim of improving their performance.

C. Information services.

The extent to which the above capacities will be deployed by the project is indicated in Part II.E. Outputs of the Project Document.

The Project Document also contains the objective of adapting advanced technologies for the production of straight, compound and blended fertilizers to suit conditions and specific requirements in Pakistan.

For full details of project objectives and outputs envisaged, reference to the full Project Document should be made.

During the Terminal Tripartite Review Meeting held in Faisalabad on 21 June 1989, it was agreed by all the parties concerned to undertake an in-depth evaluation in order to assess the overall achievement of the project and to identify the need for further assistance.

II. SCOPE, PURPOSE AND METHODS OF THE EVALUATION

In accordance with the provisions of the UNDP Policies and Procedures Manual (PPM), the primary purposes of the the in-depth evaluation are as follows:

Project concept and design

A. To assess the achievements of the project against its objectives and outputs.

B. Re-examine the project design to assess whether:

1. The problem the project was supposed to solve was clear and the approach to be used was sound;
2. The beneficiaries and the users of the project results were identified;
3) The objectives and outputs were stated explicitly, precisely and in terms that are verifiable;
4) The objectives were achievable and whether the relationship between the objectives, the outputs, the activities and the inputs was clear, logical and commensurate, given the time and resources available; and
5) A workplan was included in the Project Document and whether it was folowed.

C. To identify and assess factors which have facilitated the achievement of project objectives, as well as those factors that have impeded the fulfillment of those objectives.

In connection with the above, assess project implementation with respect to:

1. The quality and timeliness of the inputs;
2. The quality and timeliness of the activities;
3. The quality and timeliness of the responsiveness of project management to changes in the environment of the project;
4. The quality and timeliness of monitoring and backstopping by all parties to the project; and
5. The efficiency and effectiveness of the sub-contracted portion of the project.

D. To examine the extent to which the results of the project have contributed towards increasing the Institute's capabilities to carry out testing; R + D; advisory and information services as stipulated in the Project Document.

The evaluation mission should record:

1. The results of the project: whether the project is producing or has produced its outputs effectively and efficiently; their quality and how they are being utilized; and whether the project has achieved, or is likely to achieve, its objectives and when.

2. The effect on target group(s) or institutions the project is aimed at. Any unintended effects should be enumerated.

3. The significance of the results achieved for the country or region.

E. As part of the above-mentioned tasks, the evaluation team should especially review and assess the following issues:

1. The performance of the Institute against stated objectives and achievement indicators, especially during the post project phase.

2. The factors which may have caused any shortcomings as identified, including those caused by project implementation performance.

3. Whether the Institute has reached a level for long-term self-sustainability.

4. The extent to which the training provided by the sub-contractor met the specialized needs of the Institute.

5. The extent to which further training is required and how identified training needs can be effectively provided.

6. The extent to which the equipment provided meets the needs of the Institute and whether the equipment is properly utilized.

7. The extent to which the sub-contractor provided equipment at reasonable prices and whether some purchases could have been made locally, thereby freeing resources for other essential requirements.

8. The extent to which the Institute will have adequate resources from the NFC to run and further development of the Centre without UNDP resources.

9. Whether the Pilot Plant has been established as envisaged and whether it is being effectively used for process optimization studies in the fields of input substitutions, production problem solving, etc.

10. The extent to which the Institute is able to provide testing services to NFC with respect to catalysts, raw materials, chemical lubricants and processed products.

11. The extent to which the Institute is capable of identifying technological improvements requirements and how many recommendations have been adopted by NFC.

12. The level, quality and quantity of technical advisory services the Institute is capable of and is actually providing to the fertilizer units of NFC.

13. The quality and utilization of the technical information and documentation services.

14. Whether the Institute is effectively marketing its service capabilities to industry.

15. Whether the Institute should establish closer links with the private sector to inter alia maximize the use of the Institute's service capabilities.

16. Whether the Institute should aim at self-financing.

17. Whether a second phase of the project is required. What the parameters of the second phase should be, including its timing.

18. The extent to which further assistance would provide important benefits to the fertilizer and/or other industries such as the chemical industry.

F. The evaluation team should also record any significant lessons that can be drawn from the experience of the project and its results, in particular anything that worked well and that can be applied to other projects and anything that worked badly and should be avoided in the future.

III. COMPOSITION OF THE MISSION

The evaluation team will be composed of the following:

- One representative of UNDP;
- One representative of the Government of Pakistan; and
- One representative of UNIDO.

These representatives should not have been directly involved in designing, appraisal and implementation of the project.

The team should be composed of persons with the following combination of qualifications:

- Extensive fertilizer industry experience, especially with respect to the establishment and/or management of similar fertilizer service institutes;

- Knowledge of and experience with UN technical co-operation activities in this or related fields; and

- Knowledge of and experience with evaluation methodologies and procedures.

UNIDO will appoint one of the mission representatives as the mission leader.

IV. CONSULTATIONS IN THE FIELD

The mission will maintain close liaison with the resident representative of UNDP in Pakistan, the concerned Government Organisations, local UNIDO staff and the project's national and international staff.

The mission is expected to visit Islamabad, Faisalabad and Lahore and establish close contacts with the end-users both in the private and the public sector.

Although the mission should feel free to discuss with the authorities concerned all matters relevant to its assignment, it is not authorized to make any comments on behalf of UNDP or UNIDO.

V. TIMETABLE AND REPORT OF THE MISSION

Insofar as required, the UNDP and UNIDO mission representatives will receive briefings at their respective headquarters. Upon arrival in Islamabad, the mission will be briefed by the resident representative of UNDP, who will also provide the necessary substantive and administrative support. The mission will attempt to complete its work within a period of three weeks in the field starting at a time suitable to the parties concerned. Upon completion of its work, it will be debriefed by the resident representative of UNDP. At the end of the mission, the resident representative will organize a meeting involving senior Government officials, at which the mission will present and be ready to discuss its initial findings, conclusions and recommendations.

The mission will conclude its findings with an evaluation report written in the UNDP format.

بسم الله الرحمن الرحيم

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NATIONAL FERTILIZER CORPORATION OF PAKISTAN (PVT) LTD.
1st FLOOR ALFALAH (Tail Wing) SHAHRAH - E - QUAID - E - AZAM LAHORE

NFC

NFC/F-181(FR&DI)/ 928

May 29, 1991

Acting General Manager
Fertilizer Research
& Development Institute Ltd
Faisalabad

SUB: REVISION IN EXPENSES SHARING RATIO

Dear Sir,

It is to be intimated that the Chairman NFC has approved the ratios by which recurring expenses of FR&DI are now to be shared by NFC Companies. The revised sharing ratio is given as below:-

		% Share
a)	PFL	46.14
b)	PSFL	39.46
c)	PAFL	2.91
d)	LC&FL	2.49
e)	PCFL	6.78
f)	HPFL	2.22
		100.00

This was in pursuance to the Board of Directors of the Company's desire that ratio for sharing of recurring expenses of FR&DI should be re-examined at NFC level and HPFL being a producing unit should also contribute towards the expenses of the Institute.

You are advised to take necessary action accordingly and allocate the net revenue deficit (Total expenditure minus deferred income reserve & other income) for the year 1990-91 on the revised basis to the operating NFC Units.

Yours faithfully

(ANEES AHMAD)
GENERAL MANAGER (FINANCE)

Annex III

LIST OF EQUIPMENT PROVIDED TO THE PROJECT

AS WELL AS THEIR PLANNED USE

PILOT PLANT SECTION

EQUIPMENT PROVIDED BY NFC

01.	Granulation Pilot Plant.	
02.	Pan Granulator	1 No.
03.	Drum Granulator	
04.	Band Feeder	
05.	Storage Tank Phosphoric Acid 5-8 Ton Capacity	2 Nos.
06.	Inert Removal Unit	
07.	Super Granule bench Equipment	
08.	Steam Generator	

PILOT PLANT SECTION (UNIDO)

Sr. No.	Name of Equipment	U S E S
	Phosphoric Acid Concentration Pilot Plant	
	a. Heat Exchanger b. Evaporation Vessel c. Vacuum Pump d. Diaphram Pump (2 No.)	Concentration of Phosphoric Acid
	Sweco Separator	Sieving
	Pressure Filter Complete	Filteration
	Heating Bath (2 Nos)	
	Top Loading Balance 60 Kg.	Weighing
	Weighing Plate Form 2000-3000 Kg.	Weighing
	Heating Oven/Drier	
	Vibrating Feeder	Feeder
	Hot Plate IKAMAG RCT (2 Nos.)	
	Peristaltic Pump (1 No)	
	Stop Watach (1 No)	
	Generating Set (1 No)	
	Digital Oscilliscope type m 6011 (1 No)	
	Vidio Equipment (1 No)	
	IBM PC-AT Compatible Computer	

LIST OF VEHICLE

Sr. No.	Name of Vehicle	Provided By
01.	Toyota Hilux X-68-1906	UNDP/UNIDO
02.	Toyota Car FDK-4303	NFC
03.	Toyota Hiace FDK-4905	NFC
04.	Suzuki Car FDN-9909	NFC
05.	Suzuki Car FDL-5582	NFC
06.	Suzuki Van FDH-5582	NFC
07.	Suzuki Motorcycle FDH-8871	NFC

LIST OF OFFICE EQUIPMENT (NFC)

Sr. No.	Name of Equipment	Qty	Provided By
01	Silver Reed EX-78 Electronic Typewriter	1 No.	UNDP/UNIDO
02	UBX Photocopier	1 No.	"
03	Silver Reed EX-66 Electronic Typewriter	1 No.	N F C
04	Photocopier	1 No.	N F C
05	Manual Typewriter	1 No.	N F C
06	Punching-cum-Binding Machine	1 No.	N F C
07	Paper cutter	1 No.	N F C
08	IBM Computer	1 No.	UNDP/UNIDO
09	Office Furnishing	-	N F C

FERTILIZER DEVELOPMENT LAB.

LIST OF EQUIPMENT PROVIDED BY NFC

Sr. No.	Name of Equipment	Qty	U S E S
	Peristaltic Pump	2 Nc.	Feeding of Chemicals
	Stirrer	7 No.	Stirring
	Stand Assembly	4 No.	For stirring arrangement
	Flotation Machine	1 No.	Lab. scale flotation studies
	Band Feeder	1 No.	Feeding
	Reactor S.S.	2 No.	Fertilizer Manufacture tests
	Viscometer with Spindles	1 No.	Viscosity Measurement
	Ball Mill	1 No.	Grinding (Wet & Dry)
	Conditioner	2 No.	For preliminary Reaction.
	Temperature Controller	8 No.	Automatic Temperature Controlling in Reactors
	Digital Temp. Contoller	2 No.	
	Compressor	1 No.	For drying product (Hot air)
	Reagent Feeder	2 No.	Feeding of reagents in pilot plant flotation
	Thermocouple	8 No.	Controlling of Temperature
	Refrigerator	1 No.	To cease the reactions.
	Rod Mill	1 No.	Gringding of sample

FERTILIZER DEVELOPMENT LAB.

LIST OF UNIDO EQUIPMENT

Sr. No.	Name of Equipment	Qty	U S E S
01	Balance Sartorius 3862	1 No.	Weighing
02	Balance Sartorius 3826	1 No.	Weighing
03	Balance Precision Mettler 360	1 No.	Weighing
04	Band Feeder	1 No.	Rock Feeding
05	PID Controller	1 No.	Automatic Control of Temperature in the reactor
06	Feeding Chanel type DRT.75	1 No.	For Beneficiation studies.
07	Control Centre	1 No.	Automatic control of temerature in the reactors.
08	Denver Spiral trough, Wet reagent	1 No.	
09	Feeder	1 No.	Pilot Plant flotation studies
10	Flotation Machine 6 Cell 935/3	1 No.	
11	Ammonia Gauge	1 No.	Controlled Feeding of Ammonia.
12	Microscope Stereo	1 No.	Crystallcgraphic studies.
13	Heating Mantle 500 ml	1 No.	
14	Heating Mantle 1000 ml	1 No.	Heating purpose
15	Heating Mantel 2000 ml	1 No.	
16	Oven	1 No.	Heating & Drying.
17	Vacuum Pump	1 No.	Filteration
18	pH Meter Digital	2 No.	pH determination
19	Peristaltic Pump 1-100 (2) 6-600 (1)	3 No. 1 No.	Feeding of Acids Filteration
20	Diaphragm Pump. Type MES	4 No.	Stirring
21	SWR 226-514 Rotar Haildolph	5 No.	Fertilizer Manufacture tests
22	Reactor SS	2 No.	Heating & Stirring
23	Magnetic Stirrer	4 No.	Stirring
24	SWR 220-010 Stirrer Haildolph	4 No.	For arranging experiments
25	SWR 226-5306 Stand Assembly	1 No.	Sieving
26	Sieve Set with Vibrator	1 No.	Sulfate determination
27	Turbidimeter C/W RT	1 No.	For recording time duration
28	Stop Watch Digital	1 No.	For cleaning Sieves
29	Ultrasonic Bath Ball Mill	1 No.	Grinding
30	Triple Beam Balance	1 No.	Weighing
31	Vibrating Feeder	1 No.	Feeding
32	Conditioner	1 No.	For preliminary Reaction
33	Crusher	3 No.	Crushing of rocks.
34	Reagent Feeder.	1 No.	Feeding of reagents in flotation pilot plant.

SPECIAL CHEMICAL DEVELOPMENT LAB.

Sr. No.	N F C Equipment	Qty	U S E S
01	Cooling Tower	1	For Evaluation of water Treatment Chemicals
02	Refrgetor 10 ft^3.	1	For the storage of organic solvents
03	Dube Oil Reclamation Unit	1	For the purification of used lubricating oil of NFC.

SPECIAL CHEMICALA DEVELOPMENT LAB: (UNIDO)

Sr No.	Description of Equipment Donated by UNDP/UNIDO	Qty	U S E S
1.	Mettler Balance AE 166	1	To get accurate weight of chemicals.
2.	Refractometer	1	To determine purity of Organic Solvents.
3	Kotterman Shaking Bath	1	For microbiological culture growth. For homogenous mixing at controlled temp.
4	Rotavapour Bouchi 461	1	For urea coating purpose. Separation of organic solvents.
5	Low Tem. Circulating Bath Lauda RM 20	1	For carry out organic reaction at low temperature and high temperature.
6	Vacuum Oven Heraeus VTR 5036	1	Under vacuum drying of organic ompound.
7	Hot Plat IKAMAG RCT	1	Generally purpose heating and stirring.
8	Drying Oven Heraeus	2	For drying of Glassware.
9	Branson 120 Ultrasonic Cleaner Bath	1	For cleaning of Corrosion Coupons.
10	Hermal Centrifuge	1	For Separation of suspended matter in Lube Oil etc.
11	Julabo High Temp. Circulating Bath (Low Capcity)	1	To provide high temperature circulating fluids in order to maintain required temperature in Organic synthesis.
12	Haake 001-0623 Circulating Bath (High Capacity)	1	
13	Chromatography Equipmet	2	For physical separation of organic compound
14	Triple Beam Balance	1	Weighing of Chemicals.
15	BHD Basket Centrifuge	1	For separation of micro-particles.
16	Crison Micro pH 2002	1	For the determination of pH of water and other products.
17	Electromantle	3	To carry out organic synthesis reaction at controlled temperature.
18	Part Pressure Reactor 4542	1	For the hydrolysis of Fatty oils.
19	Potentiostat/Galvanostat Model-273 with Apple 11e and Epsn Printer	1	For corrosion studies
20	Hitachi UV Spectrophotometer 100-10	1	UV/Coorimetric analysis.

21	Hitachi 270-30 I.R. Spectrophotometer	1	To determine Functional Groups of Organic compounds.
22	Conductivity Meter PCM 3	1	To determine the conductivity of water etc.
23	Digital Colony Counter DC 3	1	For the counting of microboilogical colonies.
24	Microscope Olympus BH2 with Photomicrographic system	1	Microbiological/Crystallographic studies.
25	Retterman Incubator 2770	1	For incubation of microbiological cultures.
26	Gilson differential Respirometer	1	For the evaluation of Biocide.
27	Melting Point Temprature.	1	For the determination of melting point of organic compounds.

ANALYTICAL PHYSICAL LAB EQUIPMENT LIST INPUT BY UNIDO

Sr. No.	Name of Equipment	Quantity	U s e s
01.	Flame Photometer	1	Analysis
02.	Auto Dispensing Apparatus	1	"
03.	UV Spectrophotometer	1	"
04.	Gas Chromatograph	1	"
05.	HPLC Chromatograph	1	"
06.	Viscometer	1	"
07.	Water Bath Shaker Model 3047	1	"
08.	PH Meter Digital	1	"
09.	Triple Beam Balance	1	"
10.	Heraeus T5042 EK Heating and Drying oven	1	"
11.	Stop Watches	1	"
12.	Orsate Apparatus Type C 10 612	1	"
13.	Conductivity Meter P CM3	1	"
14.	DL 18 Kari Fischer Titrator	1	"
15.	GA44 Alphanumerical Printer	1	"
16.	DL40RC Mettler Memotitrator	1	"
17.	Fuly Electronic Macro Analytical Balance	1	"
18.	Electronic Presision Balance PE360	1	"
19.	184-8191 A Immersion Circulator D 8-9	1	"
20.	LAUDA Compact Low-temperature Thermostat RMT 20 S/N G22002-003	1	"
21.	B-321 220/50 SPEC 7MM EL Distillation Unit No.351001	1	"
22.	B430 KJEHLDAHL Apparatus No.51 781	1	"
23.	Ministrob 600 Flashilight Stroboscope Appliance No. 12611/85	1	"
24.	Sartoriu Electronic Precision Balance Type 1507 MP8	1	"

25.	335 Laboratory Sieving Machine Type Vibro	1	"
26.	Critical Relative Humidity Meter	1	"
27.	Abrasion Resistance Meter	1	"
28.	Measurement of Dustiness	1	"
29.	Angle of Repose Meter	1	"
30.	Measurement of Self-Sustaining Decomposition	1	"
31.	Measurement of Flowability of Fertilizer	1	"
32.	Shattering Test	1	"
33.	Granule Roundness Measurement	1	"
34.	Caking Measurement Equipment	1	"
35.	Sieve Analysis Equipment	1	"
36.	Salar Digital Sampler	1	"
37.	Rinsing Value Manual 10 Channel	1	"
38.	Peristaltic Pump 16CH.W.AIRINJ	1	"
39.	2 CH Module Holder Complete	1	"
40.	Module NH4	1	"
41.	Circulating Waterbath	1	"
42.	Power Supply for 2 x 6000	1	"
43.	Photometer PLUT-IN Module 6000	1	"
44.	Recorder 2 Channel Flatbed	1	"
45.	2 Channel Datasystem	1	"
46.	Start up KIT	1	"
47.	251605 GAS Meter for experimental Work Plast for dry tests, 2Ltr With Screw Thread 3/4.	1	"
48.	Gallen Kamp Viscometer, Universal	1	"
49.	Torison	1	"
50.	Vacuum Pump Model S4A	1	"
51.	Muffle Furnace Model KS120	1	"
52.	Muffle Furnace Model MR260	1	"

53.	Water Still No.2012 Fuly Automatic	1	"
54.	Falling Ball Viscometer Model B	1	"
55.	Heating Bath and Irculator Model D 8-1	1	"
56.	IKA Calorimeter Thermostal C 400 Adiabatic	1	"
57.	Calorimeter BOMB 7 CI	1	"
58.	Tablet Press C21	1	"
59.	Oxygen Purifier C30	1	"
60.	Cooling Water Supply KV 400	1	"
61.	IKA-TRON Digital Calorimeter Thermometer KDT 400 C	1	"
62.	Control Calculator and Recording Unit SRD 100, Complete	1	"
63.	Digital Oscilloscope type M 6011	1	"
64.	Showa Pellet Tester Type PT-11 (Alongwith Indication) with X-Y Recorder	1	"
65.	Varian Techtron Atomic Absorption Double Beam Spectrophotometer Model AA-1475ABD	1	"
66.	Air Compressor with aire service unit	1	"
67.	urner: Nitrous oxide/Acetylene	1	"
68.	Maintenance KIT for AA-1275/1475 for routine operations	1	"
69.	IEE Alphanumeric Printer/Plotter	1	"
70.	"I" Option for AA-1275/1475	1	"
71.	Recorder L-1201, Part No.00-100360-02	1	"
72.	2 Froncol 5 Mili I-RO 15 50H_z No cart	1	"

LIST OF EQUIPMENT INPUT BY NFC
ANALYTICAL / PHYSICAL

i)	Spares of all equipments	8 No
ii)	Hollow cathod Lamps	6 No
iii)	Gas Cylinder with regulator	2 No
iv)	Cappillary column of gas Chromotograph	2 No
v)	Four valves of G.C.	1 No
vi)	Columns of G.C.	1 No
vii)	Memmert oven UL-50 large size	1 No
viii)	Water bath China	1 No
ix)	Hot Plate	
x)	Vacuum pump	
xi)	Glass are of general Lab. use	
xii)	Chemical and standard of Lab. use	
xiii)	Furniture & Fixture of laboratories.	
xiv)	five alarm and extinguisting system	
xv)	Airconditioning/Natural gas/electricity telephone and water supply system	
xvi)	Common Fensik capillay tubes	6 No
xvii)	Brookfield viscometer with disk	1 No
xviii)	Bulk density apparatus	1 No
xix)	Desicators	6 No
xx)	Buld density meter	1 No
xxi)	Refrigegator	1 No

PROJECT IMPLEMENTATION DETAIL

Sr.No	Activity	Duration Planned	A c t u a l	R e m a r k s
01.	Civil Engineering design of Building Building and utilities/infrastructure	January - February 1984	Nov. 1983 (preliminary May/ June 1984 (Revised)	Amendment made as per instruction of short term consultant
02	Erection of Building	January 1984 - June 1985	Feb 1985 - July 1986	Due to redesigning/civil work could not be stared as planned.
03	Appointment of Staff	Jan 1984 - December 1985	Prior Jan 84-Oct 1985	
04	Short-term consultant	January - February 1984	March-April 1984	
05	Signing of Sub-Contract	April 1984	December 1984	UNIDO Vienna knows better about delay in contracting
06	Execution of Sub-Contracted	June 1984 to Dec 1986	Feb 1985-March 1987	
07	Purchase of equipment	August 1984-February 1985	December 85-August 86 Jan 89 (Reappropriation)	Delayed due to budget reappropriation because of crucy fluctuation rate.
08	Installation of equipment	July 1985 - April 1986	July - August 1986	---------- Do ----------
09	Study Tours	March - November 1985	Nil	
10	Fellowship Training	July 1984 - July 1985	September 1985-July 1986	Sent in two split teams of local training first.
11.	Preparation of detailed Research Work Plan	June 1985	July 185 - January 1986	
12.	Execution of Research Programme (Initial operation of the Institute)	December 1985-Dec 1986	July 1986	Due to subcontractor late arrival in Pakistan
13.	Reporting and evaluation (Sub-contract)			
	i. Progress Report	June 1984-Dec 1984 June 1985-Dec 1985 June 1986	March, June, Sep, Dec 84 & March, June Sep, Dec 85 March, June, Sept & Jan 87	---------- Do ----------
	ii. Tri-Partitie Review meeting	Dec 1984, Dec 1985, Oct 1986	Feb 1985, March 1987, June 1989	
	iii. Project Evaluation	Oct 84, Oct 85, August 86	December 1985	
	iv. Draft terminl report (Sub-Contractor)	September 1986	April 1987	

Annex IV

DETAIL OF THE RESEARCH PROJECTS COMPLETED

S.No.	Title of Research Project	Objectives	Conclusion	Benefit
01.	beneficiation studies for the up-gradation of Eastern Phosphorite.	To beneficiate local low grade phosphate rock to make it suitabe for manufacture of phosphatice fertilizer.	- Up-gradation upto 33%- P_2O_5 with 83% recovery is possible. - Impurities (SiO_2) cut down from 24% to 8%.	Know-how/experties in this field have been developed at pilot plant level.
02.	Manufacture of TSP from local Phosphate rock	To assess suitability of TSP manufacture from local rock and its product acid.	TSP 46% P_2O_5 (80% water-soluble with 97% available P_2O_5) can be manufactured.	Utilization of local siliceous deposit - Foreign exchange can be saved. - Experties developed to do such work for utlization of other indigenous deposit.
03.	Manufacturing of compound fertilizer 16:16:16 using local siliceous, dolomitic & imported Jordan rocks by mixed acid process.	- To compare the behavious of local rock phosphate deposits with commercial (Jordan rock/Phosphoric acid).	- 16:16:16 grade can be-manufactured. - Siliceous rock gave better results for manufacture this grade-as compared to dolomitic rock phosphate.	Fertilizer of uniform granules Composition - Expertise/know-how for develomp a complex grade fertilizer achieved. Import of Fruit and Vegetable Fertilizer can be reduce (2 million ton/year requirement)
04.	Water Treatment Chemicals	Development of local and economical substitute of imported water treatment chemicals	Substitute of an imported-Biocide was developed.	Know-how/expertiese in this field developed - Other chemical industries also coming forward to benefit from our caliber - Minimum benefit of Rs.54,000/ year can be achieved by the produced.
05.	Reclamation of Lube Oils.	Development of economical methods for reclamation of used lubricating oils of NFC Units presently sold as waste.	- The experiments and-economic feasibility indicted that oil can be reclaimed. - Plant scale reclamation-is possible.	Re-utilization of oils which were being sold as waste. - Saving of handsome amount (about 50%) Expertisen/know-how developed for further research work in this field.

Annex V

06.	Increasing quantity and quality of Zinc Sulphate unit at LC&FL.	To develop a continuous process and optimize the operating parameters for Zinc Sulfate manufacturing at Plant. level.	- Operating parameters which effect the optimum percentage yield were investigated/identified. - Fo quality improvement measures were proposed.	At plant, capacity/quality was enhanced. Farmer's confidence developed due to better quality. Import of this micronutrient was reduced. - Rice yield was enhanced.
07.	Elimination of SO_2/SO_3 from the stacks of sulphuric acid plants and comparison of soda and ammonia wash methods.	- To reduce the discharge of SO_2 from stack which is polluting atmosphere/sorronding locality.	Scrubbing the gas with Scdium Carbonate at Lab. and Plant gave better results.	Adjoining areas polution due to gas will be reduced. - Basic expertise/know-how developed for scrubbing the other gaseous at fertilizer plant developed. - Other chemical/process industries are approaching for monitoring their gas discharge. - A profitable by-product will be formed. - Stack tower is being designed on the basis of our work by design group of NFC.
08.	Removal of fluorides from dirty cooling wate of Pakarab Fertlizer.	To investigate malfunctioning of the effluent treatment plant for fluoride removal.	- Flouride level can be reduced by modifying the unit and process. - Level of Flouride can be further reduced by addition of fiacullant in the system (400 to 6 ppm).	Level of flouride in the effluent water is reduced within acceptable limit. Hence water can be used for agriculture purpose. Know-how/Expertise for effluent treatment developed.
09.	Pilot Plant studies for the concentration of local impure phosphoric acid.	Concentration of phosphoric acid produced from local rock upto 50% for making TSP, MAP, DAP and investigate the problem due to impurities.	- Upto 37% P_2O_5 concentration for dolomitic phosphate is possbile. - The concentration of prduct acid from Jordan rock upto 52% is possible without any	Know-how of this field was developed. Scale up of piot plant has become possible.

			problem. - Upto 50% P_2O_5 concentration of cid for Eastern rock is possible.	
10.	Manufacturing of 10:20:20: grade using silicous dolomitic and imported (Jordan rock).	- To assess the suitability of local rocks and their concentrated acids for manufacture of 10:20:20 grade. - To identify the problems for developing this grade.	- Performance of siliceous- and imported (Jordan) rock was found better than dolomitic phosphate-rock. - Flow of reacted slury was problematic in case of dolamatic. - P_2O_5 water soluble was low (75%) with dolomitic rock as compared to imported (89%).	Manufacturing of compound instead of blended fertilizer is posible. 10:20:20 grade which has been found best fertilizer for Tobacco in Country, its local manufacturing will be possible. Presently being imported . (15000 Ton/Year) - Expertises/know-how for developing such complex grade has been achieved.
11.	Parameters otimization of SSP granulation at existing granulation plant and using ench scale Pan ranulator.	Optimization of operating parameters for SSP granulation at plant for its smooth operation.	- Conditions of cured and-uncured product identified. - Improvement in the feed system was studied. - Uniformity and consistancy in flow of solid feed was necessary. - Improvement of the crushing system and dryer needed.	Know -how /expertise in granulation was developed. - Standard granulation of SSP was achieved. - Pan granulator know-how for solid and slurry product was developed.
12.	Bench scale studies for blending and granulation of NPK 10:20:20 grade.	To investigate whether NPK grade of fertilizer required for Tobacco crops can be economically developed locally by blending.	A fertilizer grade 10:20:20-can be developed in an economical way be blending.-(Improt 15000 ton/Year).	Saving of foreing exchange. Timely availability of this fertilizer to farmers. - Agronomically responsed better than imported

				one.
13.	On stream chemical cleaning of polyblock heat exchanger at LC&FL.	To develop a chemical method so that cleaning of polyblock could be carried out effectively without opening the heat exchangers.	Polyblocks can be cleaned effectively by the procedures developed at FR&DI without opening the heat exchangers.	Frequent plant shut down eliminated. Replacement of spare parts reduced.
14.	CAN Caking elimination studies.	To determine effective and suitable method for elimination of CAN Caking.	- To reach the full crystal stability more potassium sulfate is necessary. - The coating with inert powder after application of oil Amine will decrease caking.	Better maintenance of keeping quality. Improvement in marketability.
15.	A report on Corrosion control of Calcium Nitrate Brine Circuit at NP plant at Pakarab Fertilizer.	To study corrosion problem of CN brine circuit and suggest effecive preventive measures.	Problem was solved after improving the surface preparation technique on welded joints.	Reduction of production cost due to non recycling of caked material. - Reductin of loses of brine solution - Reduction of frequent repair and maintenance.
16.	A report on development of Antifoaming Chemicals for Pakarab Fertilizer.	Development of local substitute for imported antifoaming chemicals used in NP process.	- Local substitute developed. - Efficiency is almost same as compared with imported antifoam.	Improvement in cooling efficiency. - Foreign exchange savig. Timely avilability of product - Know-how and expertise in this filed achieved.
17.	Bench scale studies for the evaluation of eastern rock phosphate for phosphoric acid and phosphatic fertilizers manufacture.	Possible utilization of local deposits for manufacture of dihydrate/phosphoric acid to make MAP/DAP and TSP by DEN/Slurry Process.	- H_3PO_4 can be manufactured with low P_2O_5 content 26% P_2O_5) - Various fertilizer grades like TSP, MAP and DAP can be produced by this acid.	Utilization of local ore bodies. - Development of know-how for making convensional grades fertilizers.
18.	Bench scale studies for evaluation of Batkanala	-do-	- Weak acid (18% P_2O_5) can be manufactured.	-do-

	rock phosphate for phosphoric acid and phosphatic fertilizers manufacture.		- Acid produced contain impurities. - Fertilizer product quality is also poor due to impurities.	
19.	Bench scale studies for the evaluation of Southern rock phosphate for phosphoric acid and phosphatic fertilizers manufacture.	-do-	-do-	-do-
20.	Bench scale studies fo the valuatioon of composite rock phosphate for phosphoric acid and phosphatic fertilizers manufacture.	-do-	- Phosphoric acid of 25% P_2O_5 can be produced. - P_2O_5 recovery is better than dolomitic rock phosphate. - Fertilizer product (TSP) keeping quality was not satisfactry due to hygroscopic nature.	-do-
21.	Bnch scale studies for the evaluation of Beneficited Eastern rock phosphate for phosphoric acid and phosphatic fertilizers manufacture.	-do-	- P_2O_5 recovery and filtration rate of beneficiated were better. - Quality of TSP formed was non-hygroscopic and free-flowing	-do-
22.	Bench scale studies for the evaluation of 1:1 blend of Jordan - Composite ock phosphate for phosphoric acid and phosphatic fertilizers manufacture.	Possible utilization of local deposits for manufacture of dihydrate/phosphoric acid to make MAP/DAP and TSP by Den/Slurry Proces.	- Overall P_2O_5 recvery- and filtration rate was better than composite-rock for manufacture of H_3PO_4. - TSP formed was non-hygroscopic	Utilization of local ore bodies. Development of know-hcw for making convensionl grades fertilizers.

			- Phosphatic fertilizer can be manufactured safely by this blend.	
23.	Evaluation of Imported fertilizer raw-materials phosphaterock.	Evaluation of different phosphate rock other than Jordan for manufacture of SSP.	i) Egyption rock:- - Consumption of acid will be higher than Jordan. - Due to high MgO content, end poduct is sticky with low water solubility. - Excessive foaming due to higher carbonate content. ii) Sri-Lankan rock:- - Due to excesive amount of R_2O_3, its processing for quality of SSP manufacture will be difficult as end product is wet. iii) Chinese rock:- - Desireable reaction rate can be achieved by increasing the fineness. (about 82-200 mesh). - Carbonate content are low than Jordan rock. - Impurities are witin persmissible range.	- Selection of alternate raw materials for running our plants to manufacture phosphatic fertilizer. - Data generation for reference about various sources of rock in the World.

Sr. No.	Project Title	Date Drafted	Date Finished	Duration Month	Man-Hours	Results	Type of Raw Material	Material Cost	For whom Carried Out	Problem
1.	Beneficiation of Batkanala rock (Dolomitic Rock)	July 1986	June 1988	24	330	Rock P_2O_5 24% Concentrate 25-26% Poor P_2O_5 Grade P_2O_5 recovery upto 50% (Low)	Batkanala Rock usual Lab. chemical and Glassware. Collector, Oleic acid + Fuel Oil Antidepressant Na_2CO_3 Depressant Na_2SiO_3	7,600	SDA NWFP Govt.	(Dolomite & Apatite) minerals gives poor
2.	Beneficiation of Eastern Rock (Siliceous) Lab./Bench scale studies	April 1987	June 1988	15	660	Rock up-graded from 28% P_2O_5 to 34% P_2O_5 while SiO_2 was reduced to 9% from 16-22% P_2O_5 recovery efficiency was 65-70%	Collector. Oleic acid acid + Fuel Oil Dow Fex Antidepressant Na_2CO_3 Depressant Na_2SiO_3 Usual Lab. chemical	9,500	SDA NWFP Govt	
3.	Beneficaition of Eastern Rock Pilot Plant Studies	July 1988	June 1989	12	520	As a result of Pilot plant studies 10-12 ton Eastern rock was beneficiated. P_2O_5 of the rock was up-graded from 29-34% while SiO_2 was reduced to 9% from 16-22% SiO_2 in the rock 55-65% flotability (efficiency) of P_2O_5 was achieved.	- Conditions was fabricated - Reagent feeder fabricated. Oleic Acid Fuel Oil Na_2CO_3 Na_2SiO_3 12-15 ton Eastern Rock	12,800	SDA NWFP Govt	
4.	Beneficiation of Malakand rock Carbonatite Lab./bench Scale	July 1989	June 1990	12	390	Malakand rock containing 3-5 P_2O_5 can be up-graded to 28% P_2O_5 with 65-75% recovery efficiency.	Imported flotation - Chemical - Na_2CO_3 - Na_2SiO_3 - Malaknad Rock	9,800	SDA NWFP Govt	
5.	Beneficiation of Malakand Rock Pilot Plant studies	July 1990	Under Progress	12 three man-month delay expected	410	Crushing, grinding of the Malakand optimized at pilot level. Flotation pilot plant trials will be started from 1st July & will be completed upto September, 1991	Imported flotation - Chemical - Na_2CO_3 - Na_2SiO_3 - Malakand Rock 20 Ton	6,000	SDA NWFP Govt	
6.	Evaluation of	July	December	6	250	- Phosphoric acid of 28-30%	- Phosphate Rock	8,800	SDA	

	Eatern Phosphate rocks for Phosphoric Acid manufactured.	1986	1986			P_2O_5 with better recovery efficiency 96% and having 4-5 ton/m^2/day	- Sulphuric Acid		NWFP Govt	
7.	Bench scale Continuous studies for the manufacture of MAP, DAP & TSP Eastern Rock Product Acid (Phosphoric Acid)	January 1987	September 1987	9	330	- Bench scale Ammoniate, Eastern Rock Phosphoric Acid produced MAP 11-50-0 DAP 14-48-0 (Satisfactory) - Den Process - Slurry Process Experiments completed. TSP of 46% P_2O_5 with good physical quality formed.	- Ammonia gas - Phosphoric Acid of Eastern Rock - Eastern Rock - Usual Lab. Chemicals & Glassware.	7,000	SDA NWFP Govt.	
8.	Evaluation of Batakanala Phosphate Rock for Phosphoric acid manufacture	October 1987	December 1987	3	330	Impure Acid of low P_2O_5 contents 18-22% P_2O_5 with very low filteration less than 2 Ton P_2O_5/m^2/day 67-91 recovery efficiency	- Phosphate Rock - Sulphuric Acid - Other Chemicals	6,800	SDA NWFP Govt	Low recover & Filterati rate due to 4-5% MgO in Rock
	Evaluation of Southern Phosphate Rock for phosphoric Acid Manufacture	January 1988	March 1988	3	330	Impure acid low P_2O_5 content 19-21% P_2O_5 with poor filteration 2-3.5 Ton/P_2O_5/m^2/- day was achieved. P_2O_5 recovery efficiency 80-85% was achieved.	- Phosphate Rock - Sulphuric Acid - Other Chemicals	5,900	SDA NWFP Govt	Low recover & filterati rate due to 4-5% MgO in Rock

Sr. No.	Project Title	Date Drafted	Date Finished	Duration Month	Man-Hours	Results	Type of Raw Material	Material Cost	For whom Carried Out	Problem
10.	Bench scale Ammoniation of Batkanala Phosphoric Acid of MAP DAP manufacture.	June 1988	September 1988	3	330	Due to high MgO (3%) in the Acid Ammoniation was problemati (Viscosity max.) No Fluidity poor grade MAP - 9-38-0 DAP - 16-36-0 achieved.	- Ammonia - Phosphoric Acid	6,000	SDA NWFP Govt	
11.	Evaluation of phosphoric using composite Rock.	June 1988	September 1988	3	330	Product Acid 26-28% P_2O_5 low filteration Rate 1.9 - 2 Ton/m^2/day Recovery efficiency 88-92%	- Phosphate Rock - Sulphuric Acid	5,500	SDA NWFP Govt	
12.	Bench scale studies for the Evaluation of Jordan Rock, Jordan Acid.. Composite Rock, Composite Acid for TSP manufacture.	October 1988	December 1988	3	390	With Jordan rock, Jordan Acid TSP of 46% P_2O_5 was good physical condition achieved. With Composite Rock & Composite Hygroscopic TSP was achieved due to 2% MgO in Acid.	- Phosphoric Acid - Phosphate Rock - Jordan Rock - Glassware (General)	8,800	SDA NWFP Govt	
13.	Bench scale studies for the manufacture MAP/DAP using	January 1989	March 1989	3	390	Satisfactory grade of MAP - 10-50 DAP - 15-46	- Ammonia Gas - Phosphoric Acid - Glassware (General)	8,000	SDA NWFP Govt	

	product Acid.					phosphoic acid.			
14.	Bench scale studies for the manufacture MAP, DAP & TSP using 1:1 blend of Composite & Jordan Rock	July 1989	September 1989	3	390	Satisfactory TSP 46% P_2O_5 and MAP & DAP was produced.	- Ammonia Gas - Phosphoric Acid - Chemical	6,000	SDA NWFP Govt
15.	Bench scalse studies for the manufacture of MAP, DAP & TSP using Product Acid of Beneficiated Eastern Rock	October 1989	December 1989	3	260	Satisfactory grade of TSP 46% P_2O_5 and good quality MAP & DAP was produced. MAP 12-53-0 DAP 18-48-0 (saisfactory grade).	- Ammonia Gas - Phosphoric Acid - Sulphuric Acid - Phosphate Rock	9,000	SDA NWFP Govt

Sr. No.	Project Title	Date Drafted	Date Finished	Duration Month	Man-Hours	Results	Type of Raw Material	Material Cost	For whom Carried Out	Problem
16.	Micronutrient Development Urea basd Complex	October 1987	June 1989	24	520	Preparation of straight Micronutrient Fe_2O_3 15% Nitrogen 25% ZnO 15% Nitrogen 25% CuO 15% Nitrogen 25%	- Ferrous Sulphate - Zinc Sulphate - Ferrous Sulphate - Copper Sulphate - Urea - Chelating Compound	15,000	NFC/ NFML	
17.	Manufacture of NPK 16:16:16 using Eastern Rock Bench scale studies	April 1988	June 1988	3	330	NPK grade of 13, 15, 16 was was achieved.	- Phosphoric Acid - Sulphuric Acid - Phosphate Rock - Ammonia Gas - Nitric Acid	9,000	NFC	
18.	Manufacture of NPK 10:20:20 using Eastern rock	April 1989	June 1989	3	330	NPK grade of 8:19:19 was achieved.	- Phosphoric Acid - Sulphuric Acid - Phosphate Rock - Ammonia Gas - Nitric Acid	10,000	NFC	
19.	Manufacture of NPK 16:16:16, 10:20:20 using Beneficiaited Eastern Rock Bench scale studies.	January 1990	March 1990	3	330	Required grade 16:16:16 10:20:20 could be achieved	- Phosphoric Acid - Sulphuric Acid - Phosphate rock - Ammonia Gas - Nitric Acid	15,000	NFC	
20.	Manufacture of NPK 16:16:16 10:20:20 using Batkanala Dolomitic Rock & Jordan Rock	April 1990	June 1990	3	330	Dolomitic rock having MgO 5% could also be utilized and the required grade 16:16:16 & 10:20:20 could be achieved	- Phosphoric Acid - Sulphuric Acid - Phosphate rock - Ammonia Gas - Nitric Acid	15,000	NFC	
21.	Manufacture of NPK 13:13:21 using Batkanala rock dolomitic	January 1991	March 1991	3	330	Dolomitic rock having high MgO 5% can be utilized and required grade 13:13:21 could be achieved.	- Phosphoric Acid - Sulphuric Acid - Phosphoric Acid - Ammonia Gas - Nitric Acid	11,000	NFC	

Sr. No.	Project Title	Date Drafted	Date Finished	Duration Month	Man-Hours	Results	Type of Raw Material	Material Cost	For whom Carried Out	Problem
22.	Manufacture of pure Phosphoric acid through HCI route.	July 1988	June 1990	24	910	- P_2O_5 conversion efficiency 99% - Extraction efficiency 95% & stripping efficiency of 100% was achieved. Phosphoric acid of 15% P_2O_5 was produced.	- n-Butyl alcohol - Aldehyde - Iso-butyle alcohol - Amyl alcohol	27,000	NFC	
23.	Partial Acidulation of Rock	July 1990	June 1991	12	400	Partially acidulated rock having 45-60% water solubility and 20-25% Citrate solubility can be produced by using 30-40% less sulphuric acid of 60% concentration	- Phosphate rock - Sulphoric Acid	4,000	NFC	
24.	Tailoring Urea to Urea Nitrate Phosphate 27-9 grade.	July 1990	June 1991	12	2080	UNP grade 27:9 was developed and it is being produced at the rate of 8kg/hour at bench scale unit continuously.	- Urea - Nitric acid - Phosphate rock	9,000	NFC	
25.	Reclamation of Refrigeration Oil Calvus-15	July 1986	June 1987	12	1175	Oil was successfully reclaimed (Report submitted to the Unit)	- Used Oil - Clay - Filter Cloth	5000	PAFL	
26.	Reclamation of Refrigeration Oil Clavus - 68	July 1987	March 1988	9	800	Oil was successfully reclaimed (Report submitted to the Unit)	- Used Oil - Clay - Filter Cloth	5000	PFL	
27.	Reclamation of Compressor Oil Perfecto SS	July 1988	April 1991	22	1500	Successul reclamation in Lab. Trial on pilot scale relamation at	- Base Oil - Used Oil - Clay PCFL was carried out.	15000 - Filter Cloth	PCFL	
28.	Reclamation of Turbine Oil T-46	April 1988	December 1988	9	700	Oil was successul reclaimed but additives not identified the Unit)	- Base Oil - Used Oil - Clay (Report submitted to	3000 - Filter Cloth	PSFL	

Sr. No.	Project Title	Date Drafted	Date Finished	Duration Month	Man-Hours	Results	Type of Raw Material	Material Cost	For whom Carried Out	Problem
29.	To make Ureas Slow Release by Coating with ASPHALT	July 1988	September 1988	3	150	Coating disintegrates after six weeks.	- Asphalt - Urea	200	General	
30.	To make urea slow Release by Coating with Gypsum	April 1988	May 1988	2	100	Coating disintegrates after six weeks	- Urea - Agrogypsum - Plaster of Paris	1000	General	
31.	To make Urea Slow Slow Release by	October 1988	December 1989	15	700	Coating successful and found technically	- Petroleum - Wax	2000	General	

	Coating with WAX					feasible.	- Urea		
32.	To make Urea Slow Release by Coating with Urea Formaldehyde	January 1988	March 1989	3	150	Coating not successful due to lump formation	- Urea Formaldehyde - Urea	1500	General
33.	To make Urea Slow Release by Coating with Multani Clay	May 1988	June 1989	2	175	Coating good but pinholes on the surface of making it inefficient	- Multani Clay - Urea	100	General
34.	To make Urea Slow Release by Coating with Bentonite Clay	July 1988	December 1989	6	200	The Physical strength of coating poor.	- Bentonite Clay - Urea	500	General
35.	To make Urea Slow Release by Coating with Formaldehyde	January 1990	March 1990	4	100	Coating poor at low temperature and lump formation at high temp.	- Formaldehyde - Urea	500	General
36.	To make Urea Slow Release by Coating with Phenol Formaldehyde	July 1990	November 1991	4	200	Coating satisfactory	- Phenol Formaldehyde - Urea	2000	General
37.	To make Urea Slow Release by Coating with Lignosulfonate	December 1990	March 1991	4	350	Coating satisfactory	- Lignosulfonate - Urea	1000	General

Sr. No.	Project Title	Date Drafted	Date Finished	Duration Month	Man-Hours	Results	Type of Raw Material	Material Cost	For whom Carried Out	Problem
38.	Development of a local substitute of Imported Biocide	July 1986	September 1987	15	1300	- Local substitute developed. - Economic feasibility worked out. - Report submitted.	- MBT - DMF - Stabilizer	5000	PSFL	
39.	Comparative Study of Chromate System with Non-Chromate System	October 1987	December 1988	15	250	Non-chromate system was not found economical compared with Chromate System.	-	-	PFL	
40.	Studies on Electro-Magnetic Device of Water Treatment	January 1988	June 1988	6	400	The device was found effective on Mg but not effective on higher TDS	-	-	General	
41.	Studies on solubility behaviour of MBT	July 1989	December 1999	6	450	Data produced for future reference	- MBT - Solvents	3000	PSFL	
42.	Development of substitute of imported Antifoaming used in NP Process.	April 1988	April 1989	12	900	Substitute produc was successfully developed (Report submitted)	- Fatty acid - Alcohal - H_3PO_4	12000	PFL	

43.	To solve the Corrosion probem of CN-Brine Circuit	January 1987	September 1990	21	600	The cause of Corrosion and preventive measures determined. (Report submitted)	- Welding electrodes	1000	PFL	
44.	Studies on concentration of Phosphoric acid produced from local rocks	March 1987	September 1989	30	1500	Acid concentrated from 22% to %0%	Dilute phosphoric acid from Local rock and Jordan rock.	6000	FR&DI	Nil
45.	Colouring of SSP	January 1990	March 1991	15	1200	Colouring successful and economical	SSP Powder Cured - Dry	20,000	NFML	Nil

Sr. No.	Project Title	Date Drafted	Date Finished	Duration Month	Man-Hours	Results	Type of Raw Material	Material Cost	For whom Carried Out	Problem
46.	Inert Removal	September 1987	April 1991	43	550	Bench scale studies successful	NP dissolution Slurry	17,000	PFL	Nil
47.	Urea Super Granules bed ulator	July 1990	March 1991	9	800	Bench scale process developed for anufacture USG of size 10 mm to 12 mm	Urea	7,559	FR&DI	To control temperature of Pan Gran
48.	Removal of Fluorides from fluent water	October 1989	March 1990	6	500	Level of luorides reduced from 400 ppm to 30 ppm	Nil	Nil	PFL Multan	Operating problem
49.	SO_2/SO_3 Removal from stacks of Acid Plants	December 1988	June 1989	7	500	90% of SO_2 removal from stack gases achievd.	Na_2CO_3 Sol	Nil	LC&FL Faisalabad	Nil
50.	Improving capacity and Quantity of $ZnSO_4$.	July 1989	June 1987	12	900	Objective successfully achieved	Zn dust H_2SO_4	1000	LC&FL	Nil
51.	Tobacco Fertilizer	July 1986	December 1986	6	500	Objective successfully achieved	- SSP - DAP - SOP - Alumonium Sulphate	5000	NFML	
52.	SSP Granulation	July 1986	June 1988	35	2000	Desired quality achieved by once through process.	- SSP	-	LC&FL	
53.	CAN Cakaing	July 1986	March 1989	36	1730	Caking problem was very much reduced. (Report submitted to Unit)	- K_2SO_4 $(NH_4)_2SO_4$	700	PFL Multan	
54.	On Stream Chemical Cleaning of Poly-block Heat Exchanger.	July 1990	September 1990	3	310	Plant down time was minimized	- Na_2CO_3	300	LC&FL	

Annex VI

PLANNED WORKPROGRAMME 1991/92

NAME OF PROJECT:	KEY TARGETS:
Local Rock Development	Lab./bench scale studies for the evaluation of beneficiated Malakand rock for single supersphophate and phosphoric acid.
Manufacturing of NPK 14-28-14 on Bench Scale Unit using Jordan Rock.	Optimization of parameters, flow rates of raw-materials for the manufacturing of 14-28-14.
Fabrication/Installation of UNP/NPK Pilot Plant.	Designing of NPK pilot plant for the manufacture of UNP/TSP.
Micronutrient Development	To manufacture a blend of complex micronutrients urea based and phosphate based for apples and citrus fruits.
Urea Tailoring to Urea Nitrate Phosphate	Preparation of urea nitrate phosphate 19:19 directly and then by blending 27:9 with TSP and DCP having different water solubilities.
Reclamation of Lube Oils	Utilization of waste turbine oils of NFC Units.
Evaluation of Non-Chromate System	1. Evaluation of Kurita System. 2. Evaluation of ICI System.
Development of Water Base Antifoam	To synthesis water base antifoam for Pakrab Fertilizer Limited, Multan (N.P. Process).
Unit Problem No. 1	To find a solution regarding scaling problems of cooling water for Pakchina.
Unit Problem No. 2	To develop a method for chemical cleaning for heat exchanges of PCFL.
Sulphur Mud (Unit Problem)	Utilization of Sulphur Mud available at sulfuric acid plant of LC&FL for manufacturing of Na_2So_3.

Analytical Services (Chemical analysis/ Instrumental analysis)	(i) Analysis of various samples from different sections. (ii) Development of various analytical methods. (iii) Analytical services for NFC units. (iv) Analytical services for others.
Trace Elements Analysis	Extraction and analysis of trace elements in various rock phosphates and phosphatic fertilizers.
Effluent Analysis (Gaseous)	The analysis of various gaseous effluents of all the NFC Units.
Physical Analysis	(i) Physical analysis of various samaples from different research projects. (ii) Physical analysis for NFC Units.
Inert Removal from NP Liquor	Inert removal studies by filteration.
Granulation Studies	Gramulation of powder/slurry triple super phosphate/urea nitro phosphate.
To manufacture Acidic Fertilizer Lab. & Bench Scale	To manufacture complex (phosphate & nitrogen based) acidic fertilizer.
Unit Problems	To set-up a granulation (once through) unit capacity 60 tons/day at LC&FL.

ON-GOING RESEARCH PROJECTS

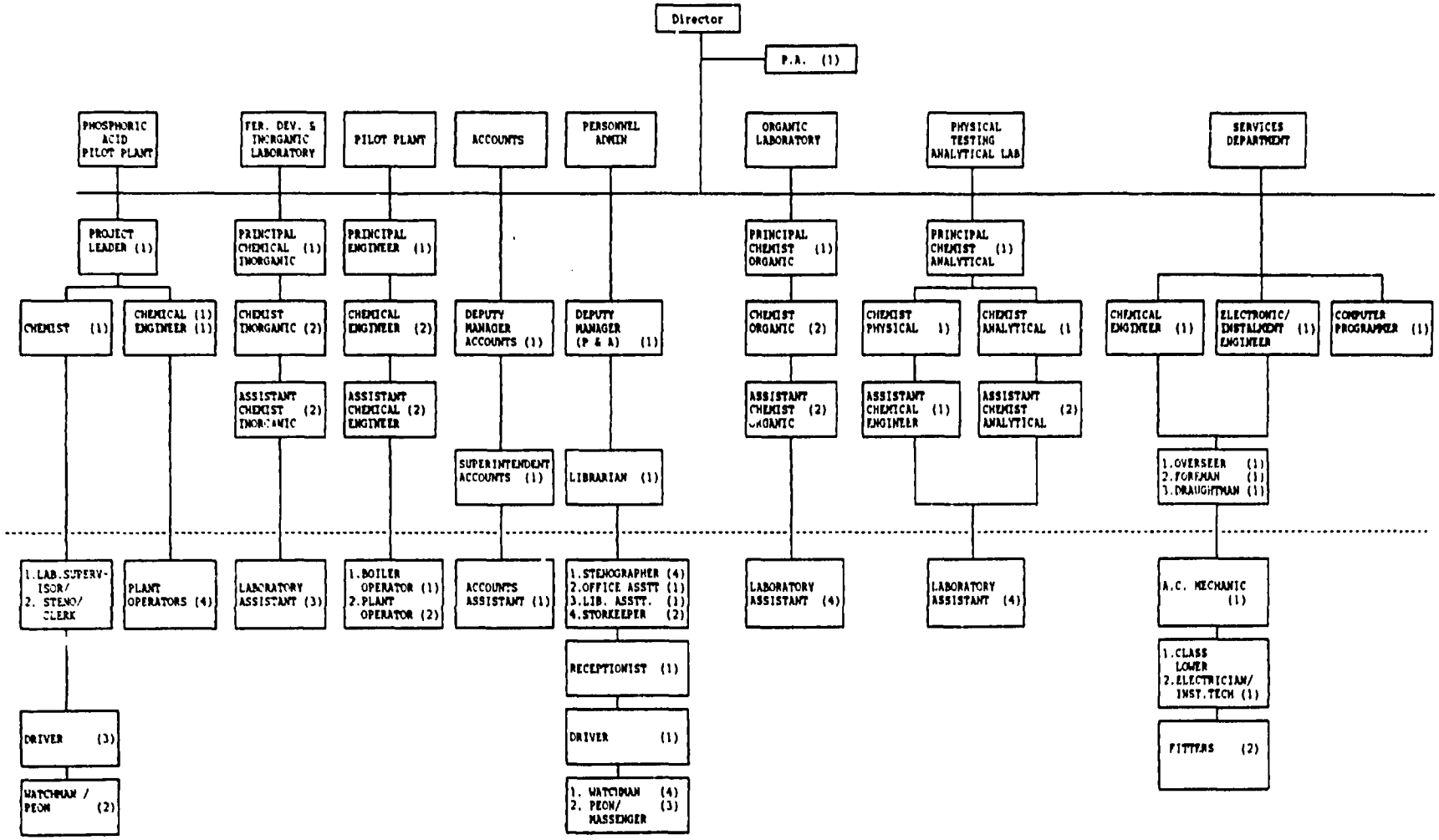
S.No.	Title of Research Project	Objective	Programme
1.	Reclamation of Lube Oil Perfecto S.S.	To develop a method of reclamation used Compressor oil for in-house cost saving of Pakchina Fertilizers Ltd.	On Lab. scale evaluation/reclamation have been done. Reclamation on pilot scale plant trial are in hand.
2.	Evaluation of non-chromate System.	To study the possibilities of replacing existing chromate system with non-chromae system.	Evaluation of two re-knowned system on experimental cooling tower. For this purpose, Cooling Tower is under installation.
3.	Slow Release Urea	Development of methods to make urea slow release.	Various coating on urea prill at Lab. and bench scale studies. Their agronomic evaluation is in hand at Agriculture station.
4.	Utilization of Sulphur Mud available at Sulphuric Acid Plants.	To develop economical method for recovery of Sulpnur and its further utilization.	Lab. scale studies to recover Sulphur completed. Bench scale work is in hand.
5.	Development of Water Base Antifoam.	Synthesis of a water base antifoam suitable for use in NP process at Pakarab Fertilizers.	Experiments for sulfonation are in hand.
6.	Trace element Analysis in Raw-material and finished product.	Analysis of trace elements and development of their methods of analysis considering our existing facilities.	Methods have been developed and analysis of raw-material and finished product is in hand.
7.	Utiliztion of Waste Urea Solution.	To develop a method for removal of urea from waste effluent and its beneficial utilization.	Different methods of urea hydrolysis studied and its feasibility is being worked out.
8.	Scaling problem of Cooling Tower	To suggest a chemical treatment in order to minimize the scaling.	Study of composition of scales. Selection of suitable scale in inhibitor is in hand.
9.	Decolourization of CO_2 washing solution.	Development of effective and economical method for decolourization.	Study of chemical changes occuring. To determine causes of colouration and methods for decolourization is in hand

Annex VII

S.No.	Title of Research Project	Objective	Programme
10.	Micronutrient Development	To manufacture phosphatic and citrate base complex micronutri .t of Zinc and Fe.	Optimization ofreaction of conditions of these product were conducted. Relative availabilities of these phosphatic base complexes and citrate base alkaline pH was studied. Their agronomic evaluation is in progress.
11.	Urea Tailoring to urea Nitrate Phosphate.	Preparation of urea Nitrate Phosphate with (27-9-0) using rock phosphate urea and nitric acid.	Lab. scale studies were studied and operating parameters were recorded. Bench scale studies are in hand.
12.	Partial Acidulation of Rock Phosphate to develop low cost S.S.P.	To manufacture SSP having high available P_2O_5 with minimum acid consumption.	Different acid/rock ration having different acid strength on Lab. scale were studied. Study of various parameters at bench scale is in hand.
13.	Manufacture of Phosphoric Acid through HCI route.	To manufacture MAP/DAP and Tri-Sodium phosphate via HCI route and record Unit operations.	All the studies/evaluation have been done and report writing is in progress.
14.	study of complete scrubber choking at HPFL Plant.	To diagnose the actual reason of choking of scrubber at SSP Plant.	Samples were got from plant and analysed. The actual reason was found out. Recommendations have been conveyed to plant people.
15.	Inert Removal from NP Liquor	To find out the suitable and effective methods for removal of inerts from NP Liquor.	Lab & bench scale studies for the removal of Inerts.
16.	Manufacture of Super Granles of Urea.	Bench scale studies for the manufacture of Urea Super Granules.	To make granuels of different size for pot-trial evaluation.
17.	NPK Pilot Plant	Designing of elevator for Pilot Plant.	To design & fabricate the elevator.
18.	Analysis of various liquid effluents of all the NFC Units.	To avoid losses and control pollution.	To collect the samples from various units & analyse.

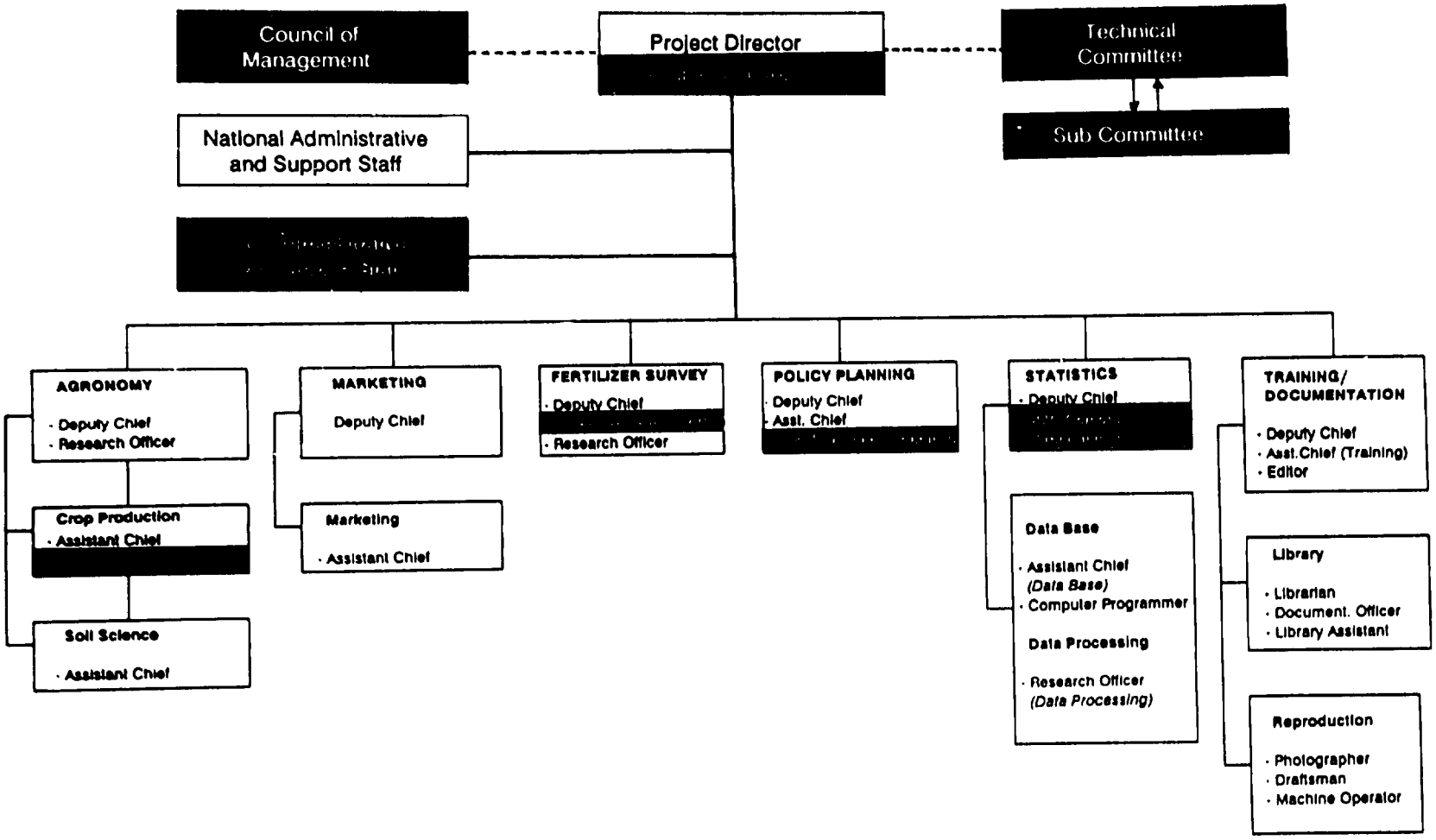
ORGANOGRAM

FERTILIZER RESEARCH & DEVELOPMENT/INITIATIVE (PVT) LIMITED, PAKISTAN



NFDC
ORGANIZATIONAL CHART

PROPOSED



Annex IX

R&D/Analytical Services Provided to Private Industries

Sr.No.	Project	Objective	Actual Activity	Scope of Work	Conclusions
01.	Analytical Services	To contact various private sectors for analytical services and extend the analytical facilities to private industry.	50 Industries were contacted. Response from some of them is as below:-		- We started analytical as well as R & D services to private sectors at nominal cost.
			1.1 Three water samples of Sui-Northern Pipelines Ltd.	Most of the industrial sectors cannot afford such a costly analytical instruments. As FR&DI is equipped with latest instruments and is providing its analytical services at a very nominal cost to all private sector.	- As a result, the objective to generate the income source of the Institute is being gradually achieved.
			1.2 Two samples of Bin Bak glass wool and sui gas condensate.		
			1.3 Two wheat straw samples from Packages Ltd.		
			1.4 Extra pure grade water supplied to Rafhan Maize Product.	This service is helping Rafhan Maize Product in manufacturing its extra pure grade product.	
02.	R&D Services	To contact the private sectors and extend our R&D services.	40 Private Industries were contacted for R&D services The response from their side is below:-		
			2.1 Haziness problem of MEG of ICI Polyester Ltd. was localized and report submitted.	We identified the neusence element causing haziness in MEG and Polyester, which result in improving the quality of ICI product.	
			2.2 Utilization of H_2SO_4 plant stack gas effluents of Prime Chemicals Ltd., Haripur Hazara is in hand.	By solving this problem to control their environmental pollution and getting a valuable by-product.	

Annex X

FELLOWSHIP/TRAINING

Sr. No.	Name of Person	Field of Training	Duration (man / month)
01.	Mr. Ishtiaq Ahmad	Testin & evaluation of phosphate rock for the manufactur of phosphatic fertilzer in Lab. and Pilot Plant scale.	2.5
02.	Mr. Kamran Sibtain	Research work related to fertilizer raw material like rock phosphate development and beneficiation etc.	3
03.	Dr. M. Anwarul Haq	Research work related to Pilot Plant design and Development	2.5
04.	Mr. L. H. Rindhawa	NPK mixed fertilizer blending/granulation techniques and its pilot plant operation	3
05.	Mr. M. Daud Ali Alvi	Testing evaluation and blending of material utilized for synthesis of anti-Caking/ani-foaming flocculant & ureas inhibitors & operation techniques in Lab and plants	2.5
06.	Dr. Mahboob Asghar Sheikh	Evaluation & blending techniqes of various chemicals for cooling and process water treatment	2.5
07.	Dr. Saqlain anwar Bhatti	Analysis of various compounds and operation of modern instrument analysis techniques	3
08.	Mr. Azmat Ali	Analytical techniques for testing the fertilizer and raw material inorganic and instrumental analysis.	3
09.	Mr. Muhammad Essa Bhatti	Reseach work related to physical testing of fertilizer product and caking elimination, microscopical studies etc.	3

CONSULTANCY/SUBCONTRACTOR SERVICES

Sr.No	Name of Consultant	Assignment	By whome contract Awarded		
01.	Progressive consultant	For civil Engineering Consultancy of Institute building	Government	7.11.83 to 1986 (till building is completed)	
02	Dr John Rogers Newzeland	Short term consultant (consultation in design of research labs)	UNIDO	March-April 1984 (5 weeks)	
03.	Kemira	Subcontractor	UNIDO	-	
				Project Area Service man month	Home Office Service man month
3.1	Anatero Horkko	Team leader & expert of R&D and fertilizer manufacturing	-	6.75	6
3.2	Erkki Aalto	Phosphate ores and other fertilizer raw mateial expedrt	-	5.75	3
3.3	Jukka Karhunen	Phosphate beneficiation and mineral Processing expert	-	5.75	
3.4	Timo Korvela	Fertilizer manufacturing and research and corrosion expert	-	6.25	3.5
3.5	Arie van der Meer	Fertilizer testing, manufacturing and computer use expert	-	5.0	1.5
3.6	Esko Saari	Analytical method's instruments and mineralogical expert		6.25	3.0
3.7	Rino Landemaki	Project coordinator and home office support	-	-	6.0
			Total:	35.75	25.0

Annex XII

LIST OF PERSONS MISSION HAD DISSCUSSION

FRDI

Dr. M. Anwar-ul-haque	(G.M.)
Mansoor ali	Manager (R&D)
Ishtiaq Ahmed	Manager (R&D)
Mohammad Aslam Baig	Manager (R&D)
Maroof Alam Khan	Deputy Manager (R&D)
Mohammad Essa Bhatti	Chemist
Dr. Sqlam Anwer Bhatti	Chemist
Azmat Ali	Chemist
Anwar Hussain Saddiqi	Manager (R&D)
Atta Muhammad Khan	Asstt. Chemist
Husnain Ali Kazmi	-do-
Daud Ali Alvi	Chemist
Zia-ul-Din Karmani	Asstt. Chemist
M. Tariq Naizi	Chemist
Muhammad Arif	Asstt. Chemist
Khalid Mehmood	-do-
Nadeem Anjum	Asstt. chem. Engineer
Nadeem Hayat	-do-
Muhammad Aslam	Mechnical Engineer
Abdul Jabbar	Asstt. Chemist
Muhammad Ashraf	Mech. Supervisor
Tahir Raza	Dy. Manager Instrument
Mohammad Ashraf	Asstt-ch.

LYLPUR CHEM & FERTILIZER SSP PLANT AT JARANWALA

Ch. Abdul Ghfoor	M.D.
Ch. Muhammed Younas	G.M. of Faisalabad unit
Mohammad Munir Ch.	G.M. of Jaranwala unit

PAK ARAB FERTILIZER LTD. MULTAN (CAN,UP, UREA)

Abdulatif Khalid	G.M. (T&P)
G.R. Akund	Unit Manager Laboratory

NFC HEAD OFFICE LAHORE

M. Nasir Butt	G.M. Tech.
T.I. Chugtai	Sr. Manager Technical
Asif Iqbal	-do-

DAWOOD HERCULES LAHORE (UREA PLANT PRIVATE LTD

Mahmood Ahmed	Director
M. Aslam Bhutta	Technical Manager

HAZARA PHOSPHATE FERTILIZER (SSP PLANT)

Mr. Chughtai	G.M. Production
Malik Doast Mohammad	G.M. Engineering

PAK CHINA FERTILIZER (UREA PLANT

Muhammad sulaman	G.M. Marketing

PILOT PLANT H_3PO_4 (FRDI)

M.S. Farooqi	Manager (R&D)
Waheed Shah	Asstt. Chemist

UNDP

Hans von Sponeck	RES. REP.
Jon Holten	UCD
Thomas Wetzel	JPO
Faran Sabih	Programme Officer

NATIONAL FERTILIZER DEVELOPMENT CENTRE

M. Thair Saleem	Director
Ian T. Twyford	Project Manager FAO

MINISTRY OF PRODUCTION

Sarwar Zahid	Dy. Chief

ADVISORY COMMITTEE MEMBER

01.	Dr.Ijaz Hussain Khan	Institute of Chemical Engineering & Technology, University of Punjab, Lahore.
02.	Mr.Asif Saeed	EXXON Chemicals Ltd., Daharki.
03.	Dr.Baqa Jilani A. Kakazai	Pakistan Science Foundation, Islamabad.
04.	Mr.Aman Mir	Fauji Foundation Company Ltd., Rawalpindi.
05.	Mr.M.Aslam Bhutta	Dawood-Hercules Chemicals Ltd., Lahore.
06.	Dr.Fariq Muhammad Chaudhry	PCSIR, Lahore.
07.	Mr.Jamshaid Khan	Agriculture Research Institute, Tarnab, Peshawar.
08.	Dr.Abdul Rashid	Ayub Agriculture Research Institute, Faisalabad.
09.	Mr.M.C. Bhutto	National Fertilizer Development Centre, Islamabad.
10.	Mr.Hans J. Seifert	National Fertilizer Development Centre, Islamabad.
11.	DR.Muhammad Rashid	National Fertilizer Marketing Limited, Lahore.
12.	Mr.Zahid Aziz	National Fertilizer Corporation of Pakistan, Lahore.
13.	Mr.Zahur Ahmad Khan	National Fertilizer Corporation of Pakistan, Lahore.