No. 9

FEASIBILITY STUDY REPORT
ON
THE ESTABLISHMENT OF UREA FERTILIZER PLANT
IN
THE KINGDOM OF NEPAL

(ANNEX)

SEPTEMBER 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

FEASIBILITY STUDY REPORT

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Annex I-1

SCOPE OF WORK FOR THE FEASIBILITY STUDY AND MINUTE OF MEETING AT PRESENTATION OF PROGRESS REPORT

SCOPE OF WORK
FOR
THE FEASIBILITY STUDY
ON
THE ESTABLISHMENT OF UREA FERTILIZER PLANT
IN
THE KINGDOM OF NEPAL

AGREED UPON BETWEEN

THE JAPAN INTERNATIONAL COOPERATION AGENCY

AND

THE MINISTRY OF INDUSTRY

HIS MAJESTY'S GOVERNMENT OF NEPAL

Kathmandu, October 4, 1983

Kenji IWAGUCHI	Ajit Narayan Singh Thapa
Leader of Japanese Survey Team	Joint Secretary
	Ministry of Industry

I. Introduction

In response to the request of His Majesty's Government of Nepal (hereinafter referred to as "H.M.G.N."), the Government of Japan has decided to conduct a feasibility study on the establishment of urea fertilizer plant (hereinafter referred to as "the study") in accordance with the laws and regulations in force in Japan

The Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will undertake the study, in close cooperation with the authorities of the Kingdom of Nepal

Ministry of Industry, H.M.G.N. (hereinafter referred to as "MOI") will be the executing agency and shall designate the Industrial Services Centre (ISC) as a counterpart agency to the Japanese study team (hereinafter referred to as "the Team") and MOI shall also act as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the study

The Present Document sets forth the Scope of Work with regard to the study.

II. Objective of the Study

The objective of the Study is to examine the technical, financial and economic feasibility of the establishment of urea fertilizer plant (hereinafter referred to as "Project") in the Kingdom of Nepal and to prepare a feasibility study report keeping in view the ammonia production process using hydrogen by water electrolysis

III. Scope of the Study

In order to achieve the above objective, the study will cover the following items :

1. Review on the background of the Project

   1) the present situation of and policy on agriculture in Nepal

   2) the present situation of and policy on fertilizers in Nepal

      (1) supply and demand of fertilizers
      (2) trend of consumption of fertilizers

   3) the present situation of and policy on industrialization

   4) relation of the Project with the overall National Development Plan

   5) the present situation and future plan of demand and supply of electric power

   6) the present situation of and policy on manpower required for the Project such as chemical engineers, plant engineers and others

   7) relevant laws and regulations

2. Study on the detailed urea fertilizer market in Nepal

   1) present and past supply and consumption
   2) present and past situation of import and its cost
   3) trend and structure of price
   4) potential demand and constraints in the application of fertilizers

5) projection of demand in the coming ten years
6) marketing and distribution system
7) cost and channel of transport and distribution from manufacturing site to major market area

3. Study on the raw materials for the urea fertilizer production

1) possibility of electric power supply

(1) present situation of electric power supply (capacity, tariff, stability, etc.)

(2) future demand and supply (construction projects, schedule, etc.)

2) water

(1) quality and quantity of water
(2) water works necessary for the Project

3) availability of Carbon Dioxide (CO_2)

(1) CO_2 from cement factory

(2) CO_2 from other sources

4) materials for packing

5) other materials

4. Study on the plant location and site

1) natural conditions of the site and its surrounding area focusing on meteorology, geology and topography

2) utilities and infrastructure such as electricity, gas, water, transportation and communication

3) regional development plan

4) selection of the plant site based on the results of the study on the availability of raw materials, utilities, infrastructure and other factors

5) conditions of transportation of equipment and its installation

5. The basic plan and conceptual design of the urea fertilizer plant

   1) comparison of production processes and determination of the most suitable process

   2) examination and determination of production scale

   3) fundamentals and major preconditions of conceptual design including list of major equipment

   4) process flow sheet

   5) layout of the plant and auxiliary facilities

   6) implementing program of the plant construction

   7) transport plan of equipment and materials for plant construction

   8) operation plan of the plant

   9) organization and manpower plan for the plant construction and operation including managerial aspects

   10) marketing and distribution system

6. Study on environmental protection

7. Financial analysis

   1) capital requirements

      (1) fixed capital (land, plant construction, auxiliary facilities and pre-operation cost, including training cost and consultancy fees, etc.)

      (2) working capital

      (3) investment schedule

   2) procurement of capital
   3) operation cost
   4) production cost
   5) projected balance sheet
   6) projected flow sheet
   7) financial internal rate of return
   8) sensitivity analysis based on possible variations in

      a) electricity tariff
      b) investment cost
      c) interest rate
      d) inflation rate
      e) sales price

8. Economic and social evaluation

9. Conclusion and recommendations

IV. Steps and Schedule of the Study

1. Steps

Step 1 : Preparatory office work in Japan

Step 2 : Field work in Nepal

Step 3 : Home office work in Japan

Step 4 : Presentation of and Discussion on the Draft Final Report

2. Schedule

As shown in Annex

V. Reports

JICA will prepare and submit the following reports to H.M.G.N.

1. Progress Reports written in English at the end of the Step 2 in the IV : 10 copies

2. Draft Final Report and its summary written in English within five (5) months after commencement of the Step 3 : 15 copies

3. Final report and its summary written in English within two (2) months after the receipt of comments on the Draft Final Report by MOI : 30 copies

VI. Undertaking of H.M.G.N.

H.M.G.N. shall accord privileges, immunities and other benefits to the Team in accordance with the laws on Nepal and, through the authorities concerned, take following necessary measures to facilitate the smooth implementation of the Study :

1. Provide adequate number of full-time counterparts

2. Arrange the Team's visits to relevant authorities concerned and ensure that the Team has access to all relevant information required for the execution of the study

3. Provide the Team with office accomodation with sufficient office supplies and equipment

4. Provide relevant information and data available to the Team

5. Exempt the Team from taxes, duties and charges in the Kingdom of Nepal on materials, equipment and personal effects brought into the Kingdom of Nepal for the purpose of the Study

6. Exempt the Team members from income taxes and charges of any kind imposed on or in connection with the staying expenses remitted from abroad

7. Ensure the security of the Team members during their stay in the Kingdom of Nepal

8. Bear claims, if any arises, against the Team members resulting from, occuring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from the gross negligence or wilful misconduct on the part of the Team members

VII. Undertaking of the Government of Japan

For the implementation of the Study, the Government of Japan will, through JICA, take following measures :

1. To dispatch, at its own expense, study teams to Nepal

2. To pursue technology transfer to the Nepalese counterpart personnel in the course of the Study

VIII. Consultation

JICA and MOI will consult with each other in respect of any matter that may arise in the interpretation or implementation of the present arrangement.

Annex

Tentative Schedule of the Study

Year & Month / Item	1983 Sep.	Oct.	Nov.	Dec.	1984 Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	1985 Jan.	Feb
Preparatory Office Work (Step 1)	====	====	====	====														
Field Work (Step 2)					■■■													
Home Office Work (Step 3)					====	====	====	====	====	====								
Presentation of Draft Final Report (Step 4)										■■■								
Submission of Final Report													△					

==== in Japan

■■■ in Nepal

MINUTES OF MEETING

In summarizing the local activities of survey and study carried out by the study team of Japan International Cooperation Agency (JICA) for the feasibility study of the establishment of urea fertilizer plant in the Kingdom of Nepal (hereinafter referred to as the "Project"), the study team presented the Progress Report at the Ministry of Industry of His Majesty's Government of Nepal (HMG/N), Kathmandu on January 27, 1984.

Based upon the detailed explanation of the Progress Report, the in-depth discussion and clarification were made among the authorities of the HMGN, the study team members and the resident representative of JICA in Nepal, and parties concerned agreed as recommended in the Progress Report in principle regarding the major issues, for formulating the Feasibility Study, on the type of product, selection of location and site, method on the demand projection and the selection of production capacity, supply conditions of raw materials and utilies, scope of facilities, management and schedule for the implementation, and assumption and basis of financial and economic analysis for the Project.

Major additional issues which were discussed and proposed to be taken into consideration during the preparation of the feasibility study report are;

- Re-examination of the schedule assumed for the implementation of the Project.
- Energy saving at the Project.
- Sharing of auxiliary facilities among the other industries in Nepal.
- Industrial uses of urea in Nepal as potential.
- Possibility of utilization of by-products from the Project in the future.

In concluding the whole activities of the study team in Nepal, this Minutes of Meeting is prepared and signed hereunder;

Kathmandu, The Kingdom of Nepal
January 27, 1984

Indu Shamsher Thapa
Senior Engineer
Ministry of Industry, HMG,
Nepal

Masayasu SAKANASHI
Leader of Study Team
Japan International Cooperation Agency

Names of Persons present in the meeting held in the office of the Secretary Ministry of Industry, Tripureswor, Kathmandu on the 27th January 1984.

Mr. I.L. Shrestha, Secretary, Ministry of Industry (MOI)
Mr. R.D. Sharma, Joint Secretary , MOI
Mr. I.S. Thapa, Senior Engineer (MOI)
Mr. B.M. Shakya, Under-Secretary, Ministry of Finance (MOF)
Mr. S.M. Shrestha, Section Officer, MOF
Mr. R.K. Bhattarai, Act. Director General, Department of Industry
Mr. R.K. Bajracharya, Senior Engineer, Department of Electricity
Mr. R.N. Dhungel, General Manager, Nepal Industrial Development Corporation
Mr. T. Hoshi, Resident Representative, Japan International Cooperation Agency

Study Team Members

Mr. M. Sakanashi, Team Leader, Techno-Economist
Mr. K. Adachi, Team Sub-leader, Chemical Engineer
Mr. Y. Fujiki, Plant Mechanical Engineer
Mr. Kuwabara, Fertilizer Chemical Engineer
Mr. T. Inooka, Fertilizer Market Expert
Mr. S. Suzuki, Electrical Engineer
Mr. T. Suzuki, Cement Chemical Engineer

Counterpart Members of ISC

Mr. M.B. Shrestha, Civil Engineer, For Chief, Industrial Projects Division
Mr. H.P. Khanal, Economist, For Chief, Feasibility Study Branch
Mr. B. Sharma, Chemical Engineer, For Chief, Project Engineering & Management Branch

MINUTES OF MEETING

The JICA Study Team led by Mr. M. Sakanashi visited Kathmandu from July 23 to 28, 1984 for the purpose of presentation of the Draft Final Report of the Feasibility Study on the Establishment of the Urea Fertilizer Plant in the Kingdom of Nepal to the Ministry of Industry and also for discussion with the concerned officials of HMG/N on the Project.

Accordingly, first review meeting on the Draft Final Report was held under the Chairmanship of Industry Secretary, Mr. I.L. Shrestha, in the Ministry of Industry on July 25, 1984 at the presence of officials and representatives of concerned ministries, departments and agencies of HMG/N, the JICA's Resident Representative in Nepal and the JICA Study Team. Likewise, second review meeting took place at the Secretariat of National Planning Commission under the Chairmanship of Hon'ble Vice-Chairman of NPC, Dr. M.M. Sainju on July 26, 1984 at the presence of NPC member, joint members and other concerned government officials. Lists of persons who were present at the meetings are attached as Appendix I and II.

1) At the review meetings, the JICA Study Team made the presentation of the Draft Final Report, summarizing the major aspects as well as the conclusion and recommendations derived from the study, and explained and made clarification on questions raised by various persons attending the meeting. The issues discussed at the meetings are attached as Appendix III and IV.

2) At the conclusion of the review meetings, Ministry of Industry, HMG/N expressed satisfaction that the Draft Final Report is comprehensive as per the scope of the study as agreed upon by the Ministry of Industry and the JICA on October 4, 1983. It was also agreed that comments on the Draft Final Report would be transmitted to the JICA by August 15, 1984 and these comments would be taken for due consideration in incorporating in the final report. It was further agreed that the JICA Study Team could proceed for the preparation of a Final Report, keeping in view the issues raised during the review meetings.

3) The Ministry of Industry, HMG/N expresses its appreciation to the JICA for the submission and presentation of Draft Final Report of the Feasibility Study on the establishment of the Urea Fertilizer Plant in the Kingdom of Nepal.

In concluding the presentation of the Draft Final Report, this Minutes of Meeting is prepared and signed hereunder.

Kathmandu, The Kingdom of Nepal
July 27, 1984.

Indu Shamsher Thapa
Senior Engineer
Ministry of Industry, HMG
Nepal.

Masayasu Sakanashi
Leader of Study Team
Japan International Cooperation Agency.

Appendix - I

Persons Present at Meeting Held at Ministry of Industry on July 25, 1984

1. Mr. I.L. Shrestha - Secretary, Ministry of Industry
2. Mr. Shiva P. Sharma - Joint Secretary, Ministry of Industry
3. Mr. Bihari Krishna Shrestha - Joint Secretary, National Planning Commission
4. Mr. R.B. Bhattarai - Acting Director General, Dept. of Indust:
5. Mr. I.S. Thapa - Senior Engineer, Ministry of Industry.
6. Mr. Narayan Regmi - Deputy Director General, Department of Agriculture
7. Mr. R.K. Bajracharya - Senior Engineer, Department of Electricity
8. Mr. R.N. Dhungel - General Manager, NIDC
9. Mr. G.B. Shah - Executive Director, I.S.C.
10. Mr. Sunder Man Shrestha - Section Officer, Ministry of Finance
11. Mr. A.M. Tamrakar - Division Chief, Agriculture Inputs Corporation
12. Mr. M.D. Bhattarai - Assistant Engineer, Ministry of Industry
13. Mr. T. Hoshi, Resident Representative, Japan International Cooperation Agency/Nepal.

JICA Study Team Members :

1. Mr. M. Sakanashi - Team Leader, Techno-Economist
2. Mr. M. Kuwabara - Fertilizer Chemical Engineer
3. Mr. T. Inooka - Fertilizer Market Expert

Counterpart Members :

1. Mr. Manohar B. Shrestha - For Chief, Industrial Projects Division,I
2. Mr. H.P. Khanal - For Chief, Feasibility Branch, ISC
3. Mr. Bishnu Sharma - For Chief, Project Engg. & Mgmt. Branch, ISC.

Appendix - II

Persons Present at Meeting Held at National Planning Commission Secretariat on July 26, 1984

1.	Dr. Mohan M. Sainju	- Honourable Vice-Chairman, National Planning Commission
2.	Dr. Bijaya B. Pradhan	- Member, National Planning Commission
3.	Mr. Shanker K. Malla	- Joint-Member & Secretary, National Planning Commission
4.	Mr. Surya P. Shrestha	- Joint-Member, National Planning Commission
5.	Mr. Iswari L. Shrestha	- Secretary, Ministry of Industry
6.	Mr. Harsha M. Shrestha	- Chief Engineer, Department of Electricity
7.	Mr. Shiva P. Sharma	- Joint-Secretary, Ministry of Industry
8.	Mr. Rameswor B. Singh	- Joint-Secretary, Ministry of Agriculture
9.	Mr. Bihari K. Shrestha	- Joint-Secretary, National Planning Commission
10.	Mr. Indu S. Thapa	- Senior Engineer, Ministry of Industry
11.	Mr. Ram P. Shrestha	- Under-Secretary, National Planning Commission
12.	Mr. R.K. Bajracharya	- Senior Engineer, Dept. of Electricity
13.	Mr. Manohar B. Shrestha	- For Chief, Industrial Projects Division, ISC
14.	Mr. Ramesh B. Adhikari	- Senior Officer, ISC. (On deputition to NPC)

15. Mr. T. Hoshi, Resident Representative, Japan International Cooperation Agency/Nepal.

JICA Study Team Members :

1.	Mr. M. Sakanashi	- Team Leader, Techno-Economist
2.	Mr. M. Kuwabara	- Fertilizer Chemical Engineer
3.	Mr. T. Inooka	- Fertilizer Market Expert

Appendix - III

Issues Discussed at Meeting After Presentation on July 25, 1984

1. Clarifications on the technological aspects (such as only one or other alternative processes).

2. Interest rate on the external loan, whether it is possible to get the long term loan at 5% and sensitivity analysis to the project profitability by its change.

3. Possibility of getting energy at cheaper rate and its implications.

4. Water/air pollution in the process and what measures are to be taken in order to control it, if any.

5. Quality aspect of the urea to be produced in Nepal.

6. Possibility of product diversification such as producing the compound fertilizer (N:P:K:)

7. Rate of return to the NEC in view of the tariff reduction for this project.

8. Sapta Gandaki implementation to be delayed by one year (1992).

9. Any possibility of redeployment of plant of proposed capacity from other countries for minimizing the total project cost.

10. 10.5% interest on Long Term Loan charged.

11. Projected price (selling) is matching with the international price or not ?

12. Potential industrial uses of urea in Nepal.

Appendix - IV

Issues Discussed at Meeting Held at the National Planning Commission on July 26, 1984

1. Technology adopted in other countries in the region
2. New technology based on the electricity
3. Possibility of establishing the mini-fertilizer plants (35 - 40 TPD) requiring about 8 - 9 MW of power.
4. There is some foreign exchange component involved in the electricity price. This could reduce the value added of the project.
5. 46% of the production cost in foreign exchange is more than the C.I.F. Calcutta price for fertilizer.
6. Use of laminted bags for the packaging of urea.
7. Secondary energy can be used only during the rainy season but not during the off-peak period.
8. Optimum capacity of 275 TPD, some basis.
9. Storage of Hydrogen gas.
10. Alternatives for making this project financially, sound.

Annex I-2

LIST OF STUDY TEAM MEMBER AND COUNTERPARTS

Annex I-2

LIST OF STUDY TEAM MEMBER AND COUNTERPARTS

Members of Study Team of JICA, Japan

Mr. Masayasu Sakanashi*	Team Leader, Techno-Economist, UNICO
Mr. Katsuo Adachi	Team Sub-leader, Chemical Engineer, JCI
Mr. Yukihiko Fujiki	Plant Mechanical Engineer, JCI
Mr. Makoto Kuwabara*	Fertilizer Chemical Engineer, UNICO
Mr. Tetsuo Inooka*	Fertilizer Market Expert, UNICO
Mr. Saburo Suzuki	Electrical Engineer, NIPPON KOEI
Mr. Terumitsu Suzuki	Cement Chemical Engineer, ONODA ENGG.

* These members also visited Kathmandu on July 23 to 28, 1984 for the presentation and discussion of the Draft Final Report.

Members of Counterpart Team, Nepal

Mr. Manohar B. Shrestha	Civil Engineer For Chief, Industrial Projects Division, ISC
Mr. Hari Prasad Khanal	Economist For Chief Feasibility Study Branch, ISC
Mr. Bishnu Sharma	Chemical Engineer For Chief, Project Engineering & Management Branch, ISC
Mr. Pushpa K. Karki	Mechanical Engineer Senior Engineer, Feasibility Study Branch, ISC
Mr. Manoj Chipalu	MBA, Senior Financial Analyst, Feasibility Study Branch, ISC
Mr. Jeevan Thaps	DPA, Officer, Feasibility Study Branch, ISC
Mr. Som N. Bhattarai	Electrical Engineer Technical Officer, Feasibility Study Branch, ISC

Annex I-3

ACTIVITY OF JICA STUDY TEAM

Annex I-3

ACTIVITY OF JICA STUDY TEAM (1)

Date	M. SAKANASHI	K. ADACHI	Y. FUJIKI	M. KUWABARA	T. INOOKA
January, 1984					
8	- Leave TKY	- Leave TKY	- Leave TKY	- Leave TKY	- Leave TKY
9	- Arrive in KTM	- Arrive in KTM	- Arrive in KTM	- Arrive in KTM	- Arrive in KTM
10	- JICA, Japanese Embassy, MOI, ISC	- JICA, Japanese Embassy, MOI, ISC	- JICA, Japanese Embassy, MOI, ISC	- JICA, Japanese Embassy, MOI ISC	- JICA, Japanese Embassy, MOI ISC
11	- National Holiday Data Summary	- National Holiday Data Summary	- National Holiday Data Summary	- National Holiday Data Summary	- National Holiday Data Summary
12	- MOI, NIDC	- MOI, NIDC	- DMG, BOC	- DMG, BOC	- MOA
13	- ISC, JICA, NBC	- Balaju Industrial District	- Balaju Industrial District, NBS	- AIC, BOC, NBS	- AIC, DOA
14	- Holiday, Data Summary	- Holiday, Data Summary	- Holiday, Data Summary	- Holiday, Data Summary	- Holiday, Data Summary
15	- NPC, MOF, DB	- NPC, MOF, DB	- NTC, NOCN, Dooar	- NTC, NOCN, Dooars, BOC	- DSSAC/DOA, DFAMS/DOA
16	- CBS, MOI, National Insurance Co., BOC	- GWDP, DOR	- GWDP, DOR	- GWDP, DOR, WSSB at Sundarighat, BOC	- Local Survey in Lalitpur District
17	- BOC	- BOC	- BOC	- BOC	- Local Survey in Bhaktapur
18	- ISC, JICA	- BOC	- BOC, CBC	- BOC	- Local Survey in Kaski District
19	- DOT (Tax), ISC	- BOC	- ISC, NOCN, NTC, BOC	- BOC	- Local Survey in Kaski District
20	-ISC, JICA, BOC	- ISC, BOC	- ISC, CBC, DMG, BOC	- BOC	- Trip, Data Summary
21	- Holiday, Trip to Hetauda	- Holiday, Trip to Hetauda	- Holiday, Trip to Hetauda	- Holiday, Trip to Hetauda	- Holiday, Trip to Hetauda
22	- BCI, Trip to KTM	- BCI, Trip to KTM	- BCI	- BOC	- Local Survey in Parsa District
23	- ISC, JICA	- ISC	- Border, BO, BID, Trip to KTM	- Trip to Raxaul, BCI, Himal Oxygen, Ghee Factory	- Local Survey in Bara District
24	- ISC, Preparation of Progress Report	- ISC, Preparation of Progress Report	- ISC, Preparation of Progress Report	- ISC, BOC	- ISC, Preparation of Progress Report
25	- ISC, Preparation of Progress Report	- ISC, Preparation of Progress Report	- ISC, Preparation of Progress Report	- ISC, Preparation of Progress Report, BOC	- ISC, Preparation of Progress Report
26	- ISC, Japanese Embassy	- ISC, Japanese Embasy	- ISC, Japanese Embassy	- ISC, Japanese Embasy	- ISC, Japanese Embassy
27	- MOI, Presentation of Progress Report	- MOI, Presentation of Progress Report	- MOI, Presentation of Progress Report	- MOI, Presentation of Progress Report	- MOI, Presentation of Progress Report
28	- Holiday	- Holiday	- Holiday	- Holiday	- Holiday
29	- Leave KTM	- Leave KTM	- Leave KTM Arrive in CLT	- Leave KTM Arrive in CLT	- Leave KTM
30	- Arrive in TKY	- Arrive in TKY	- Eng'g Firms	- Eng'g Firms	- Arrive in TKY
February 1			- HPC	- HPC	
2			- FAI, Railway	- FAI, Railway	
3			- Haldia, HPC	- Haldia, HPC	
4			- Leave CLT	- Leave CLT	
5			- Arrive in TKY	- Arrive in TKY	

ACTIVITY OF JICA STUDY TEAM (2)

Date	S. SUZUKI	T. SUZUKI
January, 1984		
15	- Leave TKY	- Leave TKY
16	- Arrive in KTM	- Arrive in KTM
17	- HCC	- HCC
18	- ISC, JICA	- HCC, Flue Gas Analysis
19	- ED, NEC	- HCC, Flue Gas Analysis
20	- ED, NEC	- HCC, Flue Gas Analysis
21	- Holiday, Trip to Hetauda	- Holiday, Trip to Hetauda
22	- HCI, Trip to KTM	- HCI, Trip to KTM
23	- ED, NEC	- HCC, Flue Gas Analysis
24	- ED, NEC	- HCC, Flue Gas Analysis
25	- ED, Preparation of Progress Report	- HCC, preparation of Progress Report
26	- ISC, Japanese Embassy	- ISC, Japanese Embassy
27	- MOI, Presentation of Progress Report	- MOI, Presentation of Progress Report
28	- Holiday	- Holiday
29	- Leave KTM	- Leave KTM
30	- Arrive in TKY	- Arrive in TKY

Annex I-4

LIST OF OFFICES VISITED AND PERSONS MET

Annex I-4

LIST OF OFFICES VISITED AND PERSONS MET

(1) Management, Financial and Economic Study Team

-Ministry of Industry	Mr. Indu Shamsher Thapa Senior Engineer
	Mr. Iswari Lal Shrestha Secretary
-ISC	Mr. Tej Kumar Sharma Chief Training Division (for Executive Director)
-NIDC	Mr. R. N. Dhungel General Manager
-NEC	Mr. L. M. Dixit General Manager
-National Planning Commission	Mr. Bed Bahadur Khadka Co-member (Agriculture)
	Dr. Bijaya Bahadur Pradhan Member
-Ministry of Finance	Mr. Hit Singh Shrestha Additional Secretary
	Mr. Bhupal Man Shakya Under-Secretary
-Department of Electricity	Mr. Harsh Man Shrestha Chief Engineer
-Central Bureau of Statistics	Mr. Shyam Biharilal Srivastava Director General
-Department of Industry	Mr. Ram Binod Bhattarai Director General
-National Insurance Co.	Mr. Bhoj Raj Sharma Manager
-Nepal Oil Corporation	Mr. Jeevan Prasad Khanal Deputy General Manager

-Hetauda Cement Factory	Mr. Rabindra Nath Rimal General Manager
-Himal Cement Co.	Mr. Indu Bahadur Shahi General Manager
-Department of Taxes	Mr. Lalit Bahadur Khadka Deputy Director

(2) Market Study Team

-Ministry of Agriculture (MOA)	Mr. Rameshwar Bahadur Singh Joint Secretary
-Agricultural Input Corporation (AIC)	Mr. P. N. Rana Chairman cum General Manager
	Mr. Amrit Man Tamrakar Planning & Evaluation Div.
-Department of Agriculture (DOA)	Mr. Purushottam B. Gorkhali Director General
	Mr. Narayan Regmi Deputy Director General, Planning & Coordination Div.
-Division of Soil Science and Agricultural Chemicals, DOA (DSSAC, DOA)	Mr. Ranjit Shah Chief Soil Scientist
-Department of Food and Agricultural Marketing Services, MOA (DFAMS, MOA)	Mr. Pushpa Ram B. Mathema Director General
-Central Regional Agricultural Directorate	Mr. S. N. Sarkar Director
	Mr. P. L. Chitrakar Ag. Officer - Planning & Ag. Extension
-District Agricultural Office, Lalitpur District	Mr. Yogendra B. Basnet District Agricultural Development Officer

-Farmers interview in Thecho Panchayat and Dhepakhel Panchayat, Lalitpur District	
-Sajha Office in Thecho Panchayat, Lalitpur Disctirct	
-District Agricultural Office, Bhaktapur District	
-Interviews with farmers from Sipadoi Panchayat, Tathali Panchayat, and Town Panchayat, Bhaktapur District	
-Western Regional Agricultural Directorate	Mr. Manik L. Pradhan Director
-District Agricultural Office, Kaskit District	
-Farmers interview in Arghaun Panchayat and Bhalam Panchayat, Kaski District	
-District Agricultural Office, Parsa District	
-Farmers interview in Sugauli Panchayat and Rengadhwa Panchayat, Parsa District	
-District Agricultural Office, Bara District	

(3) Technical Study Team

-Ministry of Industry (MOI)	Mr. Indu Shamsher Thapa Senior Engineer Mr. Mukesh Dev. Bhattarai Engineer

-Dept. of Mines & Geology (DOMG)	Mr. J. M. Tater Deputy Director
	Mr. P. P. Gorkhali Engineer
	Mr. Dwarika Shrestha Officer
-Himal Cement Co. (HCC)	Mr. Indu Bahadur Shahi General Manager
	Mr. A. M. Bania Chief, Laboratory
	Mr. C. D. Rajbhandari Chief, Planning
	Mr. S. R. Aryal Chief, Mechanical Section
	Mr. B. K. Kusle Chief, Production
-Balaju Yantra Shala (BYS)	Mr. Alex Arter Mechanical Engineer
-Structo Nepal (P) Ltd. (SN)	Ms. Yangji Sherpa Managing Director
	Mr. Urgen Sherpa Accounts Chief
-NECOENCO (P) Ltd.	Mr. Diwakar Raj Paudyal
-Foundry Project (FP)	Mr. Kamal Manandhar Engineer
-Nepal Bureau of Standards (NBOS)	Mr. Dinesh Raj Bhattarai Director
-Nepal Transport Corporation (NTC)	Mr. Krishna Raj Panday Chairman cum General Manager
	Mr. Narendra Bahadur Neucha Director
	Mr. Pramod Mani Ropeway Engineer

-National Construction Co. of Nepal (NCCN)	Mr. N. D. Sharma General Manager
	Mr. L. P. Sharma Works Manager
-Dooars Transport (P) Ltd.	Mr. S. K. Manglik Manager
-Dept. of Roads (DOR)	Mr. Bharati Sharma D. E. Design Section
	Mr. D. P. Rimal D. E. Planning Section
-Water Supply & Sewerage Board (WSSB) Sundarighat	Mr. Binod Shankar Palikhe Officer
-C.B.C. Group	Mr. Deepak Man Sherchan Managing Director
	Mr. S. B. Mathema Director
	Mr. M. Rajbhandari Structure Engineer
-Nepal Oil Corporation (NOC)	Mr. Pradhan Deputy General Manager
-Hetauda Cement Industries Ltd. (HCI)	Mr. R. N. Rimal General Manager
	Mr. Umesh Jha Deputy General Manager
	Mr. T. K. Jha Erection Manager
	Mr. D. P. Shrestha Construction Manager
	Mr. K. R. Aryal Finance Manager
	Mr. Teodoro R. Dino Consultant from ADB/M

-Himal Oxygen (P) Ltd.	Mr. Indra Ranjit Manager
-Himal Iron (P) Ltd.	Mr. Indra Ranjit Manager
-Hetauda Industrial District (HID)	Mr. Gopal Sharma Officer
-Vegetable Ghee Industries Ltd. (VGI)	Mr. D. Mathur Technical Incharge
-Department of Electricity (DOE)	Mr. K. M. Shrestha Manager, Finance & Economic Analysis
	Mr. Manik Tuladhar Officer
	Mr. R. M. Shakya Incharge, Planning & Generation Dept.
-Water Resources Commission	Mr. Deepak Gyawali Officer

Annex I-5

LIST OF DOCUMENTS RECEIVED

Annex I-5

LIST OF DOCUMENTS RECEIVED

Author/Title	Received from
(1) Management, Financial and Economic Study Team	
1) Investors' Guide to Nepal	ISC
2) Investing in Industry in Nepal	ISC
3) Industrial Enterprises Act 2038 (1982)	ISC
4) Economic Survey, Fiscal Year 1982-83 (Ministry of Finance, 1983)	ISC
5) NEPAL - INDIA, Treaty of Trade, Treaty of Transit; Agreement of Cooperation	ISC
6) Nepal Recent Developments and Selected Issues in Trade Promotion, World Bank; Oct. 14, 1983	ISC
7) Nepal: Issues and Options in the Energy Sector; UNDP/World Bank, August, 1983	ISC
8) Water - The Key to Nepal's Development (Ministry of Water Resources, 1981	ISC
9) Promotion of Export Oriented Industries in Nepal (UNIDO, July 1983)	ISC
10) ISC (Introduction)	ISC
11) List of Works Accomplished by ISC	ISC
12) Industrial Profile 1981/82, Ministry of Industry	ISC
13) Company Act, 2021 (1964)	ISC
14) NIDC (Introduction)	NIDC
15) NIDC (Guidance)	NIDC
16) NIDC (Manual for Financial Assistance)	NIDC
17) Operational Statistics of Nepal Industrial Development Corporation (F.Y. 1979/80 - 1981/82)	NIDC

18)	Act Relating to Foreign Investment and Technology 2038 (1982)	NIDC
19)	Industrial Policy and Act of HMGN (1982)	NIDC
20)	Review of Performance of Public Sector Enterprises (1981) Ministry of Finance	MOF
21)	Population in Nepal by Districts and Geography (1971, 1981) CBS	CBS
22)	Organizational Chart of HMG/N	ISC
23)	Operating Cost Data at Himal Cement	Himal Cement
24)	Financial Data at Hetauda Cement	Hetauda Cement
25)	Data on Financing Conditions for Hetauda Cement, MOF	MOF

(2) Market Study Team

1)	AIC, "Basic Statistics of Agricultural Inputs in Nepal", (Jan. 1983)	AIC
2)	S.S. Rawal and T.M. Pradhan (AIC), "Import Management of Chemical Fertilizers in Nepal"	AIC
3)	A.M. Tamrakar (AIC), "A General Review on the Fertilizer Marketing System in Nepal", (Aug. 1979)	AIC
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6)	Div. of Soil Science & Agri. Chemistry, "Soil Reaction May of Nepal (Provisional)", (1983)	Div. of SSAC, DOA
7)	Div. of Soil Science & Agri. Chemistry, "Response of N/P_2O_5 Fertilizer"	Div. of SSAC, DOA

8) Dept. of Food and Agri. Marketing Services, "Agricultural Statistics of Nepal, 1977", (1977) — DFMAS, MOA

9) DFMAS, "Hand Book of Agricultural Statistics of Nepal", (1978) — DFMAS, MOA

10) DSSAC, DOA, "Generalized Soil Map of Nepal (Provisional)", (1978) — DSSAC, DOA

11) DFMAS, "Cropped Area and Production by Region and Zone 1971 - 1981" — DFMAS

12) AIC, "Demand Projection of Fertilizer" — AIC

13) AIC, "Data on Transportation Cost of Fertilizer" — AIC

14) AIC, "Data on Import and Consumption, 1980 - 1982" — AIC

15) AIC, "Data/Information on Fertilizer Marketing and Distribution" — AIC

16) AIC, "Map of Distribution Routes of Fertilizer" — AIC

17) AIC, "Map of Chemical Fertilizer Distributed" — AIC

(3) Technical Study Team

1) Montnly Bulletin, Hetauda Cement Industries Limited, Nov. 1983

2) Industrial profile, Statistical Data No. 15, For Fiscal Year 1982-1983, Hetauda Industrial District, Pashupati Nagar, Hetauda

3) Ribbed - Torsteel, Himal Iron and Steel (P) Ltd., Kathmandu, Nepal

4) Feasibility Study for Replacement of Bridges on Kathmandu-Raxaul Highway, Department of Roads, June 1981, Kathmandu, Nepal

5) Surface Water Records of Nepal, Supplement No. 7, 1972, No. 8 (1973), No. 9 (1974), No. 10 (1975), Department of Irrigation, Hydrology and Meteorology, Ministry of Food, Agriculture and Irrigation, June 27, 1974, Kathmandu, Nepal

19) Labor Wages for Kathmandu District Fixed by His Majesty's Government of Nepal (F.Y. 1982/83), ISC

20) Micro Seismicity Epicenter Map (Jan. 1982 - Dec. 1982), HMG/Seismological Laboratory, DMG Epicenter Map (1911-1982), HMG/Department of Mines and Geology

21) Industrial Profile For Fiscal Year 1982-1983, Hetauda Industrial District

22) Report of Soil Investigation for Hetauda Cement Plant at Hetauda - Nepal (December 1980), Development Consultants Private Limited

23) List of Transport Facilities, Nepal Transport Corporation

24) Information on the questionnaire submitted to Hetauda Cement Industries, and Hetauda Industrial District (CIVIL)

25) Plant Lay-out Hetauda Cement Project, Hetauda, Nepal

26) Contract Documents (CIVIL) of Hetauda Cement Industries Ltd.

27) Information on the Questionnaire Submitted by the Urea Fertilizer Feasibility Study Mission to the Himal Cement Co. Chobar, Kathmandu, Nepal

28) Sapta Gandaki Hydroelectric Project Proposal for Development Electricity Department

29) Budhi Gandaki Hydroelectric Project - Power Simulation Studies and Evaluation of Alternative Project, Electricity Department

30) Electricity Load Forecast for Period 1983 - 2001, (1983) Electricity Department

31) Tariff Rates (1976 - 1983) NEC

32) Report on Tariff Study, Electricity Department

33) Rate Analysis of Civil Work, CBC Group

34) NCCN, a brief history

Annex II

Annex II-1

METHODOLOGY AND PROCEDURE OF DEMAND PROJECTION

Annex II-1

METHODOLOGY AND PROCEDURE OF DEMAND PROJECTION

(1) General

The demand for fertilizer was projected through the following process.

1. Projection of cultivated area of major crops by region
2. Projection of demand for fertilizer
3. Projection of type-wise demand for fertilizer

Details are described in the following sections.

(2) Projection of cultivated area of major crops

i) Method of projection

The future cultivated area (trend) of major crops was projected by region at each projection level shown below on the basis of past trend of change in the cultivation area.

Level 1: Change in the area devided into the following groups, namely, agricultural area, pasture land, forest, and other area including industrial area and urban area. (Note: Level 1 projection was omitted in this Study due to the lack of data.)

Level 2: Change in the area devided into the following groups out of agricultural area, namely, short term crops (multi-cropping crops), long term crops (less than one cropping annually), and perennial crops.

Level 3: Change in the cultivated area of individual crops.

The total of each projected area in Level 2 in the region in question are adjusted to be equal to the agricultural area in Level 1. Further, the total of cultivated areas of each crop projected in Level 3 in each group shown in Level 2 are adjusted to be equal to the adjusted area projected in Level 2. Here, the total of cultivated area of short-term crops means the total of cultivated area multiplied by multi-cropping ratio of each crops.

The areas of each component (for example, agricultrual area and pasture land, etc. in Level 1) included in each Level either increase or decrease affected by economic and/or social factors. If the agricultural area has been expanded, then the expansion will be limited in the future because of approaching the limit of available land. In other words, the urban area may also be expanded at the same time, and the expansion of agricultural area may be depressed by the expansion of urban area. These pressures for expansion by each component and the adjustment function among these components have been reflected on the past trend of changes in the area of individual factors. These trends shown in the past are expected to continue in the future if there is no significant change in the economy, policy or technology, etc. The projection procedure described above represents the adjustment of discrepancies between the projected result of total of individual factors and aggregated factor with calculating the expanding (or shrinking) pressure of each factor by time series analysis.

The cultivated area by region and by crop described above were projected by the following regions, and the result is shown in tables of Annex II-2.

- Eastern Development Region:	1. High Hill 2. Hill 3. Terai
- Central Development Region:	1. High Hill 2. Hill 3. Terai
- Kathmandu Valley:	
- Western Development Region:	1. High Hill 2. Hill 3. Terai
- Mid-western Development Region:	1. High Hill 2. Hill 3. Terai
- Far-western Development Region:	1. High Hill 2. Hill 3. Terai

ii) Data and data Sources

The projection of cultivation area was based on the past 12 years data of 1971 through 1982 provided by Food and Agricultural Marketing Service Department, Marketing Services Division, Ministry of Agriculture (FAMSD).

(3) Projection of fertilizer demand

i) Methodology of projection

"Physically optimum dosage level of fertilizer" may be calculated for each crop. The level varies depending on the soil condition, climatic condition of the area as well as fertilizer response of the crop, and represents the dosage level at which maximum additional output per unit input in terms of volume is expected. However, this level does not necessarily represent the economic optimum dosage level. When the application of fertilizer is increased gradually in the same manner as described above, then there will be the dosage level at which maximum output in terms of value is expected by input of unit value of fertilizer. This level is called "Economic optimum dosage level of fertilizer". Every farmer has the possibility to increase the application level up to this level. However, due to the following factors which adversely affect the use of fertilizer, the actual application level is usually lower than the economic optimum dosage level.

1. Natural disasters such as drought and flood.
2. Delay in the supply of irrigation water or inadequate drainage.
3. Insufficient purchasing ability of farmers to buy fertilizer, or lack of an adequate credit system for fertilizer purchase.
4. Unstable yield of crops.
5. Lack of sufficient knowledge on fertilization technic or effects of fertilization on crop yield.
6. Shortage or delay in supply of fertilizer.
7. Other factors which discourage farmers from fertilization.

When the "economic optimum dosage level" multiplied by "cultivation area" is defined as "potential demand", then the difference between the "potential demand" and actual consumption is understood to have been caused by the factors described above. The ratio of actual consumption to the potential damand is called the "realization rate" of the potential demand. The past trend of improvement of restricting factors of fertilization may be applicable to the future, as long as there is no significant change in the policies on agriculture and fertilizer distribution. In other words, the past trend of realization rate can be applicable to the future. However, it should be noted that if there will be significant changes in the factors, which affect influences on the fertilizer use, then the past trend of the realization rate can not be applied to the future. If such is the case, the future realization rate should be examined year by year taking into account the change in the factors. These factors include the following.

1. Construction or improvement projects of irrigation/ drainage facilities.

2. Large scale intervention by the government on price formation of either agricultural products or fertilizers, including introduction of a subsidy system and/or price support system.

3. Development or introduction of crop varieties which have high fertilizer response.

4. Improvement of the agricultural extension system.

5. Improvement of the fertilizer distribution system.

6. Other changes in the factors which stimulate the farmers to increase the fertilizer application.

The "potential demand" was defined in the above as "optimum dosage per unit cultivation area" mutiplied by "cultivation area". If appropriate data are avaslable, then the better estimate may be obtained regarding the "potential demand" using "per hectare economic optimum dosage" multiplied by "fertilized area" in replace of "cultivation area". In this case, the "cropped" area will be divided into two, namely, "fertilized area" and "non-fertilized area", and the trend of rate of fertilized area to total cropped area will be first projected with examination made of the probability that the upper limit of the rate will be attained. This projection process is better than that explained above, in that maximum potential rate of fertilized area is sometimes less than 100% because of natural conditions, lack of irrigation facilities, and other reasons, and therefore, the area of which fertilization is impossible, should be deducted from the objective area for calculation of fertilization in the future.

ii) Process of demand projection

The procedure for projection of future demand was as follows.

1. Comparison of the potential demand with actual demand in the past analyzing factors affecting fertilizer consumption and extent of their effects.
2. Projection of potential demand on the basis of projected cultivated area and the potential dosage by crop.
3. Projection of future realization rate of potential demand.
4. Calculation of projected demand multiplying the potential demand with realization rate.

iii) Data sources are as follows, and the details of the data on projection are included in Annex II-3.

1. Potential dosage:

The economic optimum dosage level was firstly calculated using the fertilizer response data*/ provided by the Division of Soil Science and Agricultural Chemistry, Department of Agriculture (Div. of SSAC), and the result is shown in Table 2-20 (Chapter 3, Part II). The calculation results thus obtained were found to meet the recommended dosages provided by Div. of SSAC, and therefore, the recommended dosages were regarded as the economic optimum dosage level is this Study.
(Note: */ data are included in Annex II-5.)

2. Actual consumption:

Regional consumption data provided by AIC, which are included in Annex II-4.

(4) Projection of type-wise demand for fertilizer

Based on the result of total demand projection, type-wise demand was projected as follows.

1. Examination of crops (or regions) on which the type of fertilizer in question is applicable.

2. Calculation of potential demand from the above crops (or regions).

3. Projection of type-wise fertilizer demand taking into account the future supply ability and past trend of type-wise fertilizer consumption.

Annex II-2

PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

Table II-2(1) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- EASTERN HIGH HILL -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	38	37	92	103	110	111	110	107	107	102	125	129	132	144	153	156
MAIZE	165	161	161	161	155	160	151	180	170	170	167	166	165	162	159	157
WHEAT	25	25	13	7	8	8	8	14	18	10	7	7	6	2	0	0
OTHER CEREALS	48	49	49	48	48	47	47	44	44	50	47	47	46	45	44	43
BARLEY	17	17	17	11	11	11	11	9	9	9	8	7	6	2	0	0
POTATOES	39	39	40	49	49	47	49	49	49	49	50	50	50	51	51	51
OTHER OIL CROPS	7	8	7	4	3	4	4	4	4	2	2	2	1	0	0	0
TOBACCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUTE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUGAR CANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	407	407	407	407	407	407	407	407	407	407	407	407	407	407	407	407

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(2) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- EASTERN HILL -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	424	432	437	440	438	463	459	509	572	488	505	507	508	516	520	522
MAIZE	652	659	659	660	706	718	662	719	814	797	764	771	778	818	860	877
WHEAT	64	66	65	86	100	100	102	117	130	151	144	151	159	194	229	242
OTHER CEREALS	170	174	174	165	177	192	190	183	189	203	191	191	191	190	190	190
BARLEY	12	13	11	9	10	9	9	7	5	8	6	5	5	2	0	0
POTATOES	126	133	137	136	136	138	138	127	129	129	130	129	129	125	122	121
OTHER OIL CROPS	73	73	74	76	110	111	107	80	70	86	90	90	90	90	90	90
TOBACCO	2	2	2	2	1	2	2	1	1	1	1	1	1	0	0	0
JUTE	16	9	9								0	0	0	0	0	0
SUGAR CANE	2	2	2	2	2	2	2	4	2	1	2	2	2	2	1	1
TOTAL	1695	1695	1695	1695	1695	1695	1695	1695	1695	1695	1695	1695	1695	1695	1695	1695

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(3) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- EASTERN TERAI -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	3392	3443	3640	3585	3605	3543	3556	3567	3601	3295	3581	3587	3593	3611	3617	3616
MAIZE	124	132	127	159	162	186	167	191	210	280	244	256	268	328	386	409
WHEAT	290	372	421	458	451	456	494	370	336	606	507	517	527	568	599	609
OTHER CEREALS	52	41	46	38	51	61	62	56	54	49	56	57	58	62	66	67
BARLEY	8	8	6	5	5	4	4	4	4	3	3	3	2	1	0	0
POTATOES	39	40	34	33	32	31	32	37	42	46	39	39	39	41	42	43
OTHER OIL CROPS	98	103	93	101	138	157	139	157	125	56	126	127	128	132	135	136
TOBACCO	18	18	18	21	24	23	23	23	22	27	24	24	24	25	26	27
JUTE	309	332	261	261	261	261	261	261	261	261	193	181	169	118	78	64
SUGAR CANE	20	17	19	26	27	26	27	22	31	31	30	31	32	35	37	38
TOTAL	2821	2821	2821	2821	2821	2821	2821	2821	2821	2821	2821	2821	2821	2821	2821	2821

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(4) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- CENTRAL HIGH HILL -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	63	61	61	61	63	61	61	59	61	64	62	62	62	63	64	64
MAIZE	146	146	146	146	146	149	149	128	145	135	140	140	139	137	135	133
WHEAT	34	34	24	27	27	27	27	39	39	36	34	34	35	37	39	40
OTHER CEREALS	41	41	41	40	39	43	43	41	41	40	41	41	42	42	43	43
BARLEY	9	9	9	8	8	8	8	8	8	10	8	8	8	8	8	8
POTATOES	34	34	34	37	36	41	41	33	32	44	39	39	40	41	42	43
OTHER OIL CROPS	3	3	3	3	3	3	3	2	4	2	3	3	3	3	2	2
TOBACCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUTE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUGAR CANE	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
TOTAL	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333	333

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(5) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- CENTRAL HILL -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	317	317	319	340	348	349	364	376	403	532	446	460	474	520	551	562
MAIZE	530	521	521	521	513	519	489	505	505	479	505	506	507	485	457	446
WHEAT	77	77	81	90	108	104	108	126	158	219	175	186	197	239	272	284
OTHER CEREALS	122	121	121	110	105	106	109	108	116	108	108	108	107	100	92	88
BARLEY	5	5	5	7	5	6	7	9	9	8	9	9	9	11	12	12
POTATOES	44	44	52	52	51	51	53	56	57	57	58	59	60	60	59	58
OTHER OIL CROPS	101	92	90	74	86	48	45	34	61	62	39	34	29	2	0	0
TOBACCO	2	2	1	1	1	1	1	1	1	1	1	1	1	0	0	0
JUTE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUGAR CANE	9	9	9	8	9	9	8	8	8	19	12	12	12	13	14	15
TOTAL	1350	1350	1350	1350	1350	1350	1350	1350	1350	1350	1350	1350	1350	1350	1350	1350

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(6) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- CENTRAL TERAI -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	3496	3524	3405	3427	3385	3430	3435	3415	3413	3149	3342	3334	3327	3292	3258	3245
MAIZE	529	549	499	470	432	430	381	436	450	572	436	431	426	406	390	384
WHEAT	599	652	1000	1034	1048	977	993	1092	1020	1316	1240	1276	1310	1459	1581	1626
OTHER CEREALS	78	81	81	75	73	72	70	75	71	113	84	85	86	91	96	98
BARLEY	47	48	31	26	44	50	49	49	50	35	43	43	43	42	42	42
POTATOES	53	51	41	39	30	31	31	30	34	76	39	39	38	37	36	35
OTHER OIL CROPS	342	330	307	237	327	360	277	245	125	234	206	194	182	119	57	31
TOBACCO	21	33	34	35	46	43	42	37	36	56	43	43	44	46	48	48
JUTE	3	1	1								0	0	0	0	0	0
SUGAR CANE	71	68	70	82	119	114	117	119	131	123	140	147	154	188	223	236
TOTAL	3439	3439	3439	3439	3439	3439	3439	3439	3439	3439	3439	3439	3439	3439	3439	3439

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(7) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- WESTERN HIGH HILL -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	8	7	7	3	3	1	1	0	0	0	0	0	0	0	0	0
MAIZE	24	24	24	24	24	24	24	23	9	9	15	13	12	6	0	0
WHEAT	10	10	5	5	5	6	6	7	10	9	6	6	6	5	4	3
OTHER CEREALS	12	12	12	11	11	11	11	11	11	11	12	12	12	11	11	10
BARLEY	11	11	12	12	12	12	12	15	15	15	16	16	16	17	18	18
POTATOES	8	8	8	8	8	9	9	7	7	7	8	8	8	7	6	6
OTHER OIL CROPS	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
TOBACCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUTE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUGAR CANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(8) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- WESTERN HILL -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	520	521	520	519	587	579	570	575	708	726	670	683	696	738	772	785
MAIZE	780	782	792	786	790	800	774	819	797	976	850	855	860	861	859	858
WHEAT	142	144	147	199	224	246	248	263	279	297	309	324	339	398	449	468
OTHER CEREALS	391	391	390	410	391	382	382	354	343	384	354	348	343	309	278	266
BARLEY	25	23	24	23	22	22	22	21	22	21	20	19	19	16	14	13
POTATOES	51	52	55	58	62	58	58	52	50	58	56	56	56	54	52	51
OTHER OIL CROPS	28	28	34	33	32	36	36	24	22	21	25	24	24	20	16	15
TOBACCO	1	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0
JUTE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUGAR CANE	7	7	6	4	4	4	4	3	3	3	2	1	1	0	0	0
TOTAL	2260	2260	2260	2260	2260	2260	2260	2260	2260	2260	2260	2260	2260	2260	2260	2260

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(9) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- WESTERN TERAI -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	1613	1631	1631	1763	1739	1752	1739	1823	1771	1758	1833	1851	1869	1952	2028	2055
MAIZE	195	202	202	177	177	168	155	169	173	73	122	113	105	62	17	0
WHEAT	384	425	434	448	506	502	519	594	592	655	659	688	716	864	1017	1078
OTHER CEREALS	27	28	28	22	28	25	25	22	25	14	21	20	20	17	14	13
BARLEY	20	20	21	10	4	7	7	7	4	3	0	0	0	0	0	0
POTATOES	22	20	17	8	7	7	7	7	12	12	6	5	5	2	0	0
OTHER OIL CROPS	86	83	86	116	147	191	138	158	128	95	149	153	156	172	186	191
TOBACCO	2	2	2	2	2	3	3	3	2	2	3	3	3	3	3	3
JUTE	2	0	0								0	0	0	0	0	0
SUGAR CANE	43	39	37	50	62	58	59	75	66	70	74	77	80	96	111	118
TOTAL	1625	1625	1625	1625	1625	1625	1625	1625	1625	1625	1625	1625	1625	1625	1625	1625

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(10) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- MID-WESTERN HIGH HILL -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	25	24	24	24	24	23	22	22	22	21	21	21	20	18	16	15
MAIZE	50	52	52	53	52	50	48	46	44	37	43	42	42	36	31	28
WHEAT	94	75	43	40	38	36	34	32	29	29	14	10	6	0	0	0
OTHER CEREALS	37	39	39	39	39	39	39	39	39	36	41	42	42	43	44	44
BARLEY	37	37	40	36	35	35	34	34	33	31	33	32	32	29	26	24
POTATOES	22	22	22	22	21	20	19	18	17	16	17	17	16	13	10	9
OTHER OIL CROPS	3	3	4	2	2	2	2	2	2	2	2	2	1	1	0	0
TOBACCO	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
JUTE	0	0	0	0	0	0	0	0	0	0	106	112	118	138	152	157
SUGAR CANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(11) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- MID-WESTERN HILL -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	229	236	236	229	231	232	233	234	237	249	239	236	234	221	211	207
MAIZE	367	374	374	365	373	382	392	403	412	427	402	399	396	383	374	372
WHEAT	173	173	166	185	211	238	265	294	325	332	323	333	343	387	427	442
OTHER CEREALS	86	86	86	85	92	99	106	112	120	123	120	121	123	131	139	142
BARLEY	40	39	41	45	46	47	49	50	51	53	52	53	53	55	57	57
POTATOES	20	20	20	21	23	25	26	28	30	28	29	29	30	31	33	34
OTHER OIL CROPS	30	30	35	29	34	39	44	50	56	55	54	55	56	63	69	71
TOBACCO	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
JUTE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUGAR CANE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TOTAL	1154	1154	1154	1154	1154	1154	1154	1154	1154	1154	1154	1154	1154	1154	1154	1154

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(12) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- MID-WESTERN TERAI -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	997	1012	1012	959	953	939	926	912	891	1001	923	917	910	878	846	833
MAIZE	360	365	365	311	312	314	317	319	321	359	321	320	318	311	305	302
WHEAT	193	199	223	229	248	267	286	306	324	348	353	370	386	466	546	577
OTHER CEREALS	26	26	26	21	21	20	20	20	19	18	17	17	16	12	8	7
BARLEY	4	4	3	3	4	4	5	5	6	3	5	5	5	5	6	6
POTATOES	17	17	17	16	15	15	14	13	12	11	11	10	10	7	4	2
OTHER OIL CROPS	234	239	228	227	245	251	259	265	262	271	272	277	281	302	322	330
TOBACCO	4	4	3	3	3	3	3	3	3	2	2	2	2	1	0	0
JUTE	1	0	0								0	0	0	0	0	0
SUGAR CANE	1	1	1	1	2	3	4	5	6	2	5	5	5	7	9	10
TOTAL	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221	1221

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(13) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- FAR-WESTERN HIGH HILL -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	69	67	67	67	68	68	68	68	68	63	66	66	66	65	65	65
MAIZE	41	36	36	36	37	39	41	42	44	43	41	42	42	43	45	45
WHEAT	103	92	72	58	60	62	64	66	69	69	55	53	51	42	35	33
OTHER CEREALS	27	27	27	26	25	24	23	22	21	24	22	22	22	20	18	18
BARLEY	20	19	21	29	30	30	30	30	31	25	31	32	32	35	37	38
POTATOES	8	7	7	10	9	9	8	8	7	7	8	8	8	7	7	7
OTHER OIL CROPS	5	6	7	6	6	6	6	6	6	4	6	6	6	6	7	7
TOBACCO	1	1	1	1	1	1	1	1	1	0	1	1	1	0	0	0
JUTE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUGAR CANE	0	3	2	2	2	1	1	0	0	0	1	1	1	0	0	0
TOTAL	273	273	273	273	273	273	273	273	273	273	273	273	273	273	273	273

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(14) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- FAR-WESTERN HILL -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	139	137	137	130	133	138	142	146	149	175	158	161	164	179	189	193
MAIZE	144	141	141	139	138	134	131	127	124	125	124	123	121	113	103	98
WHEAT	181	192	159	160	166	172	177	180	182	259	204	207	211	229	241	245
OTHER CEREALS	54	54	54	51	53	55	57	60	61	66	64	65	67	74	79	81
BARLEY	20	20	24	23	23	22	21	21	20	18	20	20	20	20	19	19
POTATOES	10	10	10	10	10	11	11	12	12	12	12	12	13	14	14	15
OTHER OIL CROPS	14	14	21	16	19	17	15	12	9	9	12	11	11	9	7	6
TOBACCO	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
JUTE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUGAR CANE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
TOTAL	605	605	605	605	605	605	605	605	605	605	605	605	605	605	605	605

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(15) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- FAR-WESTERN TERAI -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	620	630	660	680	668	664	659	655	658	703	703	712	721	765	809	827
MAIZE	151	162	162	172	169	165	160	156	152	201	180	183	187	205	224	232
WHEAT	91	93	151	166	177	187	197	207	219	232	243	253	264	310	353	369
OTHER CEREALS	19	19	19	19	19	19	19	20	20	19	20	20	20	22	23	23
BARLEY	0	0	1	1	1	1	2	2	2	1	2	2	2	3	3	3
POTATOES	9	9	8	7	7	6	6	5	5	7	5	5	5	4	4	3
OTHER OIL CROPS	92	95	118	128	142	152	161	174	174	197	204	215	227	289	355	383
TOBACCO	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
JUTE	1	0	0								0	0	0	0	0	0
SUGAR CANE	1	1	1	1	1	1	1	1	1	2	1	1	1	2	2	2
TOTAL	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826	826

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(16) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- CENTRAL KATHMANDU VALLEY -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	321	322	312	287	311	298	285	296	307	324	298	297	296	291	284	281
MAIZ	276	277	277	276	244	249	246	249	385	426	335	342	349	384	414	426
WHEAT	280	279	282	291	306	292	291	280	271	270	285	285	285	286	283	282
OTHER CEREALS	63	63	63	58	53	49	46	48	49	34	39	37	34	23	11	6
BARLEY	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1
POTATOES	30	31	31	18	16	20	21	17	28	34	22	21	21	19	18	17
OTHER OIL CROPS	23	24	23	22	20	21	19	9	9	6	9	8	6	0	0	0
TOBACCO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JUTE	0	0	0								0	0	0	0	0	0
SUGAR CANE	3	3	2	2	2	2	2	2	2	0	1	1	1	0	0	0
TOTAL	842	842	842	842	842	842	842	842	842	842	842	842	842	842	842	842

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(17) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- HIGH HILL TOTAL -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	203	196	251	258	268	264	262	256	258	250	274	278	280	290	298	300
MAIZE	426	419	419	420	414	422	413	419	412	394	406	403	400	384	370	363
WHEAT	266	236	157	137	138	139	139	158	165	153	116	110	104	86	78	76
OTHER CEREALS	165	168	168	164	162	164	163	157	156	161	163	164	164	161	160	158
BARLEY	94	93	99	96	96	96	95	96	96	90	96	95	94	91	89	88
POTATOES	111	110	111	126	123	126	126	115	112	123	122	122	122	119	116	116
OTHER OIL CROPS	19	21	22	15	14	15	15	14	16	10	13	13	11	10	9	9
TOBACCO	2	2	2	2	2	2	2	2	1	0	1	1	1	0	0	0
JUTE	0	0	0	0	0	0	0	0	0	0	106	112	118	138	152	157
SUGAR CANE	0	3	2	2	2	2	2	0	0	0	1	1	1	0	0	0
TOTAL	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(18) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- HILL TOTAL -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	1950	1965	1961	1945	2048	2059	2053	2136	2376	2494	2316	2344	2372	2465	2527	2550
MAIZE	2749	2754	2764	2747	2764	2802	2694	2822	3037	3230	2980	2996	3011	3044	3067	3077
WHEAT	917	931	900	1011	1115	1152	1191	1260	1345	1528	1440	1486	1534	1733	1901	1963
OTHER CEREALS	886	889	888	879	871	883	890	865	878	918	876	870	865	827	789	773
BARLEY	103	101	106	109	108	108	109	109	108	109	108	107	107	105	103	102
POTATOES	281	290	305	295	298	303	307	292	306	318	307	306	309	303	298	296
OTHER OIL CROPS	269	261	277	250	301	272	266	209	227	239	229	222	216	184	182	182
TOBACCO	7	7	6	6	4	5	6	5	4	3	3	3	3	1	1	1
JUTE	16	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0
SUGAR CANE	23	23	21	18	19	19	18	19	17	25	19	18	18	17	17	18
TOTAL	7906	7906	7906	7906	7906	7906	7906	7906	7906	7906	7906	7906	7906	7906	7906	7906

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(19) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- TERAI TOTAL -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	10118	10240	10348	10414	10350	10328	10315	10372	10334	9906	10382	10401	10420	10498	10558	10576
MAIZE	1359	1410	1355	1289	1252	1263	1180	1271	1306	1485	1303	1303	1304	1312	1322	1327
WHEAT	1557	1741	2229	2335	2430	2389	2489	2569	2491	3157	3002	3104	3203	3667	4096	4259
OTHER CEREALS	202	195	200	175	192	197	196	193	189	213	198	199	200	204	207	208
BARLEY	79	80	62	45	58	66	67	67	66	45	53	53	52	51	51	51
POTATOES	140	137	117	103	91	90	90	92	105	152	100	98	97	91	86	83
OTHER OIL CROPS	852	850	832	809	999	1111	974	999	814	853	957	966	974	1014	1055	1071
TOBACCO	46	57	58	62	76	73	72	67	64	88	73	73	74	76	78	79
JUTE	316	333	262	261	261	261	261	261	261	261	193	181	169	118	78	64
SUGAR CANE	136	126	128	160	211	202	208	222	235	228	250	261	272	328	382	404
TOTAL	9932	9932	9932	9932	9932	9932	9932	9932	9932	9932	9932	9932	9932	9932	9932	9932

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Table II-2(20) PAST TREND AND OUTLOOK OF CROP CULTIVATION AREA IN NEPAL

- GRAND TOTAL -

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1990	1995	2000
PADDY	12271	12401	12560	12617	12666	12651	12630	12764	12968	12650	12972	13023	13072	13253	13383	13426
MAIZE	4534	4583	4538	4456	4430	4487	4287	4512	4755	5109	4689	4702	4715	4740	4759	4767
WHEAT	2740	2908	3286	3483	3683	3680	3819	3987	4001	4838	4558	4700	4841	5486	6075	6298
OTHER CEREALS	1253	1252	1256	1218	1225	1244	1249	1215	1223	1292	1237	1233	1229	1192	1156	1139
BARLEY	276	274	267	250	262	270	271	272	270	244	257	255	253	247	243	241
POTATOES	532	537	533	524	512	519	523	499	523	593	529	526	528	513	500	495
OTHER OIL CROPS	1140	1132	1131	1074	1314	1398	1255	1222	1057	1102	1199	1201	1201	1208	1246	1262
TOBACCO	55	66	66	70	82	80	80	74	69	91	77	77	78	77	79	80
JUTE	332	342	271	261	261	261	261	261	261	261	299	293	287	256	230	221
SUGAR CANE	159	152	151	180	232	223	228	241	252	253	270	280	291	345	399	422
TOTAL	19208	19208	19208	19208	19208	19208	19208	19208	19208	19208	19208	19208	19208	19208	19208	19208

NOTE 1973-1982:ACTUAL 1983-2000:PROJECTED

Annex II-3

ESTIMATED/PROJECTED CONSUMPTION NITROGEN FERTILIZER BY REGION

Table II-3(1) ESTIMATED/PROJECTED CONSUMPTION OF NITROGEN FERTILIZER BY REGION

- EASTERN HIGH HILL -

CROP	POTENTIAL DOSAGE (N Kg/ha)	CROPPED AREA							
		1981	1982	1983	1984	1985	1990	1995	2000
PADDY	30	10700	10200	12500	12900	13200	14400	15300	15600
MAIZE	30	17000	17000	16700	16600	16500	16200	15900	15700
WHEAT	30	1800	1000	700	700	600	200	0	0
OTHER CEREALS	11	4400	5000	4700	4700	4600	4500	4400	4300
BARLEY	30	900	900	800	700	600	200	0	0
POTATOES	72	4900	4900	5000	5000	5000	5100	5100	5100
OTHER OIL CROPS	34	400	200	200	200	100	0	0	0
TOBACCO	22	0	0	0	0	0	0	0	0
JUTE	34	0	0	0	0	0	0	0	0
SUGAR CANE	72	0	0	0	0	0	0	0	0
POTENTIAL DEMAND (A)		1327	1288	1339	1345	1341	1347	1352	1353
ACTUAL/PROJECTED CONSUMPTION (B)		29	55	40	54	54	67	81	95
(A/B : %)		2	4	3	4	4	5	6	7

Table II-3(2) ESTIMATED/PROJECTED CONSUMPTION OF NITROGEN FERTILIZER BY REGION

- EASTERN HILL -

CROP	POTENTIAL DOSAGE (N Kg/ha)	CROPPED AREA 1981	1982	1983	1984	1985	1990	1995	2000
PADDY	80	57200	48800	50500	50700	50800	51600	52000	52200
MAIZE	00	81400	79700	76400	77100	77800	81800	86000	87700
WHEAT	60	13000	15100	14400	15100	15900	19400	22900	24200
OTHER CEREALS	11	18900	20300	19100	19100	19100	19000	19000	19000
BARLEY	30	500	800	600	500	500	200	0	0
POTATOES	72	12900	12900	13000	12900	12900	12500	12200	12100
OTHER OIL CROPS	34	7000	8600	9000	9000	9000	9000	9000	9000
TOBACCO	22	100	100	100	100	100	0	0	0
JUTE	34	0	0	0	0	0	0	0	0
SUGAR CANE	72	200	100	200	200	200	200	100	100
POTENTIAL DEMAND (A)		14902	14258	14031	14148	14274	14907	15535	15791
ACTUAL/PROJECTED CONSUMPTION (B)		224	354	281	283	285	447	466	474
(A/B : %)		2	2	2	2	2	3	3	3

Table II-3(3) ESTIMATED/PROJECTED CONSUMPTION OF NITROGEN FERTILIZER BY REGION

- EASTERN TERAI -

CROP	POTENTIAL DOSAGE (N Kg/ha)	CROPPED AREA							
		1981	1982	1983	1984	1985	1990	1995	2000
PADDY	00	360100	329500	358100	358700	359300	361100	361700	361600
MAIZE	20	21000	28000	24400	25600	26800	32800	38600	40900
WHEAT	00	33600	60600	50700	51700	52700	56800	59900	60900
OTHER CEREALS	11	5400	4900	5600	5700	5800	6200	6600	6700
BARLEY	30	400	300	300	300	200	100	0	0
POTATOES	72	4200	4600	3900	3900	3900	4100	4200	4300
OTHER OIL CROPS	34	12500	5600	12600	12700	12800	13200	13500	13600
TOBACCO	22	2200	2700	2400	2400	2400	2500	2600	2700
JUTE	34	26100	26100	19300	18100	16900	11800	7800	6400
SUGAR CANE	72	3100	3100	3000	3100	3200	3500	3700	3800
POTENTIAL DEMAND (A)		43848	44124	45513	45788	46060	47249	48215	48554
ACTUAL/PROJECTED CONSUMPTION (B)		1287	963	1365	1374	1382	1890	1929	1942
(A/B : %)		3	2	3	3	3	4	4	4

Table II-3(4) ESTIMATED/PROJECTED CONSUMPTION OF NITROGEN FERTILIZER BY REGION

- CENTRAL HIGH HILL -

CROP	POTENTIAL DOSAGE (N Kg/ha)	CROPPED AREA							
		1981	1982	1983	1984	1985	1990	1995	2000
PADDY	30	6100	6400	6200	6200	6200	6300	6400	6400
MAIZE	30	14500	13500	14000	14000	13900	13700	13500	13300
WHEAT	30	3900	3600	3400	3400	3500	3700	3900	4000
OTHER CEREALS	11	4100	4000	4100	4100	4200	4200	4300	4300
BARLEY	30	800	1000	800	800	800	800	800	800
POTATOES	72	3200	4400	3900	3900	4000	4100	4200	4300
OTHER OIL CROPS	34	400	200	300	300	300	300	200	200
TOBACCO	22	0	0	0	0	0	0	0	0
JUTE	34	0	0	0	0	0	0	0	0
SUGAR CANE	72	0	0	0	0	0	0	0	0
POTENTIAL DEMAND (A)		1048	1103	1068	1068	1076	1037	1094	1099
ACTUAL/PROJECTED CONSUMPTION (B)		679	864	865	897	925	957	963	967
(A/B : %)		65	78	81	84	86	88	88	88

Table II-3(5) ESTIMATED/PROJECTED CONSUMPTION OF NITROGEN FERTILIZER BY REGION

- CENTRAL HILL -

CROP	POTENTIAL DOSAGE (N Kg/ha)	CROPPED AREA							
		1981	1982	1983	1984	1985	1990	1995	2000
PADDY	80	40300	53200	44600	46000	47400	52000	55100	56200
MAIZE	00	50500	47900	50500	50600	50700	48500	45700	44600
WHEAT	60	15800	21900	17500	18600	19700	23900	27200	28400
OTHER CEREALS	11	11600	10800	10800	10800	10700	10000	9200	8800
BARLEY	30	900	800	900	900	900	1100	1200	1200
POTATOES	72	5700	5700	5800	5900	6000	6000	5900	5800
OTHER OIL CROPS	34	6100	6200	3900	3400	2900	200	0	0
TOBACCO	22	100	100	100	100	100	0	0	0
JUTE	34	0	0	0	0	0	0	0	0
SUGAR CANE	72	800	1900	1200	1200	1200	1300	1400	1500
POTENTIAL DEMAND (A)		10054	11263	10453	10631	10808	11119	11273	11318
ACTUAL/PROJECTED CONSUMPTION (B)		1557	1987	1882	2020	2162	2446	2593	2603
(A/B : %)		15	18	18	19	20	22	23	23

Table II-3(6) ESTIMATED/PROJECTED CONSUMPTION OF NITROGEN FERTILIZER BY REGION

- CENTRAL TERAI -

CROP	POTENTIAL DOSAGE (N Kg/ha)	CROPPED AREA							
		1981	1982	1983	1984	1985	1990	1995	2000
PADDY	00	341300	314900	334200	333400	332700	329200	325800	324500
MAIZE	20	45000	57200	43600	43100	42600	40600	39000	38400
WHEAT	00	102000	131600	124000	127600	131000	145900	158100	162600
OTHER CEREALS	11	7100	11300	8400	8500	8600	9100	9600	9800
BARLEY	30	5000	3500	4300	4300	4300	4200	4200	4200
POTATOES	72	3400	7600	3900	3900	3800	3700	3600	3500
OTHER OIL CROPS	34	12500	23400	20600	19400	18200	11900	5700	3100
TOBACCO	22	3600	5600	4300	4300	4400	4600	4800	4800
JUTE	34	0	0	0	0	0	0	0	0
SUGAR CANE	72	13100	12300	14000	14700	15400	18800	22300	23600
POTENTIAL DEMAND (A)		51650	54095	53357	53588	53804	54734	55466	55714
ACTUAL/PROJECTED CONSUMPTION (B)		5209	6617	6403	6966	6995	8757	9429	9471
(A/B : %)		10	12	12	13	13	16	17	17

Table II-3(7) ESTIMATED/PROJECTED CONSUMPTION OF NITROGEN FERTILIZER BY REGION

- WESTERN HIGH HILL -

CROP	POTENTIAL DOSAGE (N Kg/ha)	CROPPED AREA							
		1981	1982	1983	1984	1985	1990	1995	2000
PADDY	40	0	0	0	0	0	0	0	0
MAIZE	60	900	900	1500	1300	1200	600	0	0
WHEAT	40	1000	900	600	600	600	500	400	300
OTHER CEREALS	11	1100	1100	1200	1200	1200	1100	1100	1000
BARLEY	30	1500	1500	1600	1600	1600	1700	1800	1800
POTATOES	72	700	700	800	800	800	700	600	600
OTHER OIL CROPS	34	0	0	0	0	0	0	0	0
TOBACCO	22	0	0	0	0	0	0	0	0
JUTE	34	0	0	0	0	0	0	0	0
SUGAR CANE	72	0	0	0	0	0	0	0	0
POTENTIAL DEMAND (A)		201	197	233	221	215	169	125	120
ACTUAL/PROJECTED CONSUMPTION (B)		18	16	28	31	30	24	18	17
(A/B : %)		9	S	12	14	14	14	14	14

Table II-3(8) ESTIMATED/PROJECTED CONSUMPTION OF NITROGEN FERTILIZER BY REGION

- WESTERN HILL -

CROP	POTENTIAL DOSAGE (N Kg/ha)	CROPPED AREA							
		1981	1982	1983	1984	1985	1990	1995	2000
PADDY	80	70800	72600	67000	68300	69600	73800	77200	78500
MAIZE	00	79700	97600	85000	85500	86000	86100	85900	85800
WHEAT	80	27900	29700	30900	32400	33900	39800	44900	46800
OTHER CEREALS	11	34300	38400	35400	34800	34300	30900	27800	26600
BARLEY	30	2200	2100	2000	1900	1900	1600	1400	1300
POTATOES	72	5000	5800	5600	5600	5600	5400	5200	5100
OTHER OIL CROPS	34	2200	2100	2500	2400	2400	2000	1600	1500
TOBACCO	22	100	0	0	0	0	0	0	0
JUTE	34	0	0	0	0	0	0	0	0
SUGAR CANE	72	300	300	200	100	100	0	0	0
POTENTIAL DEMAND (A)		16768	18940	17284	17538	17806	18543	19135	19354
ACTUAL/PROJECTED CONSUMPTION (B)		651	888	864	877	890	1113	1339	1548
(A/B : %)		4	5	5	5	5	6	7	8

Table II-3(9) ESTIMATED/PROJECTED CONSUMPTION OF NITROGEN FERTILIZER BY REGION

- WESTERN TERAI -

CROP	POTENTIAL DOSAGE (N Kg/ha)	CROPPED AREA							
		1981	1982	1983	1984	1985	1990	1995	2000
PADDY	00	177100	175800	183300	185100	186900	195200	202800	205500
MAIZE	00	17300	7300	12200	11300	10500	6200	1700	0
WHEAT	80	59200	65500	65900	68800	71600	86400	101700	107800
OTHER CEREALS	11	2500	1400	2100	2000	2000	1700	1400	1300
BARLEY	30	400	300	0	0	0	0	0	0
POTATOES	72	1200	1200	600	500	500	200	0	0
OTHER OIL CROPS	34	12800	9500	14900	15300	15600	17200	18600	19100
TOBACCO	22	200	200	300	300	300	300	300	300
JUTE	34	0	0	0	0	0	0	0	0
SUGAR CANE	72	6600	7000	7400	7700	8000	9600	11100	11800
POTENTIAL DEMAND (A)		25217	24492	25934	26283	26639	28368	30040	30694
ACTUAL/PROJECTED CONSUMPTION (B)		1884	1883	2075	2103	2131	2837	3304	3376
(A/B : %)		7	8	8	8	8	10	11	11

Table II-3(10) ESTIMATED/PROJECTED CONSUMPTION OF NITROGEN FERTILIZER BY REGION

- MID-WESTERN HIGH HILL -

CROP	POTENTIAL DOSAGE (N Kg/ha)	CROPPED AREA							
		1981	1982	1983	1984	1985	1990	1995	2000
PADDY	40	2200	2100	2100	2100	2000	1800	1600	1500
MAIZE	60	4400	3700	4300	4200	4200	3600	3100	2800
WHEAT	40	2900	2900	1400	1000	600	0	0	0
OTHER CEREALS	11	3900	3600	4100	4200	4200	4300	4400	4400
BARLEY	30	3300	3100	3300	3200	3200	2900	2600	2400
POTATOES	72	1700	1600	1700	1700	1600	1300	1000	900
OTHER OIL CROPS	34	200	200	200	200	100	100	0	0
TOBACCO	22	0	0	0	0	0	0	0	0
JUTE	34	0	0	10600	11200	11800	13800	15200	15700
SUGAR CANE	72	0	0	0	0	0	0	0	0
POTENTIAL DEMAND (A)		739	677	1032	1028	1018	988	965	947
ACTUAL/PROJECTED CONSUMPTION (B)		3	5	0	0	10	10	10	9
(A/B : %)		0	1	0	0	1	1	1	1

Table II-3(11) ESTIMATED/PROJECTED CONSUMPTION OF NITROGEN FERTILIZER BY REGION

- MID-WESTERN HILL -

CROP	POTENTIAL DOSAGE (N Kg/ha)	CROPPED AREA							
		1981	1982	1983	1984	1985	1990	1995	2000
PADDY	80	23700	24900	23900	23600	23400	22100	21100	20700
MAIZE	00	41200	42700	40200	39900	39600	38300	37400	37200
WHEAT	80	32500	33200	32300	33300	34300	38700	42700	44200
OTHER CEREALS	11	12000	12300	12000	12100	12300	13100	13900	14200
BARLEY	30	5100	5300	5200	5300	5300	5500	5700	5700
POTATOES	72	3000	2800	2900	2900	3000	3100	3300	3400
OTHER OIL CROPS	34	5600	5500	5400	5500	5600	6300	6900	7100
TOBACCO	22	100	100	100	100	100	100	100	100
JUTE	34	0	0	0	0	0	0	0	0
SUGAR CANE	72	100	100	100	100	100	100	100	100
POTENTIAL DEMAND (A)		9317	9610	9206	9239	9286	9450	9649	9735
ACTUAL/PROJECTED CONSUMPTION (B)		49	115	92	92	93	189	193	195
(A/B : %)		1	1	1	1	1	2	2	2

Table II-3 (12) ESTIMATED/PROJECTED CONSUMPTION OF NITROGEN FERTILIZER BY REGION

- MID-WESTERN TERAI -

CROP	POTENTIAL DOSAGE (N Kg/ha)	CROPPED AREA							
		1981	1982	1983	1984	1985	1990	1995	2000
PADDY	00	89100	100100	92300	91700	91000	87800	84600	83300
MAIZE	00	32100	35900	32100	32000	31800	31100	30500	30200
WHEAT	80	32400	34800	35300	37000	38600	46600	54600	57700
OTHER CEREALS	11	1900	1800	1700	1700	1600	1200	800	700
BARLEY	30	600	300	500	500	500	500	600	600
POTATOES	72	1200	1100	1100	1000	1000	700	400	200
OTHER OIL CROPS	34	26200	27100	27200	27700	28100	30200	32200	33000
TOBACCO	22	300	200	200	200	200	100	0	0
JUTE	34	0	0	0	0	0	0	0	0
SUGAR CANE	72	600	200	500	500	500	700	900	1000
POTENTIAL DEMAND (A)		15778	17432	16342	16418	16468	16776	17093	17200
ACTUAL/PROJECTED CONSUMPTION (B)		344	657	490	493	494	671	684	860
(A/B : %)		2	4	3	3	3	4	4	5

Table II-3(13) ESTIMATED/PROJECTED CONSUMPTION OF NITROGEN FERTILIZER BY REGION

- FAR-WESTERN HIGH HILL -

CROP	POTENTIAL DOSAGE (N Kg/ha)	CROPPED AREA							
		1981	1982	1983	1984	1985	1990	1995	2000
PADDY	40	6800	6300	6600	6600	6600	6500	6500	6500
MAIZE	60	4400	4300	4100	4200	4200	4300	4500	4500
WHEAT	40	6900	6900	5500	5300	5100	4200	3500	3300
OTHER CEREALS	11	2100	2400	2200	2200	2200	2000	1800	1800
BARLEY	30	3100	2500	3100	3200	3200	3500	3700	3800
POTATOES	72	700	700	800	800	800	700	700	700
OTHER OIL CROPS	34	600	400	600	600	600	600	700	700
TOBACCO	22	100	0	100	100	100	0	0	0
JUTE	34	0	0	0	0	0	0	0	0
SUGAR CANE	72	0	0	100	100	100	0	0	0
POTENTIAL DEMAND (A)		1001	951	935	936	928	884	875	870
ACTUAL/PROJECTED CONSUMPTION (B)		4	15	9	9	9	9	18	17
(A/B : %)		0	2	1	1	1	1	2	2

Table II-3'(14) ESTIMATED/PROJECTED CONSUMPTION OF NITROGEN FERTILIZER BY REGION

- FAR-WESTERN HILL -

CROP	POTENTIAL DOSAGE (N Kg/ha)	CROPPED AREA							
		1981	1982	1983	1984	1985	1990	1995	2000
PADDY	80	14900	17500	15800	16100	16400	17900	18900	19300
MAIZE	00	12400	12500	12400	12300	12100	11300	10300	9800
WHEAT	80	18200	25900	20400	20700	21100	22900	24100	24500
OTHER CEREALS	11	6100	6600	6400	6500	6700	7400	7900	8100
BARLEY	30	2000	1800	2000	2000	2000	2000	1900	1900
POTATOES	72	1200	1200	1200	1200	1300	1400	1400	1500
OTHER OIL CROPS	34	900	900	1200	1100	1100	900	700	600
TOBACCO	22	0	0	0	0	0	0	0	0
JUTE	34	0	0	0	0	0	0	0	0
SUGAR CANE	72	100	100	100	100	100	100	100	100
POTENTIAL DEMAND (A)		4139	4973	4401	4436	4482	4674	4746	4766
ACTUAL/PROJECTED CONSUMPTION (B)		58	18	44	44	45	47	47	48
(A/B : %)		1	0	1	1	1	1	1	1

Table II-3(15) ESTIMATED/PROJECTED CONSUMPTION OF NITROGEN FERTILIZER BY REGION

- FAR-WESTERN TERAI -

CROP	POTENTIAL DOSAGE (N Kg/ha)	CROPPED AREA							
		1981	1982	1983	1984	1985	1990	1995	2000
PADDY	00	65800	70300	70300	71200	72100	76500	80900	82700
MAIZE	00	15200	20100	18000	18300	18700	20500	22400	23200
WHEAT	80	21900	23200	24300	25300	26400	31000	35300	36900
OTHER CEREALS	11	2000	1900	2000	2000	2000	2200	2300	2300
BARLEY	30	200	100	200	200	200	300	300	300
POTATOES	72	500	700	500	500	500	400	400	300
OTHER OIL CROPS	34	17400	19700	20400	21500	22700	28900	35500	38300
TOBACCO	22	100	100	100	100	100	100	100	100
JUTE	34	0	0	0	0	0	0	0	0
SUGAR CANE	72	100	200	100	100	100	200	200	200
POTENTIAL DEMAND (A)		10517	11657	11541	11778	12037	13241	14441	14917
ACTUAL/PROJECTED CONSUMPTION (B)		121	253	115	236	241	265	433	448
(A/B : %)		1	2	1	2	2	2	3	3

Table II-3(16) ESTIMATED/PROJECTED CONSUMPTION OF NITROGEN FERTILIZER BY REGION

- CENTRAL KATHMANDU VALLEY -

CROP	POTENTIAL DOSAGE (N Kg/ha)	CROPPED AREA							
		1981	1982	1983	1984	1985	1990	1995	2000
PADDY	00	30700	32400	29800	29700	29600	29100	28400	28100
MAIZE	20	38500	42600	33500	34200	34900	38400	41400	42600
WHEAT	00	27100	27000	28500	28500	28500	28600	28300	28200
OTHER CEREALS	11	4900	3400	3900	3700	3400	2300	1100	600
BARLEY	30	100	100	100	100	100	100	100	100
POTATOES	72	2800	3400	2200	2100	2100	1900	1800	1700
OTHER OIL CROPS	34	900	600	900	800	600	0	0	0
TOBACCO	22	0	0	0	0	0	0	0	0
JUTE	34	0	0	0	0	0	0	0	0
SUGAR CANE	72	200	0	100	100	100	0	0	0
POTENTIAL DEMAND (A)		10703	11358	10092	10153	10217	10543	10783	10874
ACTUAL/PROJECTED CONSUMPTION (B)		5816	6234	6358	6599	6743	7591	8303	8808
(A/B : %)		54	55	63	65	66	72	77	81

Annex II-4

CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

Talbe II-4(1) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- EASTERN HIGH HILL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	0	6	10	10	23	29	27	45
AMMONIUM SULPHATE (1)	2	0	2	2	0	-	-	-
AMMONIUM SULPHATE (2)	-	-	-	-	-	-	-	-
AMMONIUM PHOSPHATE							-	-
COMPLEX (1)	4	12	30	35	60	83	81	173
COMPLEX (2)					10	5	-	-
COMPLEX (3)	-	-	-	-	-	-	-	
COMPLEX (4)	-	-	-	-	-	-	-	-
TRIPLE SUPER PHOSPHATE	-	-	-	-	-	-	-	-
MURIATE OF POTASH	0	1	5	4	4	-	1	1
SULPHATE OF POTASH	-	-	-	-	-	-		-
OTHER NITROGEN FERTILIZER	-	-	-	-				
TOTAL (IN PRODUCT TONS)	6	19	47	51	97	117	109	219
N TOTAL (IN N TONS)	1	5	11	12	25	31	29	55
P205 TOTAL (IN P205 TONS)	1	2	6	7	14	18	16	35
K20 TOTAL (IN K20 TONS)	0	1	3	2	2	0	1	1

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(2) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- EASTERN HILL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	84	115	180	181	234	207	246	350
AMMONIUM SULPHATE (1)	32	83	95	86	30	25	30	28
AMMONIUM SULPHATE (2)	-	-	-	-	-	-	-	-
AMMONIUM PHOSPHATE							74	11
COMPLEX (1)	253	307	375	398	463	545	454	912
COMPLEX (2)					55	55	-	12
COMPLEX (3)	1	1	25	27	32	0	-	
COMPLEX (4)	-	-	-	-	-	-	0	0
TRIPLE SUPER PHOSPHATE	-	-	3	8	4	1	1	3
MURIATE OF POTASH	54	80	73	79	39	25	30	58
SULPHATE OF POTASH	1	-	-	-	-	-		-
OTHER NITROGEN FERTILIZER	-	-	-	-				
TOTAL (IN PRODUCT TONS)	425	586	751	779	857	858	835	1374
N TOTAL (IN N TONS)	96	132	182	185	224	222	224	354
P205 TOTAL (IN P205 TONS)	51	62	80	87	112	122	125	192
K20 TOTAL (IN K20 TONS)	33	48	48	52	28	15	18	35

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(3) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- EASTERN TERAI -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	618	943	1198	1332	1510	1498	1810	2821
AMMONIUM SULPHATE (1)	509	444	259	271	169	218	270	367
AMMONIUM SULPHATE (2)	-	-	-	-	-	-	0	3
AMMONIUM PHOSPHATE							223	75
COMPLEX (1)	1296	1371	1792	1085	1832	2052	1704	4073
COMPLEX (2)					274	64	61	248
COMPLEX (3)	39	352	390	1331	350	3	15	
COMPLEX (4)	-	-	-	-	-	-	0	4
TRIPLE SUPER PHOSPHATE	17	21	39	43	25	16	6	9
MURIATE OF POTASH	210	279	281	199	211	202	292	441
SULPHATE OF POTASH	0	-	8	13	2	-		
OTHER NITROGEN FERTILIZER	0	-	0	2				
TOTAL (IN PRODUCT TONS)	2689	3410	3967	4276	4373	4053	4381	8041
N TOTAL (IN N TONS)	656	854	1022	1087	1212	1160	1287	963
P205 TOTAL (IN P205 TONS)	273	337	435	437	493	433	463	910
K20 TOTAL (IN K20 TONS)	132	220	231	326	180	122	178	265

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(4) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- CENTRAL HIGH HILL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	102	236	649	607	800	909	1078	1417
AMMONIUM SULPHATE (1)	85	125	253	196	281	358	326	206
AMMONIUM SULPHATE (2)	-	-	-	-	-	-		
AMMONIUM PHOSPHATE							2	1
COMPLEX (1)	74	84	193	168	342	629	564	845
COMPLEX (2)					-	9	-	-
COMPLEX (3)	-	0	-	40	63	50	8	-
COMPLEX (4)	0	0	-	0	-	-	-	-
TRIPLE SUPER PHOSPHATE	-	-	0	0	-	-	-	-
MURIATE OF POTASH	8	2	4	4	7	8	5	4
SULPHATE OF POTASH	-	-	-	-	-	-		-
OTHER NITROGEN FERTILIZER	-	-	-	-			-	
TOTAL (IN PRODUCT TONS)	269	447	1099	1015	1493	1963	1983	2473
N TOTAL (IN N TONS)	80	152	390	360	505	629	679	864
P2O5 TOTAL (IN P2O5 TONS)	15	17	39	40	78	135	115	170
K2O TOTAL (IN K2O TONS)	5	1	2	8	14	12	4	2

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(5) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- CENTRAL HILL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	470	748	1406	1497	2212	1288	2462	3372
AMMONIUM SULPHATE (1)	500	504	667	700	435	150	651	467
AMMONIUM SULPHATE (2)	-	-	-	-	-			
AMMONIUM PHOSPHATE							48	14
COMPLEX (1)	326	371	646	573	691	759	1303	1612
COMPLEX (2)					152	1	16	51
COMPLEX (3)	46	90	169	354	243	68	86	7
COMPLEX (4)	-	-	5	-	-	-	2	3
TRIPLE SUPER PHOSPHATE	1	1	1	0	1	1	1	2
MURIATE OF POTASH	72	47	57	25	13	4	51	20
SULPHATE OF POTASH	-	-	-	-	-	-		-
OTHER NITROGEN FERTILIZER	-	-	-	-			0	
TOTAL (IN PRODUCT TONS)	1415	1761	2951	3149	3747	2271	4620	5548
N TOTAL (IN N TONS)	393	538	941	1004	1318	786	1557	1987
P205 TOTAL (IN P205 TONS)	73	88	155	168	210	163	300	343
K20 TOTAL (IN K20 TONS)	50	42	60	68	44	13	44	13

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(6) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- CENTRAL TERAI -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	2336	4124	4493	5305	5838	9108	7839	9054
AMMONIUM SULPHATE (1)	1666	901	1808	1127	751	825	724	714
AMMONIUM SULPHATE (2)	-	34	-	-	-			
AMMONIUM PHOSPHATE							391	81
COMPLEX (1)	3028	2076	3764	3200	3435	7582	6304	10479
COMPLEX (2)					1116	35	205	828
COMPLEX (3)	878	1930	1295	1277	1813	412	481	10
COMPLEX (4)	4	163	22	2	1		8	5
TRIPLE SUPER PHOSPHATE	91	26	42	379	33	21	95	1
MURIATE OF POTASH	374	210	218	267	196	169	275	512
SULPHATE OF POTASH	117	0	53	27	30	5		2
OTHER NITROGEN FERTILIZER	0	-	-	-			-	
TOTAL (IN PRODUCT TONS)	8494	9464	11695	11584	13213	18157	16322	21686
N TOTAL (IN N TONS)	2162	2808	3395	3509	4059	5949	5209	6617
P205 TOTAL (IN P205 TONS)	779	727	968	1006	1231	1596	1604	2326
K20 TOTAL (IN K20 TONS)	415	427	353	365	405	166	238	310

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(7) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- WESTERN HIGH HILL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA						11	22	14
AMMONIUM SULPHATE (1)						-	-	-
AMMONIUM SULPHATE (2)						-		
AMMONIUM PHOSPHATE							0	2
COMPLEX (1)						16	39	45
COMPLEX (2)						-	-	-
COMPLEX (3)						1	-	-
COMPLEX (4)						-	-	-
TRIPLE SUPER PHOSPHATE						-	-	-
MURIATE OF POTASH						-	0	2
SULPHATE OF POTASH						-	-	
OTHER NITROGEN FERTILIZER							-	
TOTAL (IN PRODUCT TONS)						28	61	63
N TOTAL (IN N TONS)						9	18	16
P205 TOTAL (IN P205 TONS)						3	8	10
K20 TOTAL (IN K20 TONS)						0	0	1

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(8) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- WESTERN HILL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	99	173	306	362	549	552	615	766
AMMONIUM SULPHATE (1)	147	141	147	65	30	26	41	20
AMMONIUM SULPHATE (2)	12	14	-	-	-	-	-	
AMMONIUM PHOSPHATE							60	30
COMPLEX (1)	289	358	1340	617	887	1430	1237	2437
COMPLEX (2)					174	45	295	164
COMPLEX (3)	952	1140	349	1074	1072	246	222	3
COMPLEX (4)	2	6	0	-	-	-	0	10
TRIPLE SUPER PHOSPHATE	3	3	1	6	0	1	0	4
MURIATE OF POTASH	12	9	22	49	15	40	34	43
SULPHATE OF POTASH	0	-	-	-	-	-	3	
OTHER NITROGEN FERTILIZER	-	-	-	-			-	
TOTAL (IN PRODUCT TONS)	1516	1844	2165	2173	2727	2340	2507	3477
N TOTAL (IN N TONS)	280	356	492	465	637	593	651	888
P2O5 TOTAL (IN P2O5 TONS)	202	244	321	287	378	334	376	542
K2O TOTAL (IN K2O TONS)	150	177	66	191	170	61	55	27

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(9) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

\- WESTERN TERAI -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	985	1295	1523	1613	2150	2296	2632	2325
AMMONIUM SULPHATE (1)	118	174	168	73	5	61	103	30
AMMONIUM SULPHATE (2)	-	-	-	-	-	-	0	
AMMONIUM PHOSPHATE							154	66
COMPLEX (1)	630	1398	2458	1768	1694	1626	3031	3709
COMPLEX (2)					64	301	16	232
COMPLEX (3)	1408	807	442	1119	718	253	88	-
COMPLEX (4)	-	-	-	-	-	-	7	-
TRIPLE SUPER PHOSPHATE	11	4	2	4	240	15	68	1
MURIATE OF POTASH	101	115	139	50	74	102	204	250
SULPHATE OF POTASH	-	-	-	-	-	-	.	
OTHER NITROGEN FERTILIZER	-	-	-	-			1	
TOTAL (IN PRODUCT TONS)	3253	3793	4732	4627	4945	4654	6303	6613
N TOTAL (IN N TONS)	815	1033	1294	1279	1451	1501	1884	1883
P205 TOTAL (IN P205 TONS)	342	403	559	523	572	439	726	826
K20 TOTAL (IN K20 TONS)	272	190	150	198	152	99	136	150

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(10) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- MID-WESTERN HIGH HILL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	1	0	2	1	1	3	3	6
AMMONIUM SULPHATE (1)	2	1	1	-	-	0		-
AMMONIUM SULPHATE (2)	-	-	-	-	-	-		
AMMONIUM PHOSPHATE								-
COMPLEX (1)	3	2	1	2	-	3	2	6
COMPLEX (2)						-		-
COMPLEX (3)	2	1	-	1	2	3	5	6
COMPLEX (4)	-	-	-	-	-	-		
TRIPLE SUPER PHOSPHATE	-	-	-	-	-	0		-
MURIATE OF POTASH	0	1	0	-	-	0	0	1
SULPHATE OF POTASH	-	-	-	-	1	-		
OTHER NITROGEN FERTILIZER	-	-	-	-	0			
TOTAL (IN PRODUCT TONS)	0	5	4	4	4	9	10	19
N TOTAL (IN N TONS)	2	1	1	1	1	3	3	5
P2O5 TOTAL (IN P2O5 TONS)	1	1	0	1	0	1	1	2
K2O TOTAL (IN K2O TONS)	0	1	0	0	1	1	1	2

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(11) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- MID-WESTERN HILL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	9	21	40	70	97	81	58	127
AMMONIUM SULPHATE (1)	22	38	47	22	32	4	5	-
AMMONIUM SULPHATE (2)	0	3	-	-	-	-		
AMMONIUM PHOSPHATE							1	0
COMPLEX (1)	43	104	139	145	130	97	73	193
COMPLEX (2)					-	0	14	69
COMPLEX (3)	2	7	11	13	44	48	20	13
COMPLEX (4)	-	-	-	-	-	-		
TRIPLE SUPER PHOSPHATE	-	-	-	1	0	1		0
MURIATE OF POTASH	8	20	25	20	17	5	7	4
SULPHATE OF POTASH	-	-	-	-	-	-		
OTHER NITROGEN FERTILIZER	-	-	-	-				
TOTAL (IN PRODUCT TONS)	84	193	262	271	320	236	178	406
N TOTAL (IN N TONS)	18	40	58	68	84	65	49	115
P205 TOTAL (IN P205 TONS)	9	22	30	32	33	27	21	57
K20 TOTAL (IN K20 TONS)	5	13	17	14	17	10	7	4

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(12) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- MID-WESTERN TERAI -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	124	236	276	263	375	264	322	658
AMMONIUM SULPHATE (1)	93	143	139	103	41	70	42	117
AMMONIUM SULPHATE (2)	-	-	-	-	-	-		
AMMONIUM PHOSPHATE								-
COMPLEX (1)	202	544	476	530	646	423	580	1367
COMPLEX (2)					37	96	206	230
COMPLEX (3)	128	25	150	78	72	92	160	24
COMPLEX (4)	-	-	-	-	-	-		
TRIPLE SUPER PHOSPHATE	3	9	10	19	11	1		1
MURIATE OF POTASH	38	106	82	58	87	54	53	111
SULPHATE OF POTASH	-	-	-	-	-	-		
OTHER NITROGEN FERTILIZER	-	-	-	-				
TOTAL (IN PRODUCT TONS)	588	1063	1133	1051	1269	1000	1363	2508
N TOTAL (IN N TONS)	136	251	274	260	330	257	344	657
P2O5 TOTAL (IN P2O5 TONS)	61	117	122	126	154	121	187	330
K2O TOTAL (IN K2O TONS)	42	67	72	47	63	46	56	70

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(13) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION
- FAR-WESTERN HIGH HILL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	2	0	0	0	2	4	4	15
AMMONIUM SULPHATE (1)	0	0	2	-	0	0		0
AMMONIUM SULPHATE (2)	-	-	-	-	-	-		
AMMONIUM PHOSPHATE			3					-
COMPLEX (1)	-	0		1	3	6	12	40
COMPLEX (2)	-		-		-	-	0	1
COMPLEX (3)		-	-	-	6	0		1
COMPLEX (4)	-	-	-	-	-	-		
TRIPLE SUPER PHOSPHATE	-	-	-	-	-	-		-
MURIATE OF POTASH	0	0	0	0	0	0	0	2
SULPHATE OF POTASH	6	-	-	-	-	-		
OTHER NITROGEN FERTILIZER	-	-	-	-				
TOTAL (IN PRODUCT TONS)	8	0	5	1	11	10	16	59
N TOTAL (IN N TONS)	1	0	1	0	3	3	4	15
P205 TOTAL (IN P205 TONS)	0	0	1	0	2	1	2	8
K20 TOTAL (IN K20 TONS)	3	0	0	0	1	0	0	1

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(14) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- FAR-WESTERN HILL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	14	23	24	38	27	15	36	6
AMMONIUM SULPHATE (1)	7	13	13	6	1	0	3	7
AMMONIUM SULPHATE (2)	..	-	-	-	-	-		
AMMONIUM PHOSPHATE								-
COMPLEX (1)	35	44	51	59	140	76	168	51
COMPLEX (2)					-	8	23	15
COMPLEX (3)	34	60	112	57	46	11	10	0
COMPLEX (4)	-	-	-	-	-	-		
TRIPLE SUPER PHOSPHATE	-	-	-	-	-	-		-
MURIATE OF POTASH	5	6	5	5	4	2	6	3
SULPHATE OF POTASH	-	-	-	-	-	-		
OTHER NITROGEN FERTILIZER	-	-	-	-				
TOTAL (IN PRODUCT TONS)	95	146	205	165	218	112	246	82
N TOTAL (IN N TONS)	20	31	41	39	48	26	58	18
P205 TOTAL (IN P205 TONS)	12	18	27	20	35	19	40	14
K20 TOTAL (IN K20 TONS)	8	13	20	12	9	3	5	2

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(15) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- FAR-WESTERN TERAI -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	39	126	125	145	112	75	125	266
AMMONIUM SULPHATE (1)	35	81	22	20	1	1	2	-
AMMONIUM SULPHATE (2)	-	-	-	-	-	-		
AMMONIUM PHOSPHATE							0	41
COMPLEX (1)	85	103	151	138	177	150	209	523
COMPLEX (2)					-	3	68	72
COMPLEX (3)	104	342	212	260	59	13	35	16
COMPLEX (4)	-	-	-	-	-	-		
TRIPLE SUPER PHOSPHATE	0	7	1	0	-	-	12	7
MURIATE OF POTASH	17	33	17	18	24	14	17	32
SULPHATE OF POTASH	-	-	-	-	-	-		
OTHER NITROGEN FERTILIZER	-	-	-	-				
TOTAL (IN PRODUCT TONS)	280	692	528	581	373	256	463	957
N TOTAL (IN N TONS)	58	147	124	138	96	67	121	253
P205 TOTAL (IN P205 TONS)	33	75	63	67	44	33	68	146
K20 TOTAL (IN K20 TONS)	26	71	42	50	23	10	16	22

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(16) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION
- CENTRAL KATHMANDU VALLEY -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	5179	5614	6057	8365	8393	7926	9393	10154
AMMONIUM SULPHATE (1)	3291	5106	6787	4705	3284	2343	3021	1602
AMMONIUM SULPHATE (2)	-	107	-	21	134			
AMMONIUM PHOSPHATE							294	96
COMPLEX (1)	2058	2650	2836	1929	4199	7678	4025	6043
COMPLEX (2)					160	-	2	-
COMPLEX (3)	1464	897	50	764	284	42	8	1
COMPLEX (4)	19	9	0	0	2	69	27	9
TRIPLE SUPER PHOSPHATE	9	3	5	64	3	5	17	5
MURIATE OF POTASH	20	27	13	14	44	30	15	11
SULPHATE OF POTASH	-	-	-	-	-	-		-
OTHER NITROGEN FERTILIZER	-	-	-	-			-	
TOTAL (IN PRODUCT TONS)	12040	14413	15748	15862	16503	18093	16802	17921
N TOTAL (IN N TONS)	3706	4348	4786	5342	5505	5683	5816	6234
P2O5 TOTAL (IN P2O5 TONS)	636	667	577	530	921	1548	951	1256
K2O TOTAL (IN K2O TONS)	233	151	15	123	69	29	12	7

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(17) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- HIGH HILL TOTAL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	105	242	661	618	826	956	1134	1497
AMMONIUM SULPHATE (1)	89	126	258	198	281	358	326	206
AMMONIUM SULPHATE (2)	0	0	0	0	0	0	0	0
AMMONIUM PHOSPHATE	0	0	3	0	0	0	2	3
COMPLEX (1)	81	98	224	206	405	737	698	1109
COMPLEX (2)	0	0	0	0	10	14	0	1
COMPLEX (3)	2	1	0	41	71	54	13	7
COMPLEX (4)	0	0	0	0	0	0	0	0
TRIPLE SUPER PHOSPHATE	0	0	0	0	0	0	0	0
MURIATE OF POTASH	8	4	9	8	11	8	6	10
SULPHATE OF POTASH	6	0	0	0	1	0	0	0
OTHER NITROGEN FERTILIZER	0	0	0	0	0	0	0	0
TOTAL (IN PRODUCT TONS)	283	471	1155	1071	1605	2127	2179	2833
N TOTAL (IN N TONS)	84	158	403	373	534	675	733	955
P205 TOTAL (IN P205 TONS)	17	20	46	48	94	158	142	225
K20 TOTAL (IN K20 TONS)	8	3	5	10	18	13	6	7

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(18) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- HILL TOTAL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	5855	6694	8013	10513	11512	10069	12810	14775
AMMONIUM SULPHATE (1)	3999	5885	7756	5584	3812	2548	3751	2124
AMMONIUM SULPHATE (2)	12	124	0	21	134	0	0	0
AMMONIUM PHOSPHATE	0	0	0	0	0	0	477	151
COMPLEX (1)	3004	3834	5387	3721	6510	10585	7260	11248
COMPLEX (2)	0	0	0	0	541	109	350	311
COMPLEX (3)	2499	2195	716	2289	1721	415	346	24
COMPLEX (4)	21	15	5	0	2	69	29	22
TRIPLE SUPER PHOSPHATE	13	7	10	79	8	9	19	14
MURIATE OF POTASH	171	189	195	192	132	106	143	139
SULPHATE OF POTASH	1	0	0	0	0	0	3	0
OTHER NITROGEN FERTILIZER	0	0	0	0	0	0	0	0
TOTAL (IN PRODUCT TONS)	15575	18943	22082	22399	24372	23910	25188	28808
N TOTAL (IN N TONS)	4513	5445	6500	7103	7816	7375	8355	9596
P205 TOTAL (IN P205 TONS)	983	1101	1190	1124	1689	2213	1813	2404
K20 TOTAL (IN K20 TONS)	479	444	226	460	337	131	141	88

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(19) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- TERAI TOTAL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	4102	6724	7615	8658	9985	13241	12728	15124
AMMONIUM SULPHATE (1)	2421	1743	2396	1594	967	1175	1141	1228
AMMONIUM SULPHATE (2)	0	34	0	0	0	0	0	3
AMMONIUM PHOSPHATE	0	0	0	0	0	0	768	263
COMPLEX (1)	5241	5492	8641	6721	7784	11833	11828	20151
COMPLEX (2)	0	0	0	0	1491	499	556	1610
COMPLEX (3)	2557	3456	2489	4065	3012	773	779	50
COMPLEX (4)	4	163	22	2	1	0	15	9
TRIPLE SUPER PHOSPHATE	122	67	94	445	309	53	181	19
MURIATE OF POTASH	740	743	737	592	592	541	841	1346
SULPHATE OF POTASH	117	0	61	40	32	5	0	2
OTHER NITROGEN FERTILIZER	0	0	0	2	0	0	1	0
TOTAL (IN PRODUCT TONS)	15304	18422	22055	22119	24173	28120	28837	39805
N TOTAL (IN N TONS)	3827	5093	6109	6273	7148	8934	8845	10373
P2O5 TOTAL (IN P2O5 TONS)	1488	1659	2147	2159	2494	2622	3048	4538
K2O TOTAL (IN K2O TONS)	887	975	848	986	823	443	624	817

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(20) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- EASTERN TOTAL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	702	1064	1388	1523	1767	1734	2083	3216
AMMONIUM SULPHATE (1)	543	527	356	359	199	243	300	395
AMMONIUM SULPHATE (2)	0	0	0	0	0	0	0	3
AMMONIUM PHOSPHATE	0	0	0	0	0	0	297	86
COMPLEX (1)	1553	1690	2197	1518	2355	2680	2239	5158
COMPLEX (2)	0	0	0	0	339	124	61	260
COMPLEX (3)	40	353	415	1358	382	3	15	0
COMPLEX (4)	0	0	0	0	0	0	0	4
TRIPLE SUPER PHOSPHATE	17	21	42	51	29	17	7	12
MURIATE OF POTASH	264	360	359	282	254	227	323	500
SULPHATE OF POTASH	1	0	8	13	2	0	0	0
OTHER NITROGEN FERTILIZER	0	0	0	2	0	0	0	0
TOTAL (IN PRODUCT TONS)	3120	4015	4765	5106	5327	5028	5325	9634
N TOTAL (IN N TONS)	753	991	1215	1284	1461	1413	1540	1372
P205 TOTAL (IN P205 TONS)	325	401	521	531	619	573	604	1137
K20 TOTAL (IN K20 TONS)	165	269	282	380	210	137	197	301

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(21) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- CENTRAL TOTAL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	8087	10722	12605	15774	17243	19231	20772	23997
AMMONIUM SULPHATE (1)	5542	6636	9515	6728	4751	3676	4722	2989
AMMONIUM SULPHATE (2)	0	141	0	21	134	0	0	0
AMMONIUM PHOSPHATE	0	0	0	0	0	0	735	192
COMPLEX (1)	5486	5181	7439	5870	8667	16648	12196	18979
COMPLEX (2)	0	0	0	0	1428	45	223	879
COMPLEX (3)	2388	2917	1514	2435	2403	572	583	18
COMPLEX (4)	23	172	27	2	3	69	37	17
TRIPLE SUPER PHOSPHATE	101	30	48	443	37	27	113	8
MURIATE OF POTASH	474	286	292	310	260	211	346	547
SULPHATE OF POTASH	117	0	53	27	30	5	0	2
OTHER NITROGEN FERTILIZER	0	0	0	0	0	0	0	0
TOTAL (IN PRODUCT TONS)	22218	26085	31493	31610	34956	40484	39727	47628
N TOTAL (IN N TONS)	6341	7846	9512	10215	11387	13047	13261	15702
P205 TOTAL (IN P205 TONS)	1503	1499	1739	1744	2440	3442	2970	4095
K20 TOTAL (IN K20 TONS)	703	621	430	564	532	220	298	332

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(22) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- WESTERN TOTAL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	1084	1468	1829	1975	2699	2859	3269	3105
AMMONIUM SULPHATE (1)	265	315	315	138	35	87	144	50
AMMONIUM SULPHATE (2)	12	14	0	0	0	0	0	0
AMMONIUM PHOSPHATE	0	0	0	0	0	0	214	98
COMPLEX (1)	919	1756	3798	2385	2581	3072	4307	6191
COMPLEX (2)	0	0	0	0	238	346	311	396
COMPLEX (3)	2360	1947	791	2193	1790	500	310	3
COMPLEX (4)	2	6	0	0	0	0	7	10
TRIPLE SUPER PHOSPHATE	14	7	3	10	240	16	68	5
MURIATE OF POTASH	113	124	161	99	89	142	238	295
SULPHATE OF POTASH	0	0	0	0	0	0	3	0
OTHER NITROGEN FERTILIZER	0	0	0	0	0	0	1	0
TOTAL (IN PRODUCT TONS)	4769	5637	6897	6800	7672	7022	8871	10153
N TOTAL (IN N TONS)	1095	1389	1786	1744	2088	2103	2553	2787
P2O5 TOTAL (IN P2O5 TONS)	544	647	880	810	950	776	1110	1378
K2O TOTAL (IN K2O TONS)	422	367	216	389	322	160	191	178

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(23) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- MID-WESTERN TOTAL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	134	257	318	334	473	348	383	791
AMMONIUM SULPHATE (1)	117	182	187	125	73	74	47	117
AMMONIUM SULPHATE (2)	0	3	0	0	0	0	0	0
AMMONIUM PHOSPHATE	0	0	0	0	0	0	1	0
COMPLEX (1)	248	650	616	677	776	523	655	1566
COMPLEX (2)	0	0	0	0	37	96	220	299
COMPLEX (3)	132	33	161	92	118	143	185	43
COMPLEX (4)	0	0	0	0	0	0	0	0
TRIPLE SUPER PHOSPHATE	3	9	10	20	11	2	0	1
MURIATE OF POTASH	46	127	107	78	104	59	60	116
SULPHATE OF POTASH	0	0	0	0	1	0	0	0
OTHER NITROGEN FERTILIZER	0	0	0	0	0	0	0	0
TOTAL (IN PRODUCT TONS)	672	1261	1399	1326	1593	1245	1551	2933
N TOTAL (IN N TONS)	156	292	333	329	415	325	396	777
P205 TOTAL (IN P205 TONS)	71	140	152	159	187	149	209	389
K20 TOTAL (IN K20 TONS)	47	81	89	61	81	57	64	76

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(24) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- FAR-WESTERN TOTAL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	55	149	149	183	141	94	165	287
AMMONIUM SULPHATE (1)	42	94	37	26	2	1	5	7
AMMONIUM SULPHATE (2)	0	0	0	0	0	0	0	0
AMMONIUM PHOSPHATE	0	0	3	0	0	0	0	41
COMPLEX (1)	120	147	202	198	320	232	389	614
COMPLEX (2)	0	0	0	0	0	11	91	88
COMPLEX (3)	138	402	324	317	111	24	45	17
COMPLEX (4)	0	0	0	0	0	0	0	0
TRIPLE SUPER PHOSPHATE	0	7	1	0	0	0	12	7
MURIATE OF POTASH	22	39	22	23	28	16	23	37
SULPHATE OF POTASH	6	0	0	0	0	0	0	0
OTHER NITROGEN FERTILIZER	0	0	0	0	0	0	0	0
TOTAL (IN PRODUCT TONS)	383	838	738	747	602	378	730	1098
N TOTAL (IN N TONS)	79	178	166	177	147	96	183	286
P205 TOTAL (IN P205 TONS)	45	93	91	87	81	53	110	168
K20 TOTAL (IN K20 TONS)	37	84	62	62	33	13	21	25

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Table II-4(25) CONSUMPTION OF FERTILIZER IN NEPAL BY TYPE AND BY REGION

- GRAND TOTAL -

	1975	1976	1977	1978	1979	1980	1981	1982
UREA	10062	13660	16289	19789	22323	24266	26672	31396
AMMONIUM SULPHATE (1)	6509	7754	10410	7403	5060	4081	5218	3558
AMMONIUM SULPHATE (2)	12	158	0	21	134	0	0	3
AMMONIUM PHOSPHATE	0	0	3	0	0	0	1247	417
COMPLEX (1)	8326	9424	14252	10648	14699	23155	19786	32508
COMPLEX (2)	0	0	0	1569	2042	622	906	1922
COMPLEX (3)	5058	5652	3205	6395	4804	1242	1138	81
COMPLEX (4)	25	178	27	2	3	69	44	31
TRIPLE SUPER PHOSPHATE	135	74	104	524	317	62	200	33
MURIATE OF POTASH	919	936	941	792	735	655	990	1495
SULPHATE OF POTASH	124	0	61	40	33	5	3	2
OTHER NITROGEN FERTILIZER	0	0	0	2	0	0	1	0
TOTAL (IN PRODUCT TONS)	31162	37836	45292	47185	50150	54157	56204	71446
N TOTAL (IN N TONS)	8424	10696	13013	14115	14480	16984	16799	19373
P205 TOTAL (IN P205 TONS)	2488	2780	3383	3692	4277	4993	5003	7167
K20 TOTAL (IN K20 TONS)	1374	1422	1079	1456	1178	587	771	912

NOTE: AS1=21% AS2=26% CX1=20:20:0 CX2=23:23:0 CX3=15:15:15 CX4=5:6:7

Annex II-5

FERTILIZER RESPONSE IN NEPAL

Table II-5(1) FERTILIZER RESPONSE OF MAJOR CEREAL CROPS IN NEPAL

- Nitrogen Fertilizer on Improved Paddy -

(Yield: kg/ha)

Agroclimatic Variation	Location	Application Level (Nkg/ha)				
		0	30	60	90	120
Hill	Khumal	3,737.4	4,616.1	5,236.8	5,596.8	5,695.2
Terai	Parwanipur	2,578.0	3,070.0	3,454.0	3,730.0	3,898.0
Inner Terai	Rampur	3,093.6	3,720.9	4,204.2	4543.5	4738.8

Note: At the fixed level of 60kg P_2O_5 and 30kg K_2O per ha.

Source: Division of Soil Science and Agricultural Chemicals, DOA.

Table II-5(2) FERTILIZER RESPONSE OF MAJOR CEREAL CROPS IN NEPAL

- Phosphate Fertilizer on Improved Paddy -

(Yield: kg/ha)

Agroclimatic Variation	Location	Application Level (P_2O kg/ha)				
		0	44.8	89.6	134.4	179.2
Hill	Khumal	4,435.5	45,25.5	4,580.9	4,605.4	4,597.9
Terai	Parwanipur	3,584.8	3,600.9	3,609.0	3,609.1	3,601.2
Inner Terai	Rampur	4,941.3	5,089.4	5,185.4	5,229.2	5,220.9

Note: At the fixed level of 60kg P_2O_5 and 30kg K_2O per ha.

Source: Division of Soil Science and Agricultural Chemicals, DOA.

Table II-5(3) FERTILIZER RESPONSE OF MAJOR CEREAL CROPS IN NEPAL

- Nitrogen Fertilizer on Local Paddy -

(Yield: kg/ha)

Agroclimatic Variation	Location	Application Level (N kg/ha)				
		0	20	40	60	80
Inner Terai	Rampur	2,740.0	3,113.8	3,363.6	3,489.4	3,491.2
E. Terai	Birathagar	2,403.6	2,490.4	2,517.2	2,484.0	2,390.3
W. Terai	Nepalgunj	1,546.8	1,705.0	1,714.6	1,560.6	1,250.0

Note: At the fixed level of 60kg P_2O_5 and 30kg K_2O per ha.

Source: Division of Soil Science, and Agricultural Chemicals, DOA.

Table II-5(4) FERTILIZER RESPONSE OF MAJOR CEREAL CROPS IN NEPAL

\- Nitrogen Fertilizer on Improved Wheat -

(Yield: kg/ha)

Agroclimatic Variation	Location	Application Level (N kg/ha)				
		0	30	60	90	120
Hill	Khumal	1,665.6	2,308.2	2,884.2	3,396.6	3,836
Terai	Parwanipur	1,527.8	2,186.3	2,691.8	3,098.3	3,387.8
Inner Terai	Rampur	2,523.6	3,343.8	3,876.0	4,120.2	4,076.4

Note: At the fixed level of 60kg P_2O_5 and 30kg K_2O per ha.

Source: Division of Soil Science and Agricultural Chemicals, DOA.

Table II-5(5) FERTILIZER RESPONSE OF MAJOR CEREAL CROPS IN NEPAL

- Phosphate Fertilizer on Improved Wheat -

(Yield: kg/ha)

Agroclimatic Variation	Location	Application Level (P_2O kg/ha)				
		0	44.8	89.6	134.4	179.2
Hill	Khumal	3,889.6	4,089.2	4,152.4	4,079.1	3,869.3
Inner Terai	Rampur	2,527.2	3,244.8	3,669.5	3,801.1	3,639.7
Tarai	Bhairahawa	3,361.1	3,512.0	3,630.9	3,725.7	3,796.4

Note: At the fixed level of 60kg P_2O_5 and 30kg K_2O per ha.

Source: Division of Soil Science and Agricultural Chemicals, DOA.

Table II-5(6) FERTILIZER RESPONSE OF MAJOR CEREAL CROPS IN NEPAL

- Nitrogen Fertilizer on Improved Maize -

(Yield: kg/ha)

Agroclimatic Variation	Location	Application Level (N kg/ha)				
		0	60	120	180	240
Inner Terai	Rampur	965.8	1,587.4	1,985.8	2,161.0	2,113.0
Hill	Khumal	1,830.8	8,397.8	5,309.6	6,066.2	6,167.6
M. Hill	Kakani	1,821.0	2,003.4	2,121.0	2,173.8	2,161.8

Note: At the fixed level of 60kg P_2O_5 and 30kg K_2O per ha.

Source: Division of Soil Science and Agricultural Chemicals, DOA.

Table II-5(7) FERTILIZER RESPONSE OF MAJOR CEREAL CROPS IN NEPAL

- Phosphate Fertilizer on Improved Maize -

(Yield: kg/ha)

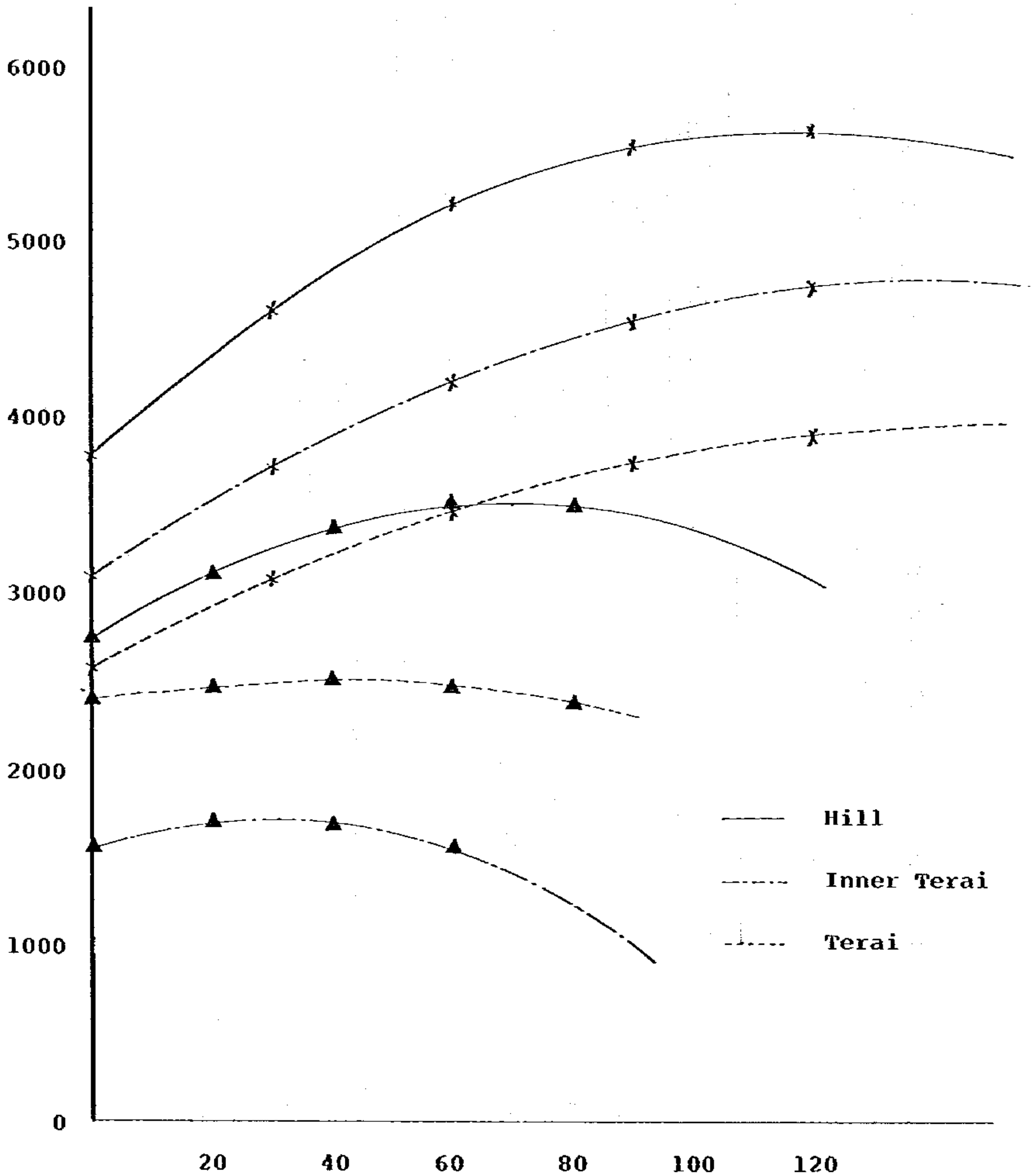
Agroclimatic Variation	Location	Application Level (P_2O kg/ha)				
		0	40	80	120	160
Hill	Khumal	4,393.2	4,562.4	4,686.8	4,766.4	4,801.2
Inner Terai	Rampur	2,033.2	2,332.0	2,502.8	2,545.6	2,400.4
M. Hill	Kakani	2,328.0	2,206.0	2,556.0	2,646.0	2,720.0

Note: At the fixed level of 60kg P_2O_5 and 30kg K_2O per ha.

Source: Division of Soil Science and Agricultural Chemicals, DOA.

Figure II-1(1) FERTILIZER RESPONSE OF MAJOR CEREAL CROPS IN NEPAL

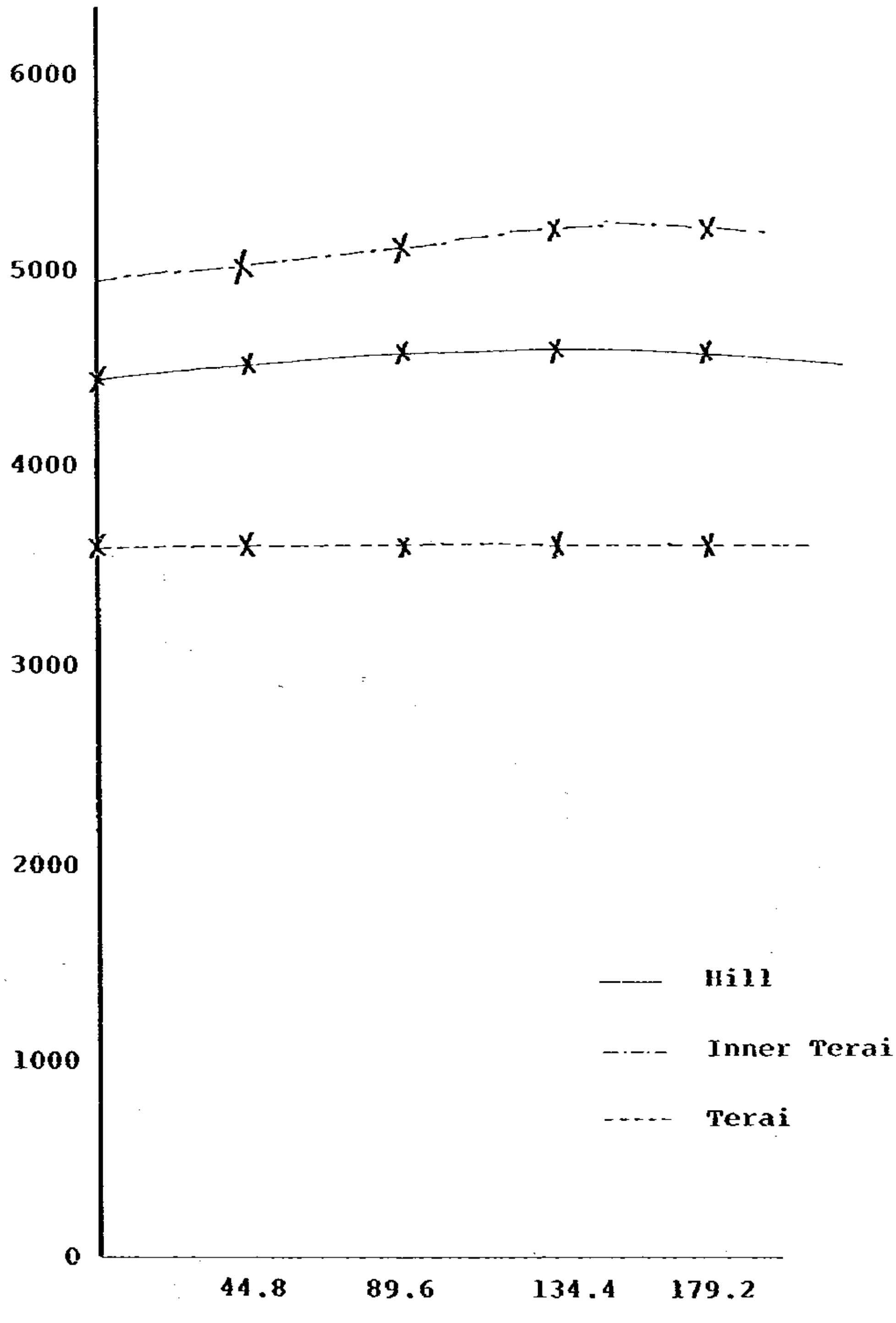
- Nitrogen Fertilizer on Paddy -



Source: Tables II-5(1) and II-5(3)

Figure II-1(2)   FERTILIZER RESPONSE OF MAJOR CEREAL CROPS IN NEPAL

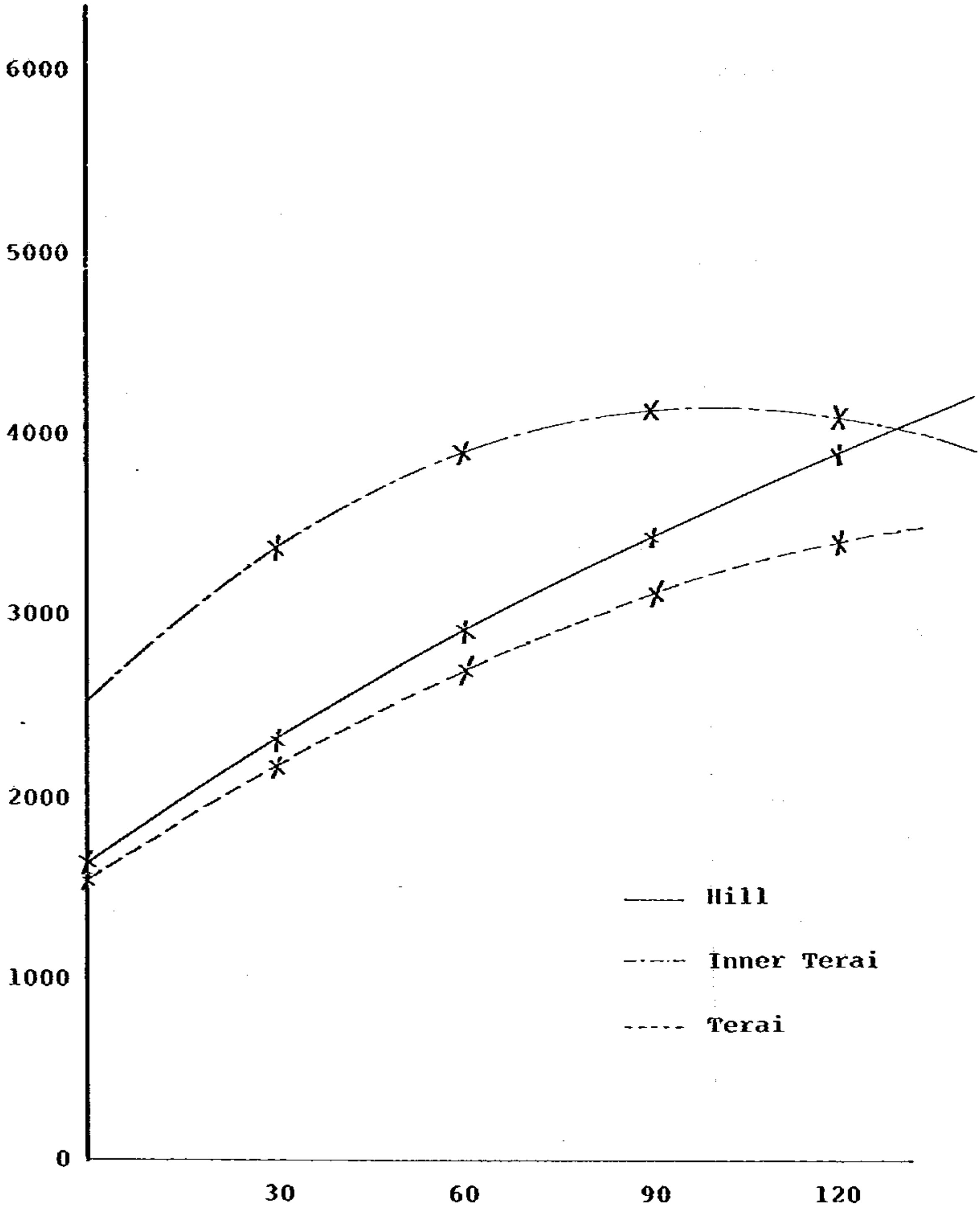
- Phosphate Fertilizer on Paddy -



Source: Table II-5(2)

Figure II-1(3) FERTILIZER RESPONSE OF MAJOR CEREAL CROPS IN NEPAL

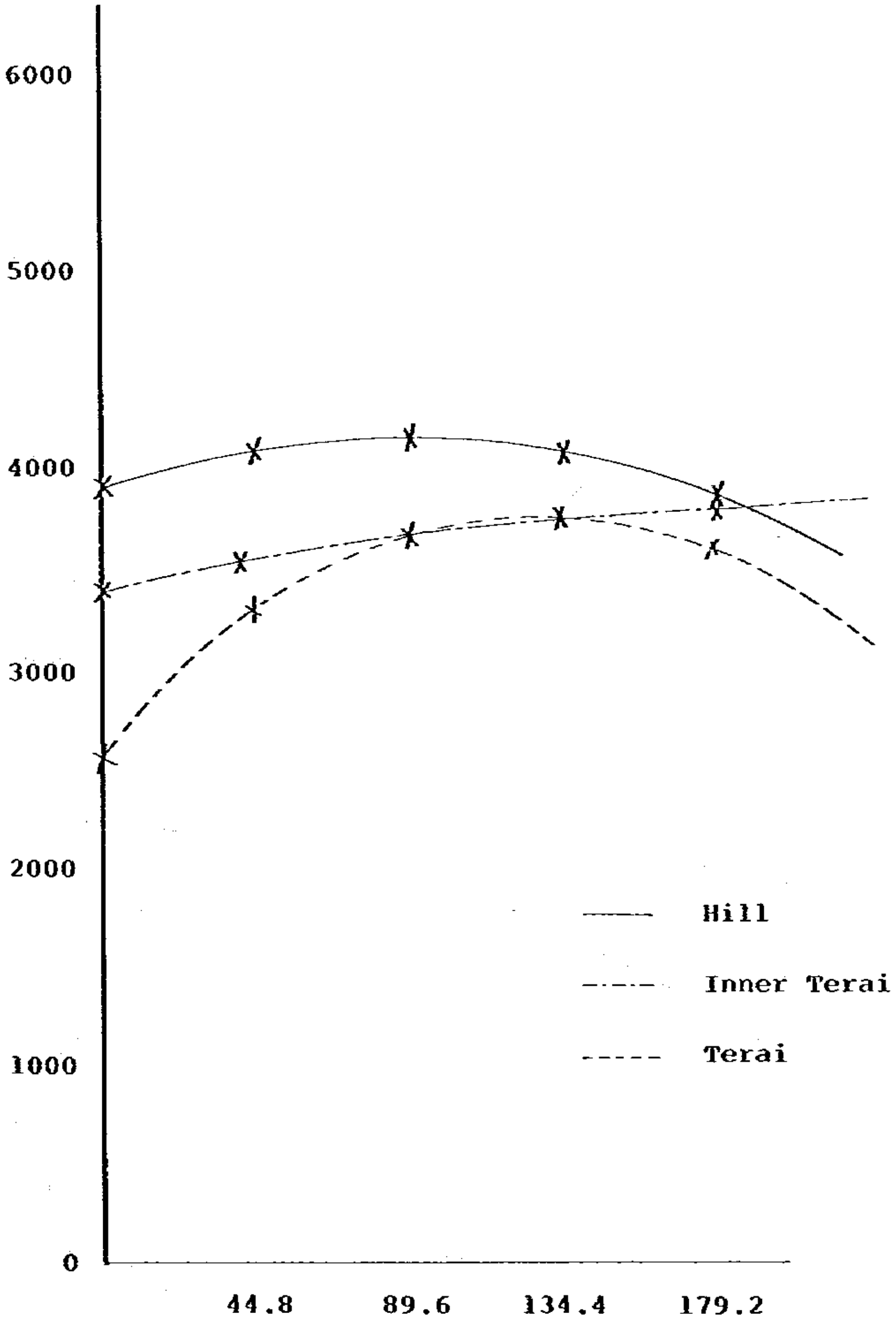
- Nitrogen Fertilizer on Wheat -



Source: Table II-5(4)

Figure II-1(4) FERTILIZER RESPONSE OF MAJOR CEREAL CROPS IN NEPAL

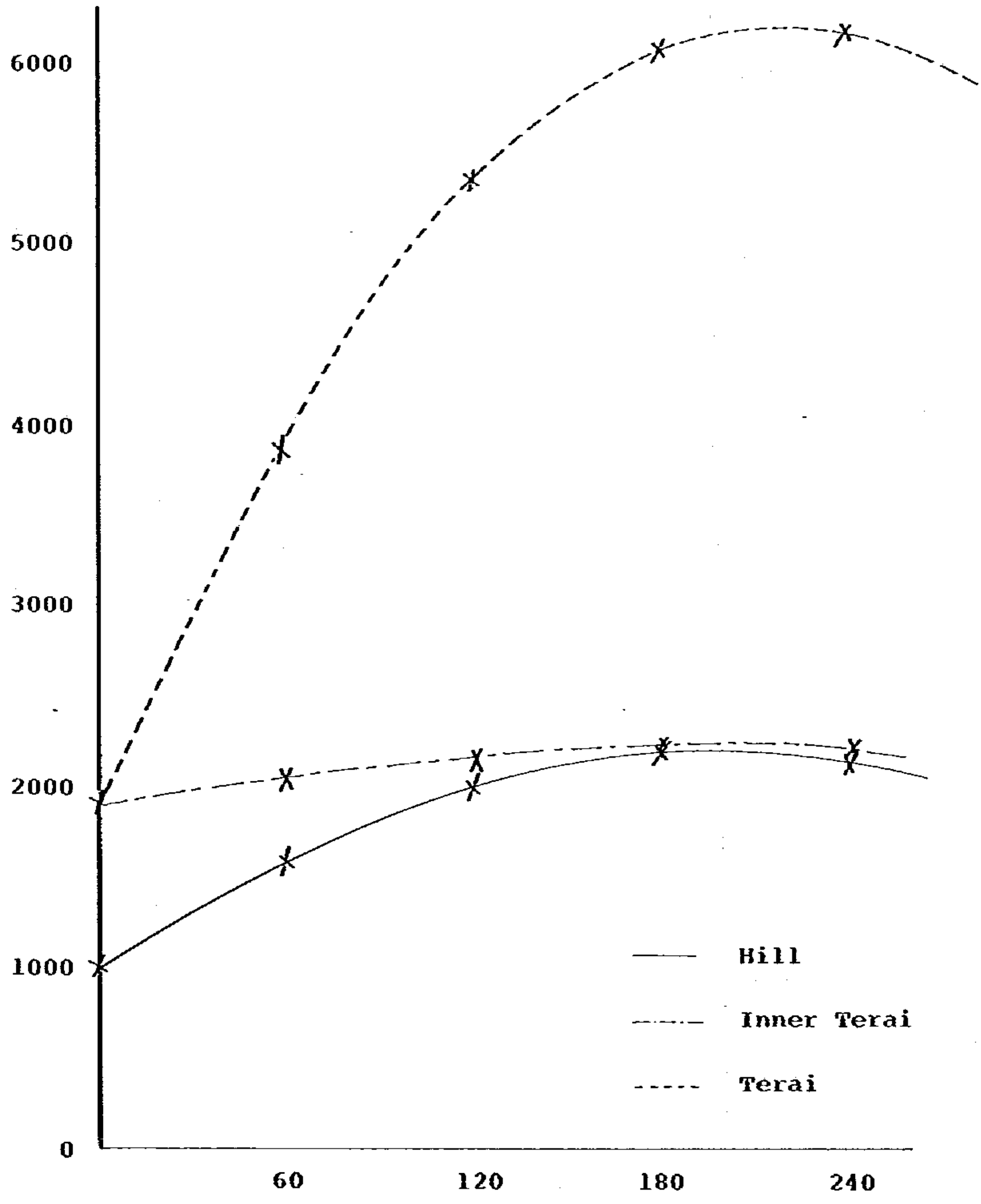
- Phosphate Fertilizer on Wheat -



Source: Table II-5(5)

Figure II-1(5) FERTILIZER RESPONSE OF MAJOR CEREAL CROPS IN NEPAL

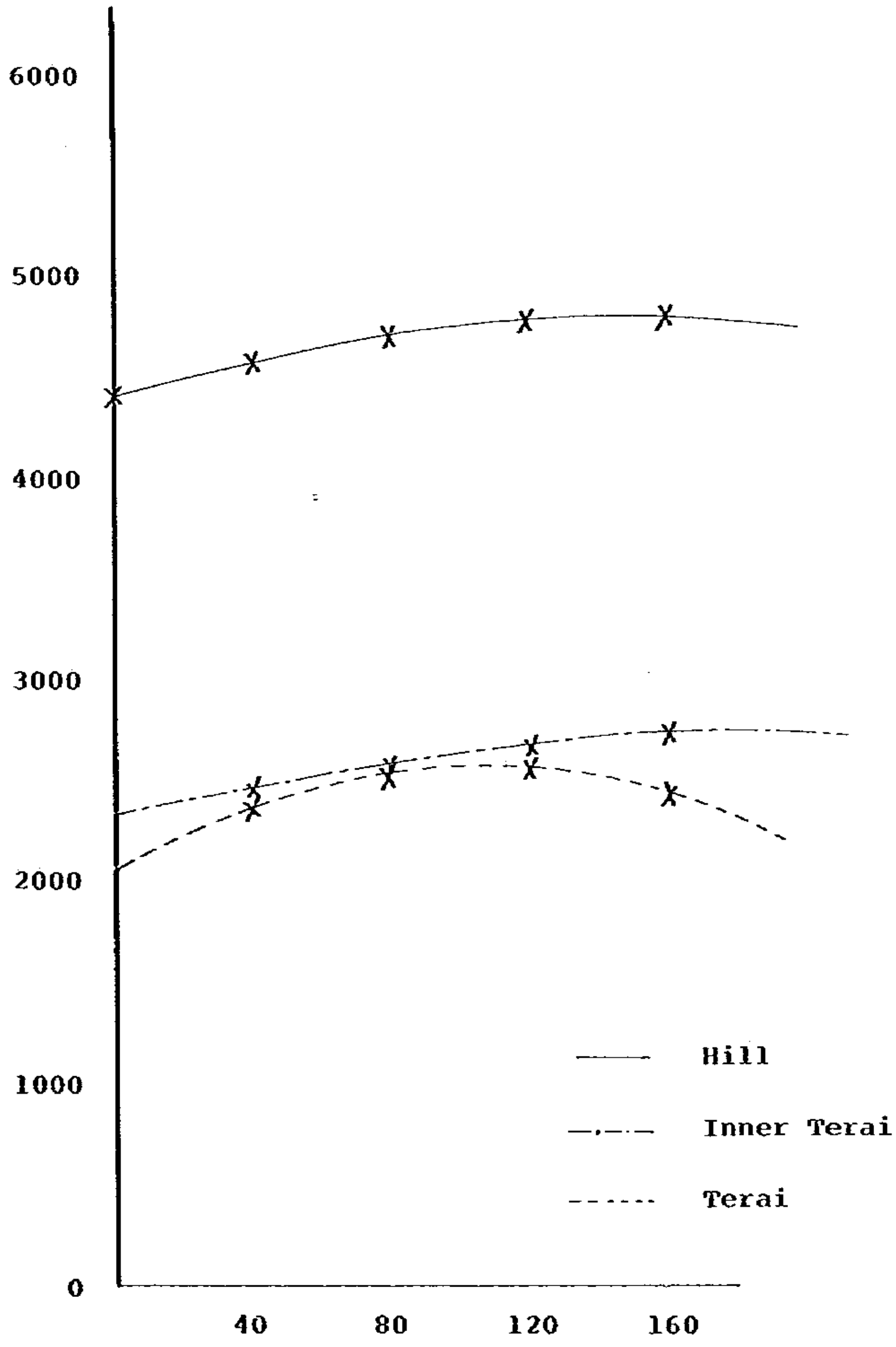
- Nitrogen Fertilizer on Maize -



Source: Table II-5(6)

Figure II-1(6) FERTILIZER RESPONSE OF MAJOR CEREAL CROPS IN NEPAL

- Phosphate Fertilizer on Maize -



Source: Table II-5(7)

Annex III

Annex III-1 BASIC DATA FOR CARBON DIOXIDE SUPPLIABILITY CONDITIONS AT CEMENT PLANTS IN NEPAL

Annex III-2 PRICE INFORMATION IN NEPAL FOR CONSTRUCTION MATERIALS, LABORERS, WORKS, AND INLAND TRANSPORT FROM CALCUTTA

Annex III-3 ELECTRIC POWER CONSUMPTION AND OVERALL LOAD FACTOR INCREASE AT THE UREA FERTILIZER PLANT

Annex III-4 WATER ELECTROLYSIS PROCESSES

Annex III-1

BASIC DATA FOR CARBON DIOXIDE SUPPLIABILITY CONDITIONS AT CEMENT PLANTS IN NEPAL

Annex III-1

BASIC DATA FOR CARBON DIOXIDE SUPPLIABILITY CONDITIONS AT CEMENT PLANTS IN NEPAL

	Hetauda Cement Industries Ltd.		Himal Cement Co. (PVT) Ltd.	
1. Outlines of Cement Plants				
Clinker Production Process	Rotary Kiln, Dry Suspension Heater		Shaft Kiln, Black Meal	
Clinker Production, TPH	31.25		5.25	
TPD	750.00		126.00	
TPY	222,750.00		37,422.00	
Completion of Plant	1985		1976	
Employee	1,200		300	
2. Site Conditions				
Location	Hetauda		Chobar, Kathmandu	
Latitude, North	27°24'		27°39'	
Longitude, East	85°01'		85°17'	
Height, Above Seal Level, m	455		1,260	
Site Area, m^2	600,000		7,200	
Theoretical Standard Pressure, mb	959.8		870.8	
ata	0.9472		0.8594	
Temperature, °C -1980				
Maximum, Absolute	38.8 (April 24)		32.3 (April 25)	
Minimum, Absolute	3.0 (January 1)		(-)1.0 (January 14)	
Monthly Average				
-Maximum	36.1 (April)		29.4 (April)	
-Minimum	5.8 (January)		1.9 (January)	
Annual Average	22.8		18.4	
Precipitation, mm -1980				
Annual	1,948		1,341	
Monthly Maximum	461 (June)		349 (June)	
Monthly Minimum	0 (January)		0 (November)	
Daily Maximum	158 (June 19)		100 (June 9)	
Relative Humidity, % -1980	AM 8:40	PM 5:40	AM 8:40	PM 5:40
Annual Average	74	68	85	65
Monthly Average				
-January	83	74	95	64
-April	43	35	65	41
-June	74	76	82	74
-September	77	79	88	79
Atmospheric Air Condition for Calculation				
Pressure, ata	0.947		0.859	
Temperature, °C	23.0		18.0	
Relative Humidity, %	70.0		75.0	
Composition, kg/kg-Dry Air				
-Nitrogen	0.7670		0.7670	
-Oxygen	0.2330		0.2330	
-Dry Air	1.0000		1.0000	
-Moisture	0.0133		0.0105	
-Total Air	1.0133		1.0105	

3. Raw Materials for Cement Production

(a) Limestone

(Unit: wt%, Dry Basis)

	Hetauda Cement Industries Ltd.		Himal Cement Co. (PVT) Ltd.	
	Average	Range	Average	Range
Chemical Analysis				
Ignition Loss	36.8	39.0 - 36.4	38.4	
SiO_2	13.3	12.3 - 6.5	9.2	
Al_2O_3	2.9	3.7 - 2.1	2.4	
Fe_2O_3	0.6	1.6 - 0.6	2.4	
CaO	44.7	47.6 - 42.8	45.5	
MgO	1.5	3.8 - 1.2	1.7	
SO_3	0.20	-	0.16	
Na_2O	0.14	-	0.01	
K_2O	0.60	-	0.55	
Cl	0.01	-	0.01	
P_2O_5	0.07	-	0.05	
TiO_2	0.12	-	0.08	
Mn_2O_3	0.15	-	0.34	
Total	101.09		100.80	
Composion after Calcination				
CO_2	36.45		37.35	
Ash, Sulfate and Phosphate	63.20		61.40	
Others as Water	0.35		0.75	
Total	100.00		100.00	
Limestone Source	Bhainse Dobhan, Hetauda		Chobar, Kathmandu	
Data Source	HCI, ITB -1977		HCC -1983	

Note: Available CO_2 is calculated assuming that $CaCO_3$ ($CO_2/CaO=0.7848$) and $MgCO_3$ ($CO_2/MgO=1.0915$)

(b) Clay

(Unit: wt%, Dry Basis)

	Hetauda Cement Industries Ltd.		Himal Cement Co. (PVT) Ltd.	
	Average	Range	Average	Range
Chemical Analysis				
Ignition Loss	8.8		7.6	
SiO_2	59.5	58 - 62	58.9	
Al_2O_3	19.0	19 - 21	20.5	
Fe_2O_3	8.1	8 - 10	8.2	
CaO	0.3	0.5 - 1.0	1.5	
MgO	0.7	0.75 - 1.25	1.0	
SO_3	0.03		0.19	
Na_2O	0.08		0.18	
K_2O	2.20		3.15	
Cl	-		0.01	
P_2O_5	0.06		0.34	
TiO_2	-		0.92	
Mn_2O_3	-		0.11	
Total	98.77		102.60	
Composion after Calcination				
CO_2	0.00		0.00	
Ash, Sulfate and Phosphate	91.20		90.80	
Others as Water	8.80		9.20	
Total	100.00		100.00	
Clay Source	Lamsure, Hetauda		Kathmandu	
Data Source	HCI, ITB -1977		HCC -1983	

(c) Iron Oxide and Gypsum

(Unit: wt%, Dry Basis)

	Hetauda Cement Industries Ltd.		Himal Cement Co. (PVT) Ltd.	
	Iron Ore	Gypsum	Iron Ore	Gypsum
Chemical Analysis				
Ignition Loss	1.2	16.8	(Not Used	16.8
SiO_2	4.6	9.3	in the Plant)	9.3
Al_2O_3	2.8	1.8	-	1.8
Fe_2O_3	89.3	1.1	-	1.1
CaO	0.8	31.0	-	31.0
MgO	0.7	2.0	-	2.0
SO_3	0.04	32.5	-	32.5
Na_2O	0.10	0.19	-	0.19
K_2O	0.92	0.24	-	0.24
P_2O_5	-	-	-	-
Total	100.46	94.93	-	94.93
Composition after Calcination				
CO_2	0.00	0.00	-	0.00
Ash, Sulfate and Phosphate	98.80	83.20	-	83.20
Others as Water	1.20	16.80	-	16.80
	100.00	100.00	-	100.00
Raw Material Source	Bihar, India or Phulchowki, Nepal	Bikaner, India	-	Bikaner, India
Data Source	HCI, ITB-1977	HCI, ITB-1977	-	HCI, ITB-1977

4. Utility for Cement Production

(a) Fuel

(Unit: wt%, Dry Basis)

	Hetauda Cemant Industries Ltd.			Himal Cement Co. (PVT) Ltd.		
	Fuel Oil	Coal	Mixed Use	Coke Breeze	Special Low Volatile Coal	Mixed Use
Chemical Analysis						
Moisture	0.05	2.4		1.9	2.2	2.1
Ash	0.01	10.0		28.7	19.5	23.8
Volatile Matter	95.0	40.0		6.5	10.7	
Fixed Carbon	4.0	47.0		64.1	67.6	63.3
Carbon	85.0	70.0		63.5	71.6	66.9
Hydrogen	11.0	5.2		0.2	2.3	1.3
Sulfur	3.5	3.5		0.5	0.2	0.4
Nitrogen	0.30	1.1		0.9	0.9	0.9
Oxygen and Others	0.30	7.2		4.4	5.1	4.6
	100.16	99.4		100.1	101.8	100.0
Heating Value, kcal/kg						
Gross (High)	11,152	7,100		5,510	5,417	5,464
Net (Low)	10,558	6,805		5,370	5,390	5,380
Specific Gravity (15/4°C)	0.96					
Chemical Analysis of Ash						
Ignition Loss	0.6	0.60	0.60	-	-	2.42
SiO_2	34.7	58.00	58.00	54.60	52.90	53.75
Al_2O_3	0.1	27.60	27.60	27.43	28.05	27.74
Fe_2O_3	8.7	5.90	5.90	7.72	11.85	9.79
CaO	4.2	2.60	2.60	3.82	5.64	4.73
MgO	1.0	0.80	0.80	3.50	1.27	2.39
SO_3	0.3	0.28	0.28			2.83
Na_2O	0.3	0.11	0.11			0.56
K_2O	0.2	1.70	1.70			2.32
TiO_2/V_2O_3	20.5	-	-			1.51
MnO/NiO	11.3	-	-			0.07
P_2O_5	-	1.25	1.25			0.88
Cl	-	-	-			0.01
	81.9	98.84	98.84	97.07	99.71	109.00
Composition after Combustion or Calcination						
CO_2	318.8	256.5				245.30
H_2O (Including Moisture)	108.2	49.2				11.04
Oxides, Sulfate, Silicate & Phosphate	0.0	10.0				30.00
	427.0	315.7				286.34
Fuel Source	India	Assam, India	-	Durgapur, India	India	India
Data Source	Consultant	HCI-ITB -1977		HCC-1984	HCC-1984	HCC-1984

Notes: 1) HCI will consume a 1/3 of heating value (net) as fuel oil and 2/3 as coal.
2) HCC is consuming a 1/2 of fuel weight as coke and 1/2 as coal.

(b) Raw Water

	Hetauda Cement Industries Ltd.	Himal Cement Co. (PVT) Ltd.
Source	River Bed Well at Kukhureni River (18.0°C, 500m^3/D)	Bagmati River (17.0°C, 30m^3/Day) Plant Well (22.5°C, 3m^3/H) Quarry Well (20.5°C, 5m^3/H) City Water (18.0°C, 0.1m^3/H)

Analysis, ppm	Kukhureni River Record	Kukhureni River Measured	Bagmati River Measured	Plant Well Measured
pH	5.85	5.8	7.2	7.8
Electric Conductivity	-	24	275	450
Total Hardness	12.5	19	97	275
Fe	0.07	0.08	3.1	-
SiO_2	-	-	-	-
Cl	-	3.3	19	18
SO_4	2.5	4	72	16
P	-	-	-	-
N	30.5	-	-	-
COD	-	1	10	-
Suspend Solid	-	1.6	80	6
Disolved Solid	-	38	198	274
Total Alkalinity	-	25	-	-

Notes: 1) Unit of electric conductivity is micromhos/cm.
2) Unit of hardness is in terms of $CaCO_3$.

(c) Electric Power

	Hetauda Cement Industries Ltd.	Himal Cement Co. (PVT) Ltd.
Source	Nepal Electricity Corp.	Nepal Electricity Corp.
Voltage, Volt	10,000	440
Frequency, Hz	50	50
Phase	3	3
Wire	3	3
Location	At Fence	At Fence

5. Raw Materials and Utilities Consumption

(Unit: Ton/Ton-Clinker, Dry Basis)

	Hetauda Cement Industries Ltd.	Himal Cement Co. (PVT) Ltd.
Raw Materials		
Limestone	1.438	1.350
Clay	0.087	0.125
Iron Ore	0.008	-
Sub-Total	1.533	1.475
Fuel		
Fuel Oil	0.0628	-
Coal, Assam	0.0833	-
Coal, Special Low Volatile	-	0.095
Coke, Breeze	-	0.095
Sub-total	0.1101	0.190
Total	1.6430	1.665
Free Moisture		
Black Meal	-	0.249
Raw Meal	0.081	-
Fuel	0.002	-
Sub-Total	0.083	0.254 (13.0%)
Grand-Total	1.726	1.957
Fuel Consumption, 10^3 kcal-LHV	850	1,033
Others		
Atmospheric Air	2.213	3.120
Gypsum	0.05	0.06
Electric Power, kWh	130	100
Process Water, m^3	-	-
Cooling Water Circulation	6.25	3.85
Fuel for Raw Meal Drying		
-Fuel Oil	0.0087	0.0117
-Coal	-	-
Jute Bag, 50kg Net, Sheet	20.1	20.1
Chemicals		
-Alum	-	0.0005
-Bleach Powder	-	-
Lube Oil, and Grease, kg	0.025	0.050
Loss during Production	0.025	0.030

Notes: 1) Clinker production of 1.0 ton is equivalent to 1.05 to 1.06 ton of bagged cement production.

6. Clinker Composition

Chemical Analysis

SiO_2	24.5	22.4
Al_2O_3	6.0	7.1
Fe_2O_3	2.3	4.7
CaO	63.3	62.3
MgO	2.2	2.6
SO_3	0.3	-
Na_2O	0.21	-
K_2O	1.07	-
	99.88	99.1

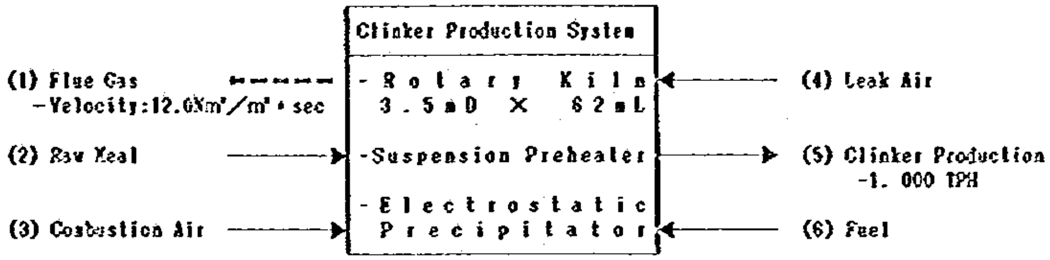
Moduli

HM	1.93	1.82
SM	3.00	1.90
IM	2.60	1.50

7. Carbon Dioxide in Flue Gas

	Hetauda Cement Industries Ltd.		Himal Cement Co. (PVT) Ltd.	
	Base Case	Extreme Case	Base Case	Extreme Case
Physical Conditions				
Temperature, °C	113	102/120	120	100/130
Pressure, ata	0.947		0.859	
Velocity, Nm^3/m^2.sec	15.0		5.7	
Location	Outlet of Electro-static Precipitator (10m)		Outlet of Stack (33.5m)	
Analysis, Wt%-Wet Gas Basis				
CO	0.10		2.16	
N_2	56.11		58.25	
O_2	8.00		10.40	
CO_2	27.16		20.63	
H_2O	8.72		8.12	
NO_x, ppm	197		51	
SO_x, ppm	600		8	
Dust	0.07		0.31	
Carbon Dioxide Gas in Flue Gas				
Hourly, TPH	25.68		4.42	
Daily, TPD	616.40		105.98	
Annual, TPY	183,069.67		31,475.09	
[24 HPD x (365-35)DPY x 0.9]				
Flow Rate of Flue Gas, Per Ton of Clinker				
Weight, Wet, TPT	3.026		4.077	
Volume, Wet, Nm^3PT	2,274		3,123	

Figure AIII-1 CARBON DIOXIDE BALANCE AT CEMENT PLANTS IN NEPAL (1)

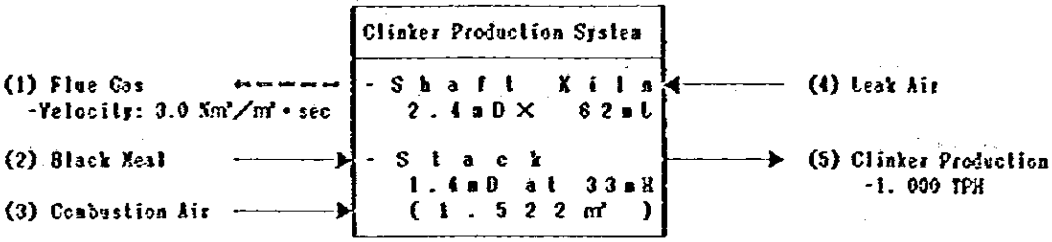


Basis:
- Company : Hetauda Cement industries Ltd.
- Location: Hetauda, Nepal
- Clinker Production: 31.25 TPH
- Atmosphere ;
  - Pressure: 0.947 ata
  - Temperature : 23.0 ℃
  - Moisture : 0.0133 kg/kg-dry air

Items	Unit Flow for 1.000 Ton of Clinker Production											
Flow Point,(+) In (-) Out	(1) , (-) Flue Gas		(2) , (+) Raw Meal		(3) , (+) Combusion Air		(4) , (+) Leak Air		(5) , (-) Clinker		(6) , (+) Fuel	
Temperature, ℃	113		200		23		23		100		23	
Pressure, ata	0.947		0.947		0.947		0.947		0.947		0.947	
Material Flow Unit	Ton	Nm³	Ton	Nm³	Ton	Nm³	Ton	Nm³	Ton	Nm³	Ton	Nm³
Metal Oxides 1)	–	–	0.938	–	–	–	–	–	1.000	0.333	0.013	–
H_2	–	–	0.002	–	–	–	–	–	0	0	0.007	–
C	–	–	0.143	–	–	–	–	–	0	0	0.081	–
N_2	–	–	–	–	–	–	–	–	0	0	0.001	–
O_2 (Organics)	–	–	0.400	–	–	–	–	–	0	0	0.005	–
Dry Solid Total	0.002	–	1.533	–	–	–	–	–	1.000	0.333	0.108	–
Moisture	–	–	0.081	–	–	–	–	–	0	0	0.002	–
Wet Solid Total	0.002	–	1.614	–	–	–	–	–	1.000	0.333	0.110	–
CO	0.002	2	–	–	0.000	0	0.000	0	–	–	–	–
N_2	1.698	1,358	–	–	0.899	719	0.799	639	–	–	–	–
O_2	0.242	169	–	–	0.273	191	0.242	163	–	–	–	–
CO_2	0.822	418	–	–	0.000	0	0.000	0	–	–	–	–
Dry Gas Total 2)	2.762	1,946	–	–	1.172	910	1.041	803	–	–	–	–
Moisture 3)	0.264	328	–	–	0.016	19	0.014	17	–	–	–	–
Wet Gas Total	3.026	2,274	–	–	1.188	929	1.055	825	–	–	–	–
Wet Material Total	3.032	2,276	1.614	–	1.183	929	1.655	825	1.000	0.333	0.055	–

NOTES: 1) Metal oxides means metal oxide, sulfate, silicate, phosphate and others which form solid materials in cement production.
2) A small amount of NO_x and SO_x are measured separately.
3) The material balance is calculated at steady state of balanced operation of calcination and raw meal drying. The unbalanced operating condition are considered in extreme case for design purpose of carbon dioxide recovery.

Figure AIII-1 CARBON DIOXIDE BALANCE AT CEMENT PLANTS IN NEPAL (2)



Basis:
Company : Himal Cement Co. (PVT) LTD.
Location: Chobar, Kathmandu, Nepal
Clinker Production: 5.25 TPH
Atmosphere:
–Pressure: 0.859 ata
–Temperature : 18.0 °C
–Moisture: 0.0105 kg/kg-dry air

Items	Unit Flow for 1.000 Ton of Clinker Production									
Flow Point, (+) In (–) Out	(1), (–) Flue Gas		(2), (+) Black Meal		(3), (+) Combustion Air		(4), (+) Leak Air		(5), (–) Clinker	
Temperature, °C	120		18		18		18		200	
Pressure, ata	0.859		0.859		0.859		0.859		0.859	
Material Flow Unit	Ton	Nm³	Ton	Nm³	Ton	Nm³	Ton	Nm³	Ton	Nm³
Metal Oxides 1)	–	–	1.004	–	–	–	–	–	1.000	0.333
H_2	–	–	0.005	–	–	–	–	–	0	0
C	–	–	0.267	–	–	–	–	–	0	0
N_2	–	–	0.002	–	–	–	–	–	0	0
O_2 (Organics)	–	–	0.333	–	–	–	–	–	0	0
Dry Solid Total	0.002	–	1,578	–	–	–	–	–	1.000	0.333
Moisture	–	–	0.255	–	–	–	–	–	0	0
Wet Solid Total	0.002	–	1.339	–	–	–	–	–	1.000	0.333
CO	0.088	71	–	–	0	0	0	0	–	–
N_2	2.375	1,316	–	–	1,162	928	1,331	985	–	–
O_2	0.424	297	–	–	0.353	247	374	262	–	–
CO_2	0.841	428	–	–	0	0	0	0	–	–
Dry Gas Total 2)	3.743	2,711	–	–	1.515	1,176	1.605	1,247	–	–
Moisture	0.331	412	–	–	0.016	20	0.017	21	–	–
Wet Gas Total	4.077	3,123	–	–	1.531	1,196	1.622	1,268	–	–
Wet Material Total	4.077	3,123	–	–	1.531	1,196	1.622	1,268	1.000	0.333

NOTES; 1) Metal oxides means metal oxide, sulfate, silicate, phosphate and others which form solid materials in cement production.
2) A small amount of NO, NO_2 and SO_2 are measured separately.

Annex III-2

PRICE INFORMATION IN NEPAL FOR CONSTRUCTION MATERIALS, LABORERS, WORKS, AND INLAND TRANSPORT FROM CALCUTTA

Annex III-2

PRICE INFORMATION IN NEPAL FOR CONSTRUCTION MATERIALS, LABORERS, WORKS, AND INLAND TRANSPORT FROM CALCUTTA

(1) Construction Materrials

Item	Specification	Unit	Price Level RS
Cement	50 kg, Bagged	Ton	2,000 - 2,900
Sand	-	m^3	38 - 45
Gravel	-	m^3	55 - 69
Round Bar	Twisted (8 - 20 mmD)	Ton	8,800 - 9,000
Round Bar	Plain (8 - 20 mmD)	Ton	8,000 - 9,000
Angle	-	Ton	6,700 - 10,000
I Beam (I Type)	-	Ton	7,150 - 11,000
Cannel	-	Ton	7,800 - 10,500
Plate	4 - 12 mm thickness	Ton	10,500 - 11,500
G.I. Plate	-	m^2	100
Pipe	1B - 2 1/2 1.0 - 2.5 Inch	Ton	10,000 - 13,000
G.I. Pipe	12 mmD	ft	3.8 - 7.0
Asbesto Slate		ft^2	7.0
Timber	Square 25 x 50 x 4,000	m^3	3,500 - 3,900
Ordinary Plywood	3 x 1,200 x 2,400	m^2	30 - 100
Planed Plank	12 x 200 x 4,000	ft^3	70 - 150
Brick	Chimney made	1,000 nos.	400 - 475
Brick	Machine made	1,000 nos.	500
Acetylene	Gas	m^3	172
Acetylene	Carbide	kg	22 - 23
Oxygen	-	Cylinder	272 - 292

Notes: 1) Generally observed price level in January, 1984 in Nepal

2) Rs = Nepalese Rupees (Exchange Rate in January, 1984 is Rs 15.65/1.0 US$)

(2) Construction Laborers

Items	Direct Daily Salary, Rs/Day		
	Trained	Experienced	Untrained
Heal Coolie	-	18	-
Coolie (Male)	-	-	16
Coolie (Female)	-	-	14
Coolie (Small)	-	-	10
Head porter	-	18	-
Porter	-	-	16
Mason, Carpenter, Painter, Plumber, Blacksmith	34	32	-
Electrician, Mechanics	32	30	-
Plumber Foreman	35	32	-
Driver (Light vehicle)	25	-	-
Truck driver	30	-	-
Driver cum Junior Mechanics	27	-	-
Truck driver cum mechanics, heavy equipment operator	32	-	-
Timber sawer	-	25	-
Wood carver, Stone carver	32	30	-
Welder, foreman	32	30	-
Security guard	25	22	-
Night watchman	25	22	-
Driller	32	30	-
Helper	-	18	-

Notes: 1) Generally observed wage level in January 1984 in Nepal. The wage level is mostly for governmental project, the wage level is approximately 30% higher in private sector.

2) Rs = Nepalese Rupees (Exchange Rate in January, 1984 is Rs 15.65/1.0 US$)

(3) Construction Works (Labor plus Materials)

Item	Specification	Unit	Price Level Rs
Earth Work - Excavation and Filling	0 - (-)3m (G.L.) Up to lead 100m	m^3	17.25 - 18.30
Earth Work - Excavation and Filling	(-)3 - (-)6m (G.L.) Up to lead 100m	m^3	36.6
Sand Filling Work	Sand	m^3	84.0
Gravel Filling Work	River Gravel	m^3	140.0
Transportation of Soil	Labor only 100-500m	m^3	20
	Labor only 100-1,000m	m^3	30
Concrete Work	(1 : 2 : 4) Plain	m^3	1,200
	(1 : 3 : 6) Plain	m^3	925
Reinforcement Concrete Work	(1 : 2 : 4)	m^3	1,280
Mild Steel Reinforcement Work		Ton	15,660
Form Work		m^2	92
Asbesto Cement Sheet Roofing		m^2	160
Brick Work	Mortar (1 : 4) Chimney-made Brick	m^3	890
Brick Work	Mortar (1 : 4) Machine-made Brick	m^3	790
Course Rubble Masonry	Mortar (1 : 4)	m^3	910

Notes: 1) Generally observed price level in January 1984 in Nepal

2) The price level indicated above is inclusive for labor materials and a 22% of administration charges.

3) Rs = Nepalese Rupees (Exchange Rate in January, 1984 is Rs15.65/1.0 US$)

(4) Inland Transport from Calcutta, India

Transport Route	Road Transport Charge US$/Freight Ton	Days Required Days	Cargo and Weight/ Length Restriction
Calcutta, Raxaul, India /Birganj, Hetauda, Nepal (860 km)	60.0	5.0	Dry Season -30 Ton -4 x 10 Meter Rain Season - 10 Ton - 4 x 10 Meter
Calcutta, Nautunwa, India/Bhairawa, Hetauda, Nepal (1,500 km)	250.0	25.0	Dry Season - 70 Ton - 4.5 x 12 Meter Rain Season - 30 Ton - 4.5 x 12 Meter
Calcutta, Raxaul, India /Birganj, Kathmandu, Nepal (990 km)	90.0	7.0	Dry Season - 15 Ton - 4 x 10 Meter Rain Season - 8 Ton - 4 x 10 Meter

Notes: 1) Rain Season in Nepal is from April to September.

2) Transport charge is not including import tax of 1.0% of CIF value which should be paid by import contractors.

Annex III-3

ELECTRIC POWER CONSUMPTION AND OVERALL LOAD FACTOR INCREASE AT THE UREA FERTILIZER PLANT

Annex III-3

ELECTRIC POWER CONSUMPTION AND OVERALL LOAD FACTOR INCREASE AT THE UREA FERTILIZER PLANT

1. Electric Power Consumption Pattern

The proposed urea fertilizer plant in Nepal will utilize secondary energy electric power as a major input for the production of urea fertilizer. The unit consumption of total electric power in the plant is 6.642 MW/Ton of urea and out of this, a major portion of 5.411 MW(81.5%) will be consumed for hydrogen gas production at water electrolysis plant and the rest of 1.231 MW(18.5%) will be utilized for ammonia synthesis, carbon dioxide recovery, urea synthesis and other facilities in the urea fertilizer plant. The supply of electric power is preferable at 132 kV level at the plant.

It is desirable to operate the whole urea fertilizer plant at the design capacity (275 TPD or 11.458 TPH) continuously throughout a day and a year except during the annual scheduled shut down for maintenance purpose for approximately 30 days a year. Generally such urea fertilizer plant by electrolysis and carbon dioxide recovery schemes would be operable at 90% of capacity utilization if adequate and stable supply of electric power is obtainable.

Therefore, for such continuous operation of urea fertilizer plant, a stable supply of electric power of hourly 76.1 MW or daily 1.827 GWh (monthly 54.8 GWh ... 30 days or annual 542.6 GWh ... 297 days) is required.

However, in Nepal the electric power supply during the dry season, especially in the morning and evening, has been and would be tight and limited, therefore specific provisions in the plant are required in the proposed plant in Nepal, such as to have hydrogen storage facility to keep continuous operation of ammonia and urea plant at technically minimum operable level (50% of design capacity) while closing down the electrolysis plant during a few hours of the peak period of electric power supply shortage to take full advantage of maximum utilization of secondary energy electric power which will be supplied at special tariff.

The highest peak of electric power consumption in Nepal is observed in the evening (from 7:00 PM to 23:00 PM) for four hours and the second peak is in the morning (from 8:00 AM to 10:00 AM) for three hours, therefore the capacity of hydrogen gas storage for two hours full operation use would be adequate to keep operation of ammonia and urea plant at a half load without manufacturing hydrogen gas during such power demand peak hours.

During such half load operation of ammonia and urea plant (5.729 TPH of urea) without water electrolysis operation, the electric power consumption is reduced to 0.6155 MW/Ton of urea. Therefore, the electric power supply of 3.526 MW hourly is the minimum level to sustain such continued operation. The daily production of urea at the plant will be flexible from 275 TPD(100%) to 137.5 TPD(50%) according to the availability of secondary energy. Therefore hourly electric power requirement are from 3.526 to 76.106 MW hourly or 0.913 to 1.827 GWh daily.

Summarizing the above analysis and discussion, the electric power consumption increase for the proposed urea fertilizer plant is calculated and shown as follows;

UREA FERTILIZER PRODUCTION AND ELECTRIC POWER CONSUMPTION

Season	Urea Production Hourly, TPH Peak Hour (3+4 Hours)	Urea Production Hourly, TPH Off-Peak Hour (17 Hours)	Urea Production Daily, TPD (24 Hours)	Electric Power Consumption Hourly, MW Peak Hour (3+4 Hours)	Electric Power Consumption Hourly, MW Off-Peak Hour (17 Hours)	Electric Power Consumption Daily, GWH (24 Hours)
Rain Season						
-Normal Operation	11.458	11.458	275.0	76.106	76.106	1.826.6
Dry Season						
-Minimum Continuous Operation	5.729	5.729	137.5	3.526	52.272	0.913.3
-Shut Down	0.0	0.0	0.0	0.0	0.0	0.0
-Annual Maintenance	0.0	0.0	0.0	0.0	0.0	0.0

The annual requirement of electric power for the urea production is, therefore calculated in accordance with the annual production schedule which is shown in Table 4-9.

ANNUAL UREA PRODUCTION AND ELECTRIC POWER CONSUMPTION

Year	Urea Production, TPY	Electric Power Consumption, GWh
1991/92	54,500	362.0
92/93	55,340	367.6
93/94	59,320	394.0
94/95	62,480	415.0
95/96	64,610	429.1
⋮	⋮	⋮
2001/02	69,750	463.3
⋮	⋮	⋮
2005/06	72,620	482.3

2. Overall Load Factor

After the completion of the urea fertilizer plant in Nepal, the additional consumption over the firm energy would be added and consequently the overall load factor will be increased. The overall load factor without urea fertilizer plant and with urea fertilizer plant is calculated and shown below;

OVERALL LOAD FACTOR OF ELECTRIC POWER CONSUMPTION

Year	Electric Power Generating, GWh	Consumption, GWh Without Urea Project (Firm Energy)	Consumption, GWh With Urea Project	Load Factor, % Without Urea Project (Firm Energy)	Load Factor, % With Urea Project
1991/92	1,725.7	1,167.8	1,529.8	67.7	88.6
92/93	2,263.9	1,299.4	1,667.0	57.4	73.6
93/94	2,690.8	1,445.6	1,839.6	53.7	68.4
94/95	(2,690.8)	1,608.0	2,023.0	(59.8)	(75.2)
95/96	(2,690.8)	1,788.0	2,217.1	(66.4)	(78.7)
:	:	:	:	:	:
2001/02	(2,690.8)	3,345.5	3,808.8	(124.3)	(141.5)

The electric power generating capability and consumption without the urea fertilizer project are shown in Table 3-5 to Table 3-7. The annual overall load factor for firm energy is 67.7, 57.4, 53.7, 59.8 and 66.4% in 1991/92, 92/93, 93/94, 94/95 and 95/96, respectively, and after the completion of the urea fertilizer plant the overall load factor will be improved up to 88.6, 73.6, 68.4, 75.2 and 78.7%, respectively.

The electric power generating capability increase in Nepal is assumed to be limited up to the completion of Sapta Gandaki plant, therefore the deficit in 2001/02, calculated above is obvious due to such consideration. The deficit would be observed even without urea fertilizer plant in dry season of 1995/96.

Annex III-4

WATER ELECTROLYSIS PROCESSES

Annex III-4

WATER ELECTROLYSIS PROCESSES

1. Introduction

The electrolysis of water to produce hydrogen and oxygen was first discovered by Dr. von Cavendish in 1766. The chemical reaction is shown in accordance with the Faraday's Law as follows,

$$H_2O + 2F = H_2 \text{ (gas)} + 1/2\ O_2 \text{ (gas)}$$

where F is the Faraday's Constant,

$$F = 96{,}484.56 \pm 0.27 \text{ Coulomb}$$

The theoretical electric power requirement in direct current to produce 1.0 $Nm^3 - H_2$ (gas) plus 0.5 $Nm^3 - O_2$ (gas) is calculated as 3.55 kWh/1.0 $Nm^3 - H_2$ with 1.48 Volts potential, however for industrial operations the electric power requirement is much higher according to the process and ranges between 4.00 to 5.00 kWh/1.0 $Nm^3 - H_2$ at 1.6 to 1.9 Voltage.

The theoretical reaction of the ammonia and urea production is described as follows,

$$3H_2 + 2N_2 = 2NH_3 \text{ (Ammonia)}$$

$$2NH_3 + CO_2 = NH_2CONH_2 \text{ (Urea)} + H_2O$$

Therefore the overall reaction in weight basis is summarized,

$$2H_2O + 2N_2 + CO_2 + 6F = NH_2CONH_2 + 3/2\ O_2$$

$$1.5H_2/NH_3 = (3 \times 1.00794)/(14.0067 + 3 \times 1.00794)$$
$$= 0.177553$$

$$2NH_3/NH_2CONH_2 = (2 \times 17.03052)/60.05516 = 0.5671626$$

The consumption of hydrogen is generally quoted in volume as follows,

1,972.93 Nm^3 - H_2 (gas)/1.0 Ton of NH_3

1,118.97 Nm^3 - H_2 (gas)/1.0 Ton of Urea

The electric power loss at the transformer and rectifier is generally 3.0% from alternating current to direct current electric power, therefore the theoretical electric power consumption for the hydrogen production by water electrolysis is calculated as follows,

3,972 kWh/1.0 Ton of Urea (Theoretical)

5,249 kWh/1.0 Ton of Urea (Industrial)

Additional electric power of 1,231 kWh is required for industrial production of ammonia and urea.

2. Industrial Water Electrolysis

Large scale industrial production of hydrogen by electrolysis of water was first done in 1930.

Hydrogen obtained by water electrolysis is utilized at present for nitrogen fertilizer production, metallurgical processes, glass manufacturing, meteorological use, fat hardening, argon purification, chemicals, nuclear power plant and cooling of electric power generators.

Regarding nitrogen fertilizer production from hydrogen obtained by water electrolysis, the major products are nitric acid and ammonium nitrate as final product.

A list of ammonia plants using electrolysis hydrogen from either water or sodium chloride is shown in Table AIII-2-1. Although some of them are now idle or shutdown, the total production capacity is approximately one million tons of ammonia yearly. The largest ammonia plants are in Norway and in Egypt with a 100,000 TPY capacity where low cost electric power is available. It may be noted that none of them are directly producing urea as the final product.

3. Water Electrolysis Processes

Several electrolysis processes are now available as commercially proven technology; the major features of such processes are summarized in Table AIII-2-2. There are basically two types of electrolysis cell, namely Bath Type and Filter Press Type. The operating conditions differ from atmospheric pressure to pressurized up to 30 ata to produce high pressure hydrogen. The electric power consumption is the most important index for the process comparison, the requirement being from 4.22 to 5.5 kWh for the production of 1.0 Nm^3 of hydrogen gas. The reactivity of the electrode is high during the initial year of operation and gradually declines, eventually requiring reactivation treatment. The consumption of electric power similarly increases with each operating year but after the reactivation, the consumption returns to the original minimum level.

Table AIII-4-1 LIST OF AMMONIA PLANTS USING ELECTROLYSIS HYDROGEN AS RAW MATERIAL

Company	Location	Compressor Type	Electrolysis	Ammonia Capacity (Name Plate Capacity x 330 days) - 1984	Final Product
				(TPY-N)	
West Europe					
- France					
Rhone Poulenc Ind.	Saint Aubar	RCP	H_2O	16,000	
- Iceland					
Arburdarverskmidjan	Gufunes, Reykjavik	RCP	H_2O	8,000	
- Norway					
Norsk Hydro S.A.	Glomfjord	RCP	H_2O	100,000	Ammonia, NA
Norsk Hydro S.A.	Rjukan	RCP	H_2O	95,000	Ammonia, NA, AN, CAN
- Spain					
Energia Ind. Aragonesas. S.A.(ARAGONESAS)	Sabinaningo	RCP	H_2O	8,000	Ammonia, NA, AS
S.A. Cros	Flix	RCP	H_2O	3,000 -Shutdown	Ammonia
- Sweden					
Uddeholm A.B.	Skoghall	RCP	NaCl	2,000	Ammonia
- Switzerland					
Emser Werke A.G.	Ems-Domat	RCP	H_2O	20,000	Ammonia, Urea, AS (Caprolactam)
				252,000	
East Europe				0	
				0	

Company	Location	Compressor Type	Electrolysis	Ammonia Capacity (Name Plate Capacity x 330 days) - 1984	Final Product
North America					
-USA					
Dow Chemical Co.	Freeport	RCP	NaCl	86,000	Ammonia
FMC Corp.	South Charleston	RCP	NaCl	18,000 Closed in 1981	Ammonia
Georgia Pacific	Plaquemine	RCP	NaCl	146,000	Ammonia, (Urea)
Jupiter Chemical Terra	Lake Charles	RCP	NaCl	58,000	Ammonia
Occidental Agri. Chem.	Taft	RCP	NaCl	67,000 Idle since 1981	Ammonia
	Tacoma	RCP	NaCl	20,000 Shutdown in 1980	Ammonia
Pennsalt Chemicals	Portland	RCP	NaCl	6,000	Ammonia, Aqua Ammonia
PPG Ind. Inc.	New Martinsville	RCP	NaCl	30,000 Shutdown in 1980	Ammonia
Vulcan Materials Co.	Wichita	RCP	NaCl	32,000 Shutdown in 1981	Ammonia
				463,000	
Latin America					
-Argentine					
Electrochor	Buenos Aires	RCP	NaCl	3,000	Ammonia
-Peru					
Industrial Cachimayo	Cuzco	RCP	H_2O	13,000 16,000	Ammonia, NA, AN
Africa					
-Zimbabwe					
Sable Chemical Ind.	Kwe Kwe	RCP	H_2O	80,000 80,000	Ammonia, NA, AN
Middle East					
-Egypt					
Egyptian Chem. Ind.	Aswan	RCP	H_2O	100,000	Ammonia, NA, AN CAN
(KIMA)				100,000	

Company	Location	Compressor Type	Electrolysis	Ammonia Capacity (Name Plate Capacity x 330 days) - 1984	Final Product
Asia					
-Japan					
Tokuyama Soda Co., Ltd.	Tokuyama	RCP	NaCl	54,000*2)	Ammonia, AC
-India					
Fertilizer Corp. of India Ltd.	Naya Nangal		-	90,000-Closed	Ammonia, NA, CAN
				144,000	
Oceania					
-Australia					
Electrolytic Zinc Co., Australaria Ltd.	Risdon, Tasmania	RCP	-	12,000	Ammonia, AS
				12,000	
WORLD TOTAL				1,067,000	

Notes: AN; Ammonium Nitrate
NA; Nitric Acid
CAN; Calcium Ammonium Nitrate
AC; Ammonium Chloride
RCP; Reciprocating
*1); Ammonial is sold to other company to produe urea.
*2); Raw material has been switched from fuel oil to chlorine cell hydrogen in 1982.

Table AIII-4-2 PROCESS COMPARISON OF WATER ELECTROLYSIS

Process	Electrolyzer				Electrolyte		Operating Conditions		Electric Power Consumption	Hydrogen Purity
	Cell		Electrode		Solution	Circulation	Temperature	Pressure		
	Type	Number	Type	Material	%	°C	°C	ata	DC-kWh/Nm^3-H_2*	%
Process A	Bath	20	Uni-Polar	Ni-Plated	NaOH - 20	Natural	75	1.02	5.5/6.0	99.7
Process B	Filter Press	235	Bi-Polar	Ni-Plated	KOH - 25	Forced	80	1.03	4.22/4.88	99.8
Process C	Filter Press	139	Bi-Polar	Ni-Plated	KOH - 25	Forced	90	30.00	4.3/4.6	99.9

* Nm^3 (Dry gas at 20°C and 1.0 ata)

Annex IV

Annex IV-1 PROJECT COST ESTIMATE

Annex IV-2 BACK DATA FOR ESTIMATING ESCALATION

Annex IV-3 BREAKDOWN OF PRE-OPERATION EXPENSES AND INITIAL WORKING CAPITAL

Annex IV-4 COMPARATIVE STUDY OF ALTERNATIVE PLANT CAPACITIES AND MANUFACTURING PROCESS

Annex IV-5 FINANCIAL PROJECTIONS (BASE ESTIMATES)

Annex IV-6 SENSITIVITY ANALYSIS OF FINANCIAL STRUCTURE BY CHANGES IN EQUITY/DEBT RATIO AND INTEREST RATES ON LOAN

Annex IV-7 ECONOMIC POWER COST

Annex IV-8 ECONOMIC RATE OF RETURN

Annex IV-1

PROJECT COST ESTIMATE

Annex IV-1 PROJECT COST ESTIMATE

Project : Urea Fertilizer Plant
Location: Hetauda, Nepal
Product : Urea, Bagged
Capacity: 275 TPD

Schedule:
-Cost Estimate ; Jan., 1984
-Contract Award ; Jan., 1988
-Mechanical Completion; Jan., 1991
-Commercial Production; July, 1991
-Project Economic Life; July, 2006 (15 years)

Unit: US$,Million

	Item	Investment Cost: Foreign Currency Component	Investment Cost: Local Currency Component	Total	Note
1.0	Land Acquisition	-	0.59	0.59	Lot (500 x 200 = 100,000 m^2) @ US$5.00/$m^2$ (100 x 180 = 18,000 m^2)
2.0	Site Preparation	1.35	0.15	1.50	Earth Moving 230,000 m^3
3.0	Plant Direct Cost	64.42	8.91	73.33	
3.1	Plant Equipment and Material	52.22	54.47	57.69	
3.1.1	Process Plant	(38.41)	(1.81)	(40.22)	
	- Hydrogen Gas	((21.58))	((0.69))	((22.27))	13,300 Nm^3PH
	- Carbon Dioxide Gas	((2.29))	((0.21))	((2.50))	4,380 Nm^3PH
	- Nitrogen Gas	((2.00))	((0.02))	((2.02))	4,440 Nm^3PH
	- Ammonia	((6.16))	((0.47))	((6.63))	160 TPD
	- Urea	((6.38))	((0.42))	((6.80))	275 TPD
3.1.2	Utility Plant	(10.17)	(0.53)	(10.70)	
	- Raw Water Supply, Water Treatment, and Cooling Water Tower	((1.55))	((0.14))	((1.69))	
	- Waste Water Treatment	((1.42))	((0.12))	((1.54))	
	- Electric Power Generation	((0.35))	((0.01))	((0.36))	
	- Electric Power Receiving	((0.20))	((0.02))	((0.22))	
	- Steam Generation	((4.17))	((0.05))	((4.22))	
	- Inert Gas Generation	((2.26))	((0.16))	((2.42))	
	- Instrument and Plant Air	((0.22))	((0.03))	((0.25))	
3.1.3	Material Handling Facility	(1.74)	(0.59)	(2.33)	
	- Bulk Urea Storage	((0.10))	((0.12))	((0.22))	
	- Urea Bagging and Loading	((1.42))	((0.17))	((1.59))	
	- Bagged Urea Storage	((0.22))	((0.30))	((0.52))	
3.1.4	Auxiliary Facility	((0.20))	((0.23))	((0.43))	
	- Maintenance Shop	((0.19))	((0.21))	((0.40))	
	- Spare Parts and Others Storage	((0.01))	((0.02))	((0.03))	
3.1.5	Offsite Facility	(1.70)	(2.31)	(4.01)	
	- Administration Building and Others	((0.94))	((1.28))	((2.22))	
	- Township	((0.76))	((1.03))	((1.79))	
3.2	Spare Parts	0.85	-	0.85	For two years uses
3.3	Catalyst and Chemicals	1.48	-	1.48	One spare set and two years uses
3.4	Construction and Erection Labor	9.87	3.44	13.31	
3.4.1	Foreign Technician	(9.87)	(2.47)	(12.34)	11,300 Man-Month
3.4.2	Local Labor	(-)	(0.97)	(0.97)	10,400 Man-Month
4.0	Construction and Erection Equipments	7.82	-	7.82	
5.0	Transportation and Insurance	2.00	2.59	4.59	
5.1	Ocean Transport and Insurance	2.00	-	2.00	Net 8,500 Ton, Freight 25,400 Ton
5.2	Custom Clearance, Import Duty and Tax	-	1.11	1.11	1.5% (F.E Portion of 3.1, 3.2, 3.3, 4.0, 5.1)
5.3	Unloading, Inland Transport and Insurance	-	1.48	1.48	Transport mode 860 km
6.0	Indirect Field Expenses	0.33	0.49	0.82	
7.0	Engineering Services Fee	9.31	0.85	10.16	
7.1	Know-How and Basic Engineering	1.34	-	1.34	
7.2	Engineering at Home Office	5.43	-	5.43	480 Man-Month
7.3	Supervisor and Service man	2.54	0.85	3.39	430 Man-Month
8.0	Project Management Services	2.45	0.33	2.78	
8.1	Technical Managerment Advisor	1.45	0.11	1.56	F.E ($9,000 x 150M/M) x 1,075 L.C $50 x 75M/M x 30
8.2	Operation and Maintenance Advisor	1.00	0.22	1.22	F.E ($6,000 x 150M/M) x 1,075 L.C $50 x 150M/M x 30
9.0	Pre-Operational Expenses	0.29	1.90	2.19	
9.1	Personnel Expenses and Overhead	0.05	0.34	0.39	
9.2	Training Expenses	0.23	-	0.23	
9.3	Losses during Start-up	-	1.54	1.54	
9.4	Miscellaneous	0.01	0.02	0.03	5% of 9.1 and 9.2
10.0	Base Project Cost, BPC - at Cost Estimate Date	87.97	15.81	103.78	
11.0	Contingency Combined	22.22	6.79	29.02	
11.1	Physical Contingency	4.41	0.08	5.21	Foreign 5%/Yr, Local 5%
11.2	Price Escalation	17.81	5.99	23.80	Foreign 3.5%/Yr, Local 6%/Yr
12.0	Initial Working Capital	0.40	2.28	2.68	
13.0	Interest during Construction	9.28	-	9.28	Interest Rate; Foreign 5%/Year Local 15%/Year
14.0	Total Financing Required for Completion of Project	119.87	24.92	144.79	Equity/Debt = 30/70

[Attachment (1) to Annex IV-1]

DISBURSEMENT AND INTEREST DURING CONSTRUCTION

TOTAL FINANCING REQUIRED:

DEBT (70.00%)	101.35
EQUITY (30.00%)	43.44
TOTAL	144.79

INTEREST RATE: 5.00% PER YEAR

DISBURSEMENT:

YEAR	%	DISBURSEMENT
1 YEAR	0.0	0.0
2 YEAR	3.00	3.04
3 YEAR	39.00	39.53
4 YEAR	46.00	46.62
5 YEAR	12.00	12.16
		101.35

INTEREST DURING CONSTRUCTION: AT THE END OF YEAR:

	1 YEAR	2 YEAR	3 YEAR	4 YEAR	5 YEAR
A. ALREADY DRAWN	0.0	0.0	3.04	42.57	89.19
B. PREVIOUS YEARS INTEREST	0.0	0.0	0.0	0.0	0.0
C. OPENING DEBT (A+B)	0.0	0.0	3.04	42.57	89.19
D. INTEREST ON OPENING DEBT	0.0	0.0	0.15	2.13	4.46
E. DRAWN DURING YEAR	0.0	3.04	39.53	46.62	12.16
F. INTEREST ON CURRENT DRAW G	0.0	0.08	0.99	1.17	0.30
G. TOTAL INTEREST FOR YEAR(D+F)	0.0	0.08	1.14	3.30	4.76
H. INTEREST PAYMENT	0.0	0.08	1.14	3.30	4.76

INTEREST DURING CONSTRUCTION:

1 YEAR	0.0
2 YEAR	0.08
3 YEAR	1.14
4 YEAR	3.30
5 YEAR	4.76
TOTAL	9.28

[Attachment (2) to Annex IV-1]

CONTINGENCY SCHEDULE BY COST GROUP

NEPAL UREA PROJECT (275 TPD) (UNIT: US$MIL.)

	MONTHS TO EXPEND DATE (MONTHS)		PHYSICAL CONTINGENCY(PCT)		PRICE CONTINGENCY(PCT)		COMBINED CONTINGENCY(PCT)	
	FOREIGN	LOCAL	FOREIGN	LOCAL	FOREIGN	LOCAL	FOREIGN	LOCAL
A. LAND ACQUISITION	30.00	30.00	0.0	5.00	9.00	15.73	9.00	21.52
B. SITE PREPARATION	42.00	42.00	5.00	5.00	12.81	22.67	18.45	28.81
C. PLANT DIRECT COST								
C-1 PROCESS UNITS	62.00	62.00	5.00	5.00	19.48	35.24	25.46	42.00
C-2 UTILITY FACILITIES	61.00	61.00	5.00	5.00	19.14	34.59	25.10	41.32
C-3 AUXILIARY FACILITIES	60.00	60.00	5.00	5.00	18.80	33.94	24.74	40.63
C-4 OFFSITE FACILITIES	58.00	58.00	5.00	5.00	18.12	32.64	24.03	39.27
D. SPAREPARTS, CATL. & CHEM.	75.00	75.00	5.00	0.0	24.02	44.04	30.22	44.04
E. CONST. & ERECTION LABOR	68.00	68.00	5.00	5.00	21.55	39.22	27.63	46.18
F. CONST. EQUIPMENT	54.00	54.00	5.00	0.0	16.76	30.04	22.60	30.04
G. TRANSPORT,INSURANCE & DUTY	61.00	61.00	5.00	5.00	19.14	34.59	25.10	41.32
H. INDIRECT FIELD EXPENCES	68.00	68.00	5.00	5.00	21.55	39.22	27.63	46.18
I. ENGINEERING SERVICES	59.00	59.00	5.00	5.00	18.46	33.29	24.39	39.95
J. PROJECT MANAGEMENT SERVICES	60.00	60.00	5.00	5.00	18.80	33.94	24.74	40.63
K. PRE-OPERATION EXPENSES	78.00	78.00	5.00	5.00	25.08	46.11	31.33	53.41
M. INITIAL WORKING CAPITAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N. INTEREST DURING CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

[Attachment (3) to Annex IV-1]

ESCALATED CAPITAL COST ESTIMATE

NEPAL UREA PROJECT (275 TPD) (UNIT: US$MIL.)

	BASE PROJECT COST		PHYSICAL CONTINGENCY		PRICE CONTINGENCY		TOTAL PROJECT COST (AS COMPLETED)		
	FOREIGN	LOCAL	FOREIGN	LOCAL	FOREIGN	LOCAL	FOREIGN	LOCAL	TOTAL
A. LAND ACQUISITION	0.0	0.59	0.0	0.03	0.0	0.10	0.0	0.72	0.72
B. SITE PREPARATION	1.35	0.15	0.07	0.01	0.18	0.04	1.60	0.20	1.80
C. PLANT DIRECT COST									
C-1 PROCESS UNITS	38.41	1.81	1.92	0.09	7.86	0.67	48.19	2.57	50.76
C-2 UTILITY FACILITIES	10.17	0.53	0.51	0.03	2.04	0.19	12.72	0.75	13.47
C-3 AUXILIARY FACILITIES	1.94	0.82	0.10	0.04	0.38	0.29	2.42	1.15	3.57
C-4 OFFSITE FACILITIES	1.70	2.31	0.09	0.12	0.32	0.79	2.11	3.22	5.33
D. SPAREPARTS, CATL. & CHEM.	2.33	0.0	0.12	0.0	0.59	0.0	3.04	0.0	3.04
E. CONST. & ERECTION LABOR	9.87	3.44	0.49	0.17	2.23	1.42	12.59	5.03	17.62
F. CONST. EQUIPMENT	7.82	0.0	0.39	0.0	1.38	0.0	9.59	0.0	9.59
G. TRANSPORT,INSURANCE & DUTY	2.00	2.59	0.10	0.13	0.40	0.94	2.50	3.66	6.16
H. INDIRECT FIELD EXPENCES	0.33	0.49	0.02	0.02	0.07	0.20	0.42	0.71	1.13
I. ENGINEERING SERVICES	9.31	0.85	0.47	0.04	1.80	0.30	11.58	1.19	12.77
J. PROJECT MANAGEMENT SERVICES	2.45	0.37	0.12	0.02	0.48	0.13	3.05	0.52	3.57
K. PRE-OPERATION EXPENSES	0.29	1.90	0.01	0.10	0.08	0.92	0.38	2.92	3.30
L. BASE PROJECT COST	87.97	15.85	4.41	0.80	17.81	5.99	110.19	22.64	132.83
M. INITIAL WORKING CAPITAL	0.0	0.0	0.0	0.0	0.0	0.0	0.40	2.28	2.68
N. INTEREST DURING CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0	9.28	0.0	9.28
O. TOTAL FINANCING REQUIRED	87.97	15.85	4.41	0.80	17.81	5.99	119.87	24.92	144.79

Annex IV-2

BACK DATA FOR ESTIMATING ESCALATION

Annex IV-2 (1) PLANT COST INDEX

(Unit: 1980=100)

Year	C.E. PLANT COST INDEX (U.S.A.)	SRI PLANT COST INDEX U.S.A.	SRI PLANT COST INDEX JAPAN	SRI PLANT COST INDEX W.GERMANY
1980	100	100	100	100
1981	113.7	116.1	104.7	105.2
1982	120.3	120.7	107.4	112.4
1983	122.0	122.4	114.4	113.8
1984	122.9	N.A.	N.A.	N.A.
Av. Ann. (1980-1984) Escalation	5.3%	5.2%	3.4%	3.3%

Source: Chemical Engineering, U.S.A.
SRI, U.S.A.

Annex IV-2 (2) PRICE INDEX IN NEPAL

F.Y.	Average F.E. Rate (Rs. per US $)	National Consumer Price Index for Urban Areas				Kathmandu Consumer Price Index			
		Rupee Terms	Changes to previous year (%)	US Dollar Terms	Changes to previous year (%)	Rupee Terms	Changes to previous year (%)	US Dollar Terms	Changes to previous year (%)
1974/75	10.56	138.0		132.4		134.0		128.54	
1975/76	11.97	137.0	- 0.72	115.9	- 12.46	141.1	+ 5.30	119.41	- 7.11
1976/77	12.50	140.7	+ 2.70	114.0	- 1.64	141.5	+ 0.28	114.67	- 3.97
1977/78	12.36	156.4	+ 11.16	128.2	+ 12.46	155.9	+ 10.18	127.77	+ 11.42
1978/79	12.00	161.8	+ 3.45	136.6	+ 6.55	161.1	+ 3.34	136.00	+ 6.44
1979/80	12.00	177.6	+ 9.77	149.9	+ 9.74	180.8	+ 12.23	152.63	+ 12.23
1980/81	12.00	201.4	+ 13.40	170.0	+ 13.41	207.2	+ 14.60	174.91	+ 14.60
1981/82	12.96	222.4	+ 10.43	173.8	+ 2.24	229.2	+ 10.62	179.15	+ 2.42
1982/83	13.40	250.7	+ 12.72	189.5	+ 9.03	252.4	+ 13.35	196.40	+ 9.63
Average Increase Rate (1977/78 - 1982/83)		10.67%		8.89%		10.75%		8.98%	

Source: Nepal Rastra Bank

Annex IV-3

BREAKDOWN OF PRE-OPERATION EXPENSES AND INITIAL WORKING CAPITAL

Annex IV-3(1)

ESTIMATE OF PRE-OPERATIONAL EXPENSES
(1984 Prices)

1. Personnel Expenses and Overhead

1.1 Initial 3 Years

- General Manager (1 x Rs. 34,200/yr x 3 yrs)	Rs.	102,600
- Managers (3 x Rs. 20,520/yr x 3 yrs)	Rs.	184,680
- Senior Engineers, and Senior Officers (6 x Rs. 15,960/yr x 3 yrs)	Rs.	287,280
- Supervisors, and Officers (10 x Rs. 13,680/yr x 3 yrs)	Rs.	410,400
- Secretary, and Workers (10 x Rs. 10,680/yr x 3 yrs)	Rs.	320,400
- General Workers (5 x Rs. 7,320/yr x 3 yrs)	Rs.	109,800
Total	Rs.	1,415,160

1.2 Last Half Year

50% of full personnel cost (Rs. 3,637,320[1] x 0.5) — Rs. 1,818,660

1.3 Total Personnel Cost (1.1 + 1.2) — Rs. 3,233,820

1.4 Overhead (1.3 x 70%) — Rs. 2,263,674

Total: (1.3 + 1.4) — Rs. 5,497,494 (US$343,600)

1.5 Overseas Trip Expenses (@US$5,000/trip x 10 trips) — US$50,000

1.6 Personnel Expenses and Overhead: Grand Total — US$393,600

Note: 1/ See Table 2-5, Part IV

2. Training Expenses (Trainings in foreign countries)

2.1 20 persons (2 months training)

- Living expenses (@US$80/diem x 20 persons x 60 days)	US$96,000
- Trip expenses (@US$1,500/trip x 20 trips)	US$30,000
Total	US$126,000

2.2 30 persons (2 months training in India)

- Living expenses (@US$50/diem x 30 persons x 60 days)	US$90,000
- Trip expenses (@US$500/trip x 30 trips)	US$15,000
Total	US$105,000

2.3 Total expenses: (2.1 + 2.2) US$231,000

3. Loss during Start-up

3.1 Utility and supply costs for production of urea

1) Electric power (@US¢3.56/kwh x 6,642 kwh/ton)	US$236.45
2) Coal (@US$40.63/ton x 0.256 tons)	US$10.40
3) Chemicals and catalysts	US$2.72
Total	US$249.57

3.2 Loss (Assuming 50% operation for 3 months and losses for 50% of the production)

US$249.57/ton x 275 tons/day x 0.5 x 90 days US$1,544,214

Annex IV-3(2)

INITIAL WORKING CAPITAL
(1991 Price)

Items	Estimated Cost (US$'000)		
	F.E. Portion	L.C. Portion	Total
1. Product Inventory (Ann. Direct Operating Cost x 20/330)			
- Foreign Exchange Component ($4,496 x 10^3) x 20/330	272	-	272
- Local Currency Component ($35,814 x 10^3) x 20/330	-	2,171	2,171
2. Account Receivable (Ann. Direct Operating Cost x 0.5/12)			
- Foreign Exchange Component ($4,496 x 10^3) x 0.5/12	187	-	187
- Local Currency Components ($35,814 x 10^3) x 0.5/12	-	1,492	1,492
3. Account Payable (15 days usance for electric power, coal, and bags)			
- Coal ($1,416 x 10^3 x 0.5/12)	-)59	-	-)59
- Electric power and bags ($33,259 x 10^3 x 0.5/12)	-	-)1,386	-)1,386
Total	400	2,277	2,677

Annex IV-3(3)

DIRECT OPERATING COST
(1991 Price)

Cost Items	Calculation Basis	Estimated Cost (US$'000)		
		F.E. Portion	L.C. Portion	Total
1. Electric Power	@$0.0356 x 1.5 x 6,642 kwh x 275 t/d x 330 days	-	32,187	32,187
2. Coal	@$40.63 x 1.5 x 0.256 t x 275 t/d x 330 days	1,416	-	1,416
3. Catalyst & Chemicals	@2.72 x 1.5 x 275 t/d x 330 days	370	-	370
4. Bags	@$0.375 x 1.5 x 21 bags x 275 t/d x 330 days	-	1,072	1,072
5. Personnel Cost	$227,333 x 1.407	-	320	320
6. Insurance				
1) Personnel	2% of Item 5	-	6	6
2) Plants	US$117.95 x 10^6 x 1.175%	-	1,327	1,327
7. Maintenance	US$117.95 x 10^6 x 3%	(80%) 2,710	(20%) 678	3,388
8. Overhead	70% of Item 5	-	224	224
Total		4,496	35,814	40,310

Annex IV-4

COMPARATIVE STUDY OF ALTERNATIVE PLANT CAPACITIES AND MANUFACTURING PROCESS

Annex IV-4

COMPARATIVE STUDY OF ALTERNATIVE PLANT CAPACITIES AND MANUFACTURING PROCESSES

1. Introduction

This Annex IV presents the results of a comparative study of urea fertilizer production economics, based on alternative plant capacities and alternative manufacturing processes. The objective of this study is to determine the optimum capacity of the proposed urea fertilizer plant, as well as an appropriate manufacturing process to be adopted for the plant. The study is made in the following two steps.

Step 1: Comparison of the production economics of water-electrolysis-based urea fertilizer plants of different size

Step 2: Comparison the production economics of the water-electrolysis-based urea fertilizer plant, with those of alternative manufacturing processes.

2. Production Economics of Water-Electrolysis-Based Urea Fertilizer Plants

The primary objective of this project is to produce urea fertilizer by efficient utilization of indigenous resources -- water and hydropower. In this context analysis of the production economics of urea fertilizer is first made on water-electrolysis-based urea fertilizer plants of different sizes. In view of the future demand for urea fertilizer in Nepal [Part II -- Market Study], the following five cases have been selected for the comparative studies:

Case 1: 100 TPD
Case 2: 200 TPD
Case 3: 250 TPD
Case 4: 275 TPD
Case 5: 300 TPD

Table IV-4(1) tabulates the project costs estimated for these five cases, and Table IV-4(3) tabulates the production costs of urea fertilizer (bagged) estimated for each case. The estimates use the same assumptions as used for the base estimate [Part IV -- Financial Analysis]. Presented in Table IV-4(3) are the production costs in current prices estimated for the year of 1997, the mean year of the 15-years project economic life span, so the given costs show a representative cost structure. They are the production costs estimated by assuming 90% capacity utilization. Figure IV-4(1) illustrates the correlation of the production costs vs. plant capacity which has been derived from the costs estimated for the 90% capacity utilization (Table IV-4(3)). Figure IV-4(2) illustrates sensitivity of the production costs to changes in capacity utilization. These estimates indicate the characteristics of the production economics as summarized below.

(1) A large size plant can produce urea fertilizer at lower production costs per ton (unit production costs), since capital related costs and other fixed costs per ton of the product are lower for a larger size plant due to scale economy. Hence, the production costs for Case 5 (300 TPD) are lowest among the five alternatives, as far as all cases assume operation at the same capacity utilization rate.

(2) Assuming operation at the same capacity utilization rate, differences in the unit production costs which accrue from differences in plant capacity would be smaller for plants

having larger capacity; assuming operation at 90% capacity utilization rate, the cost differences are US$175.39 per ton between Case 1 (100 TPD) and Case 2 (200 TPD), and US$63.53 per ton between Case 2 (200 TPD) and Case 5 (300 TPD).

(3) The unit production costs will increase if operation in done at lower capacity utilization rates [Figure IV-4(2)]. Even at lower capacity utilization rates, however, there is no change in the relative position of the unit costs due to differences in plant capacity, as far as operation at the same capacity utilization rate is assumed for all cases.

(4) Contrary to the mechanisum of production costs as mentioned in (3) above, the relative position of the unit production costs due to differences in plant capacity would change if the different capacity utilization rates are applied for each case.

Because of the characteristics of the production economics as summarized above, selection of an optimum plant capacity must be made by giving attention to the unit production costs likely to be attained for producing a projected quantity of urea fertilizer.

3. Selection of Optimum Capacity of Water-Electrolysis-Based Urea Fertilizer Plant

Table IV-4(6) tabulates the annual production of urea fertilizer projected for this project, and annual capacity utilization rates for operation which have to be achieved in order to realize the projected production. It is common practice to assume a maximum capacity utilization rate for operation of urea fertilizer plants as 90% of annual production capacity based on 330 on-stream days a year. In addition to that, there is a limited supply of electricity which is another factor limiting the capacity utilization rates [See Part III]. By taking those factors into consideration, the maximum capacity utilization rate for each case is assumed as follows:

	Daily Capacity	Annual Capacity	Max. Capacity Utilization Rate	Maximum Production (tons)
Case 1	100 TPD	33,000 TPA	90%	29,700
Case 2	200 TPD	66,000 TPA	85%	56,100
Case 3	250 TPD	82,500 TPA	83%	68,475
Case 4	275 TPD	90,750 TPA	83%	75,322
Case 5	300 TPD	99,000 TPA	80%	79,200

As in evident from the figures given in Table IV-4(6), Case 1 (100 TPD) and Case 2 (200 TPD) would be too small, while Case 5 (300 TPD) would be too large. Thus Case 3 (250 TPD) or Case 4 (275 TPD) should be an appropriate plant capacity for the project. The unit production costs which are incurred in producing the quantity projected for 1977/78 are as follows [Table IV-4(3) and Figure IV-4(2)]:

	Capacity Utilization Rate	Annual Production (ton)	Daily Costs (US$'000)	Unit Cost per Ton (US$/t)
Case 1	90.00%	29,700	20,960	705.71
Case 2	85.00%	56,100	30,854	549.98
Case 3	80.92%	66,760	35,117	526.02
Case 4	73.56%	66,760	36,165	541.72
Case 5	67.43%	66,760	37,210	557.37

[These figures are indicated with (x) mark in Figure IV-4(2)]

The given figures can use an economic parameter for judging an economic advantage of each case, because they are deemed as those representing the production cost position of each case. These cost figures imply that Case 3 (250 TPD) and Case 4 (275 TPD) are more economical than other cases, due to the following reasons.

(1) The production costs of Case 1 and Case 2, although a least cost level attained by maximum capacity utilization (i.e., 90% for Case 1 and 85% for Case 2), are still higher than those for Case 3, Case 4, and Case 5 due to the former's disadvantage in scale economy compared to others.

(2) The production cost of Case 5 in higher than those for Case 3 and Case 4, because in this case a lower capacity utilization results in cost increases more than offsetting cost advantage compared to Case 3 and Case 4.

Hence, the selection of Case 3 or Case 4 can also be justified from the viewpoint of production economics. Now, further scrutiny is made to select Case 3 or Case 4 specifically. Table IV-4(8) tabulates the unit production costs of Case 3 (250 TPD) and Case 4 (275 TPD) estimated for every year of 1991/92 - 2005/06. These costs have been estimated on the following assumption:

a. Electricity Price: 40% of the present tariff level
b. Equity/Debt Ratio: 30:70
c. Interest on Long-Term Loan : 5% p.a.

The estimates indicate that for the initial ten years (1991/92 - 2000/01) the unit production cost of Case 3 (250 TPD) will be slightly lower than than of Case 4 (275 TPD), although the position will reverse after the 12th year (2002/03).

Nevertheless the cost differences of Case 4 will not exceed 3.4% of the cost of Case 3. If the production of Case 4 increases to 80% capacity utilization due to increased demand, its production cost would become lower than that of Case 3. Hence it can be judged that they are close to each other in regard to production costs. The financial returns of those two cases are estimated as follows:

	IRR for 15 years (After Tax)
Case 3	3.79 %
Case 4	3.36 %

These figures reveal that their financial returns would be close in the order of magnitude. If Case 3 is selected, after 1999/2000 annual demand will exceed the domestic production and shortage in the supply therefore would have to be met by imports. On the other hand, if Case 4 is selected, the domestic production would fully satisfy the demand more than 15 years. From these points of view, it is judged that 275 TPD would be the optimum capacity for the project.

4. Comparison with Alternative Manufacutring Processes

Alternative processes for manufacutring urea fertilizer are based on the use of alternative feedstock -- hydrocarbon such as natural gas, naphtha, fuel oil and coal. Table IV-4(8) gives the manufacturing processes based on a variety of hydrocarbons and the consumption of those feedstock materials for manufacutring urea fertilizer, and Figure IV-4(3) illustrates a schematic flow of these processes. Natural gas is transported only through pipeline, and the use of this material therefore is possible in an area where there exist natural gas reserves available of commerical scale. In Nepal there is so far no possibility to establish a natural-gas-based urea fertilizer plant, since a commercially viable natural gas reserves have not been indentified yet. Feedstock materials usable in the country may be naphtha, fuel oil, or coal, although these materials also must be imported from India. India has no surplus of naphtha for supply to other countries, so it seems unrealistic to assume the use of naphtha for this project. In general the production cost of urea fertilizer based on coal is higher than that based on naphtha or fuel oil, because capital related costs required for a coal based urea fertilizer plant are substantially higher than those for a urea fertilizer plant using naphtha or fuel oil. Hence there is no economic advantage for establishing a coal based urea fertilizer plant unless coal is locally available.

Under these circumstances, the manufacutre of urea fertilizer from fuel oil is the only alternative process which can be compared with the water-electrolysis-based urea fertilizer manufacturing process. A urea fertilizer plant based on fuel oil can be operated at 90% capacity utilization, because its electricity consumption is comparatively small compared to that for a water-electrolysis-based plant so that limited supply of electricity will not limit annual operation. Thus a 250 TPD fuel-oil-based urea fertilizer plant would be comparable to a 275 TPD water-electrolysis-based plant. Table IV-4(9) gives capital cost estimates of a 250 TPD fuel-oil-based urea fertilizer plant, and Table IV-4(10) gives the production cost of urea fertilizer estimated for that plant. Comparison of the production cost for a 275 TPD water-electrolysis-based urea fertilizer plant with a 250 TPD fuel-oil-based urea fertilizer plant is summarized below.

ESTIMATED PRODUCTION COST PER TON

[1997: Current Price]

(Unit: US$/ton)

	275 TPD Water-Electrolysis-Based Plant 1/			250 TPD Fuel-Oil Based Plant 2/	
	(90% C.U.)	(80% C.U.)	(70% C.U.)	(90% C.U.)	(80% C.U.)
1. Variable Cost	196.08	196.08	196.08	433.84	433.84
2. Direct Fixed Cost	79.90	89.89	102.73	75.10	84.48
3. Depreciation/ Amortization	161.82	182.05	208.06	149.60	168.30
4. General Admn. Expenses	3.67	4.13	4.72	4.04	4.55
5. Interest on Long-Term Loan	37.12	41.76	47.73	35.85	40.33
Total	478.59	513.91	559.32	698.43	731.50

Notes: 1/ Assuming the electricity price as 30% of the present tariff rate. [See Table IV-4(3)]

2/ Assuming the fuel oil price as US$240/ton in 1984 and US$578.36/ton in 1997 escalated at 7% p.a. [See Table IV-4(10)]

In the variable costs as given above, the feedstock cost for the water-electrolysis-based plant (i.e., electricity cost) is US$151.30 per ton of urea, while that for the fuel-oil-based plant (i.e., fuel oil) is US$390.39 per ton of urea. The cost of a 250 TPD water-electrolysis-based plant at 70% capacity utilization is comparative to that of a 275 TPD fuel-oil-based plant. When these costs are compared, it is found that the former is lower by US$172.18 per ton of urea as compared to the latter. This reveals that the cost of a fuel-oil-based plant is equivalent to the cost of water-electrolysis-based plant for which the electricity price be US¢4.87/kWh is 1997 or US¢2.28/kWh in 1984 (US¢4.87 1.06^{13}), as calculated in the following manner.

	Cost Per Ton of Urea (US$/t)
1) Electricity Cost of Water-Electrolysis-Based Plant assuming 30% of the present tariff rate:	151.30
2) Cost Difference between Water-Electrolysis-Based Plant and Fuel-Oil-Based Plant:	172.18
Total	323.48
3) Electricity Price Equipment: 1997 (US$323.48/t 6,642kWh/t)	US¢4.87/kWh
Electricity Price Equivalent: 1984 (US¢4.87 1.06^{13})	US¢2.28/kWh

This electricity price is equivalent to about 64% of the present tariff rate.

In view of these cost differences, it is judged that the water-electrolysis-based plant can produce urea fertilizer at lower cost than that of a fuel-oil-based plant, as far as electricity can be supplied at a price lower than 64% of the present tariff rate. Further, the urea fertilizer production based on fuel oil requires a foreign exchange outlay of US$390.39 per ton of urea for importation of fuel oil, in addition to foreign exchange outlay for imports of catalyst, chemicals and spare parts, as well as repayment and interest payment for a foreign loan. Thus it is concluded that a water-electrolysis-based process would be appropriate for the project.

Table IV-4(1) CAPITAL COST ESTIMATES

(Urea Fertilizer Plant Based on water Electrolysis)

(Unit: US$ Million)

	100 TPD	200 TPD	250 TPD	275 TPD	300 TPD
A. LAND ACQUISITION	0.72	0.72	0.72	0.72	0.72
B. SITE PREPARATION	1.80	1.80	1.80	1.80	1.80
C. PLANT DIRECT COST	34.36	57.23	67.92	73.13	78.26
C-1 PROCESS UNITS	(21.27)	(38.60)	(46.77)	(50.76)	(54.70)
C-2 UTILITY FACILITIES	(6.00)	(10.44)	(12.48)	(13.47)	(14.44)
C-3 AUXILIARY FACILITIES	(1.76)	(2.86)	(3.34)	(3.57)	(3.79)
C-4 OFFSITE FACILITIES	(5.33)	(5.33)	(5.33)	(5.33)	(5.33)
D. SPAREPARTS, CATL. & CHEM.	1.19	2.26	2.78	3.04	3.30
E. CONST. & ERECTION LABOR	17.62	17.62	17.62	17.62	17.62
F. CONST. EQUIPMENT	9.59	9.59	9.59	9.59	9.59
G. TRANSPORT, INSURANCE & DUTY	3.13	4.98	5.78	6.16	6.53
H. INDIRECT FIELD EXPENSES	1.13	1.13	1.13	1.13	1.13
I. ENGINEERING SERVICES	11.78	12.45	12.67	12.77	12.86
J. PROJECT MANAGEMENT SERVICES	3.57	3.57	3.57	3.57	3.57
K. PRE-OPERATION EXPENSES	2.32	2.95	3.19	3.30	3.40
L. BASE PROJECT COST	87.21	114.30	126.77	132.83	138.78
M. INITIAL WORKING CAPITAL	1.24	2.10	2.49	2.68	2.86
N. INTEREST DURING CONST.	6.09	7.99	8.86	9.28	9.70
O. TOTAL FINANCING REQUIRED	94.54	124.39	138.12	144.79	151.34

Table IV-4(2) BREAKDOWN OF FIXED ASSETS FOR DEPRECIATION (Buildings and Plant Facilities)

(Unit: US$ Million)

	100 TPD		200 TPD		250 TPD		275 TPD		300 TPD	
	Buildings	Plants Facility	Buildings	Plants Facility	Buildings	Plants Facility	Buildings	Plants Facility	Buildings	Plants Facility
- Process Units	-	21.27	-	38.60	-	46.77	-	50.76	-	54.70
- Utility Facilities	0.47	5.53	0.82	9.62	0.98	11.50	1.06	12.41	1.14	13.30
- Auxiliary Facilities	1.24	0.52	2.02	0.84	2.36	0.98	2.52	1.05	2.68	1.11
- Offsite Facilities	5.33	-	5.33	-	5.33	-	5.33	-	5.33	-
- Spareparts, Catalysis & Chemicals	-	1.19	-	2.26	-	2.78	-	3.04	-	3.30
- Construction Equipment	-	9.59	-	9.59	-	9.59	-	9.59	-	9.59
- Construction Labor; Transport, Insurance, Duty; Engineering Service & Management Service	3.32	32.78	3.55	35.07	3.65	35.99	3.69	36.44	3.73	36.85
Total	10.36	70.88	11.72	95.98	12.32	107.61	12.60	113.29	12.88	118.85
	81.24		107.70		119.93		125.89		131.73	

Table IV-4(3) ESTIMATED PRODUCTION COST OF UREA (BAGGED)
(1997: Current Price)

Process: Water Electrolysis
Capacity Utilization: 90%
Interest on Loaned: 5% p.a.

Plant Capacity	100 TPD		200 TPD		250 TPD		275 TPD		300 TPD	
Annual Production (90% Capacity Utilization)	29,700 TPA		59,400 TPA		74,250 TPA		81,675 TPA		89,100 TPA	
	Ann. Cost (US$'000)	Cost Per Ton (US$/ton)	Ann. Cost (US$'000)	Cost Per Ton (US$/ton)	Ann. Cost (US$'000)	Cost Per Ton (US$/ton)	Ann. Cost (US$'000)	Cost Per Ton (US$/ton)	Ann. Cost (US$'000)	Cost Per Ton (US$/ton)
1. Variable Cost										
1.1 Electric Power1/	4,494	151.30	8,987	151.30	11,234	151.30	12,357	151.30	13,481	151.30
1.2 Coal2/	659	22.18	1,317	22.18	1,647	22.18	1,812	22.18	1,976	22.18
1.3 Catalysis and Chemicals3/	172	5.80	345	5.80	431	5.80	474	5.80	517	5.80
1.4 Bags4/	499	16.80	998	16.80	1,247	16.80	1,372	16.80	1,497	16.80
Sub-total	5,824	196.08	11,647	196.08	14,559	196.08	16,015	196.08	17,471	196.08
2. Direct Fixed Cost										
2.1 Personnel Cost5/	429	14.44	429	7.22	429	5.78	429	5.25	429	4.81
2.2 Maintenance Cost6/	3,587	120.78	4,739	79.78	5,270	70.97	5,528	67.68	5,781	64.88
2.3 Insurance7/	388	13.06	496	8.35	545	7.34	569	6.97	593	6.66
Sub-total	4,404	148.28	5,664	95.35	6,244	84.09	6,526	79.90	6,803	76.35
3. Depreciation and Amort.8/										
3.1 Plants and Facilities9/	7,088	238.65	9,598	161.58	10,761	144.93	11,329	138.71	11,885	133.39
3.2 Buildings10/	518	17.44	586	9.87	616	8.30	630	7.71	644	7.23
3.3 Preoperation Expenses11/	232	7.81	295	4.97	319	4.29	330	4.04	340	3.81
3.4 Interest during Const.12/	609	20.51	799	13.45	886	11.93	928	11.36	970	10.89
Sub-total	8,447	284.41	11,278	189.87	12,582	169.45	13,217	161.82	13,839	155.32
4. General Admn. Expenses13/	300	10.10	300	5.05	300	4.04	300	3.67	300	3.37
5. Interest on Long Term Loan14/	1,985	66.84	2,612	43.97	2,901	39.07	3,032	37.12	3,178	35.67
Total Cost	20,960	705.71	31,501	530.32	36,586	492.73	39,090	478.59	41,591	466.79

[EXPLANATORY NOTES TO TABLE IV-4(3)]

1/ 1984: US¢3.56/kWh x 0.3 = US¢1.068/kWh
1997: US¢2.278/kWh (US¢1.068/kWh x 1.06^{13})
US¢2.278/kWh x 6,642 kWh/t = US$151.30/t - urea

2/ 1984: US$40.63/ton - coal
1997: US$86.66/ton - coal (US$40.63 x 1.06^{13})
US$86.66/ton x 0.256 ton/t = US$22.18/t - urea

3/ 1984: US$2.72/t - urea
1977: US$5.80/t - urea (US$2.72 x 1.06^{13})

4/ 1984: US¢37.5/bag
US¢80.0/bag (US¢37.5 x 1.06^{13})
US¢80.0/bag x 21 bags/t = US$16.8/t - urea

5/ 1984: US$227,333/year
1997: US$428,670/year (227,333 x 1.05^{13})

6/ 1991: 3% of Plant Cost (Base Project Cost less: Land Acquisition Cost, Site Preparation Cost, and Part of Indirect Field Expenses - US$0.41 million)
1997: Maintenance Cost (1984) x 1.06^{6}

Plant Capacity	Plant Cost (US$'000)
100 TPD	84,280
200 TPD	111,370
250 TPD	123,840
275 TPD	129,900
300 TPD	135,850

7/ 1.175% of outstanding depreciable asset value [Table IV-4(4)]

8/ Excluding amortization of indirect field expenses because of those expenses amortized out within the initial five years

9/ 10% of the Plant Facilities Value [Table IV-4(2)]

10/ 5% of the Buildings Value [Table IV-4(2)]

11/ 10% of the Pre-operation Expenses [Table IV-4(1)]

12/ 10% of the Interest During Construction [Table IV-4(1)]

13/ 70% of the Personnel Cost

14/ (Total Financing Required) x 0.7 x 9/15 x 0.05

Table IV-4(4) VALUE OF ASSETS FOR INSURANCE (1997)

(Unit: US$'000)

	100 TPD	200 TPD	250 TPD	275 TPD	300 TPD
1. Total Assets					
1.1 Non-depreciable Assets					
1.1.1 Land	720	720	720	720	720
1.1.2 Site Preparation	1,800	1,800	1,800	1,800	1,800
Sub-total	2,520	2,520	2,520	2,520	2,520
1.2 Depreciable Assets					
1.2.1 Plant Facilities	70,880	95,980	107,610	113,290	118,850
1.2.2 Buildings	10,360	11,720	12,320	12,600	12,880
1.2.3 Indirect Field Expenses	713	713	713	713	713
1.2.4 Pre-operation Expenses	2,320	2,950	3,190	3,300	3,400
1.2.5 Interest During Construction	6,090	7,990	8,860	9,280	9,700
Sub-total	90,363	119,353	132,693	139,183	145,543
1.3 Total (1.1 + 1.2)	92,883	121,873	135,213	141,703	148,063
2. Accumulated Depreciation (up to 1996)					
2.1 Plant Facilities (Value x 7/10)	49,616	67,186	75,327	79,303	83,195
2.2 Buildings (Value x 7/20)	3,626	4,102	4,312	4,410	4,508
2.3 Indirect Field Expenses (Value x 5/5)	713	713	713	713	713
2.4 Pre-operation Expenses (Value x 7/10)	1,624	2,065	2,233	2,310	2,380
2.5 Interest During Construction (Value x 7/10)	4,263	5,593	6,202	6,496	6,790
2.6 Total	59,842	79,659	88,787	93,232	97,586
3. Total Assets less Acc. Depreciation	33,041	42,214	46,426	48,471	50,477

Table IV-4(5) ESTIMATED PRODUCTION COST OF UREA (BAGGED) BY CHANGES IN CAPACITY UTILIZATION (1997: Current Price)

(Unit: US$ Per Ton)

Capacity Utilization Rate	100 TPD	200 TPD	250 TPD	275 TPD	300 TPD
100%	654.75	496.90	463.07	450.35	439.72
90%	705.71	530.32	492.73	478.59	466.79
80%	769.41	572.10	529.82	513.92	500.63
70%	851.32	625.82	577.50	559.32	544.13
60%	960.52	697.44	641.07	619.86	602.14
50%	1,113.41	797.72	730.07	704.62	683.35

Table IV-4(6) CAPACITY UTILIZATION RATE BY DIFFERENT PLANT CAPACITY

Year	Projected Production (tons)	Capacity Utilization Rate (%)				
		100 TPD	200 TPD	250 TPD	275 TPD	300 TPD
1991/92	54,500	*	82.58	66.06	60.06	55.05
1992/93	55,340	*	83.85	67.08	60.98	55.90
1993/94	59,320	*	**	71.90	65.37	59.92
1994/95	62,480	*	**	75.73	68.85	63.11
1995/96	64,610	*	**	78.32	71.20	65.26
1996/97	65,660	*	**	79.59	72.35	66.32
1997/98	66,760	*	**	80.92	73.56	67.43
1998/99	67,860	*	**	82.25	74.78	68.55
1999/2000	68,860	*	**	***	75.88	69.56
2000/01	69,750	*	**	***	76.86	70.45
2001/02	70,540	*	**	***	77.73	71.25
2002/03	71,130	*	**	***	78.38	71.85
2003/04	71,730	*	**	***	79.04	72.45
2004/05	72,230	*	**	***	79.59	72.96
2005/06	72,620	*	**	***	80.02	73.35

Notes: Capacity Utilization Rate; Projected Production over Annual Capacity (Daily Capacity x 330 on-stream days)

* Over the maximum capacity utilization rate of 90%; maximum production being 56,700 TPA

** Over the maximum capacity utilization rate of 85%; maximum production being 56,100 TPA

*** Over the maximumm capacity uilization rate of 83%; maximum production being 68,475 TPA

TABLE IV-4(7) ESTIMATED PRODUCTION COST OF UREA FERTILIZER (BAGGED) [CURRENT PRICE]

Unit Cost per Ton (US$/t)

Year	(A) 250 TPD	(B) 275 TPD	(C) B-A	C/A
1991/92	602.3	620.7	+18.4	+3.1
1992/93	605.3	624.8	+19.5	+3.2
1993/94	581.7	601.2	+19.5	+3.4
1994/95	570.8	586.4	+15.6	+2.7
1995/96	568.5	583.4	+14.9	+2.6
1996/97	570.3	586.1	+15.8	+2.8
1997/98	576.6	592.0	+15.4	+2.7
1998/99	584.3	599.4	+15.1	+2.6
1999/2000	595.7	608.7	+13.0	+2.2
2000/01	611.2	619.9	+8.7	+1.4
2001/02	455.4	456.7	+1.3	+0.3
2002/03	475.8	475.9	+0.1	0
2003/04	497.6	496.5	-1.1	-0.2
2004/05	521.1	518.8	-2.3	-0.4
2005/06	546.2	543.1	-3.1	-0.6

TABLE IV-4(8) COMPARISON OF PROCESS AND FEEDSTOCK CONSUMPTION FOR UREA FERTILIZER PRODUCTION

Feedstock	Process Scheme	Feedstock Consumption Per Ton of Urea Fertilizer
(1) Electricity	Water Electrolysis Air Fractionation Carbon Dioxide Recovery Ammonia Synthesis Urea Synthesis	6,642.0 kWh
(2) Natural Gas	Steam Reforming Synthesis Gas Preparation Ammonia Synthesis Urea Synthesis	23.5 MMBTU-LHV
(3) Naphtha	Steam Reforming Synthesis Gas Preparation Ammonia Synthesis Urea Synthesis	0.55 Ton (10,600 kcal-LHV/kg)
(4) Fuel Oil	Air Fractionation Partial Oxydation Synthesis Gas Preparation Ammonia Synthesis Urea Synthesis	0.67 Ton (10,300 kcal-LHV/kg)
(5) Coal	Air Fractionation Partial Oxydation (Gasification) Synthesis Gas Preparation Ammonia Synthesis Urea Syntesis	1.25 Ton (6,300 kcal-LHV/kg)

Notes: Synthesis gas preparation refers generally to secondary reforming, shift reaction, carbon dioxide removal, methanation and other synthesis gas purification process.

Table IV-4(9) CAPITAL COST ESTIMATE

(Urea Fertilizer Plant Based on Partial Oxydation of Fuel Oil)

Capacity: 250 TPD

(Unit: US$ Million)

ITEMS	ESTIMATED COST
A. LAND ACQUISITION	0.72
B. SITE PREPARATION	1.80
C. PLANT DIRECT COST	54.37
C-1 PROCESS UNITS	(33.22)
-AMMONIA PLANT	[25.31]
-UREA PLANT	[7.91]
C-2 UTILITY FACILITIES	(12.48)
C-3 AUXILIARY FACILITIES	(3.34)
C-4 OFFSITE FACILITIES	(5.33)
D. SPAREPARTS, CATL. & CHEM.	2.17
E. CONST. & ERECTION LABOR	17.62
F. CONST. EQUIPMENT	9.59
G. TRANSPORT, INSURANCE & DUTY	5.29
H. INDIRECT FIELD EXPENSES	1.13
I. ENGINEERING SERVICES	12.67
J. PROJECT MANAGEMENT SERVICES	3.57
K. PRE-OPERATION EXPENSES	4.04
L. BASE PROJECT COST	112.97
M. INITIAL WORKING CAPITAL	5.89
N. INTEREST DURING CONST.*	7.90
O. TOTAL FIANACING REQUIRED	126.76

Note: * Assuming equity/debt ratio of 30:70 and 5% p.a. loan interest

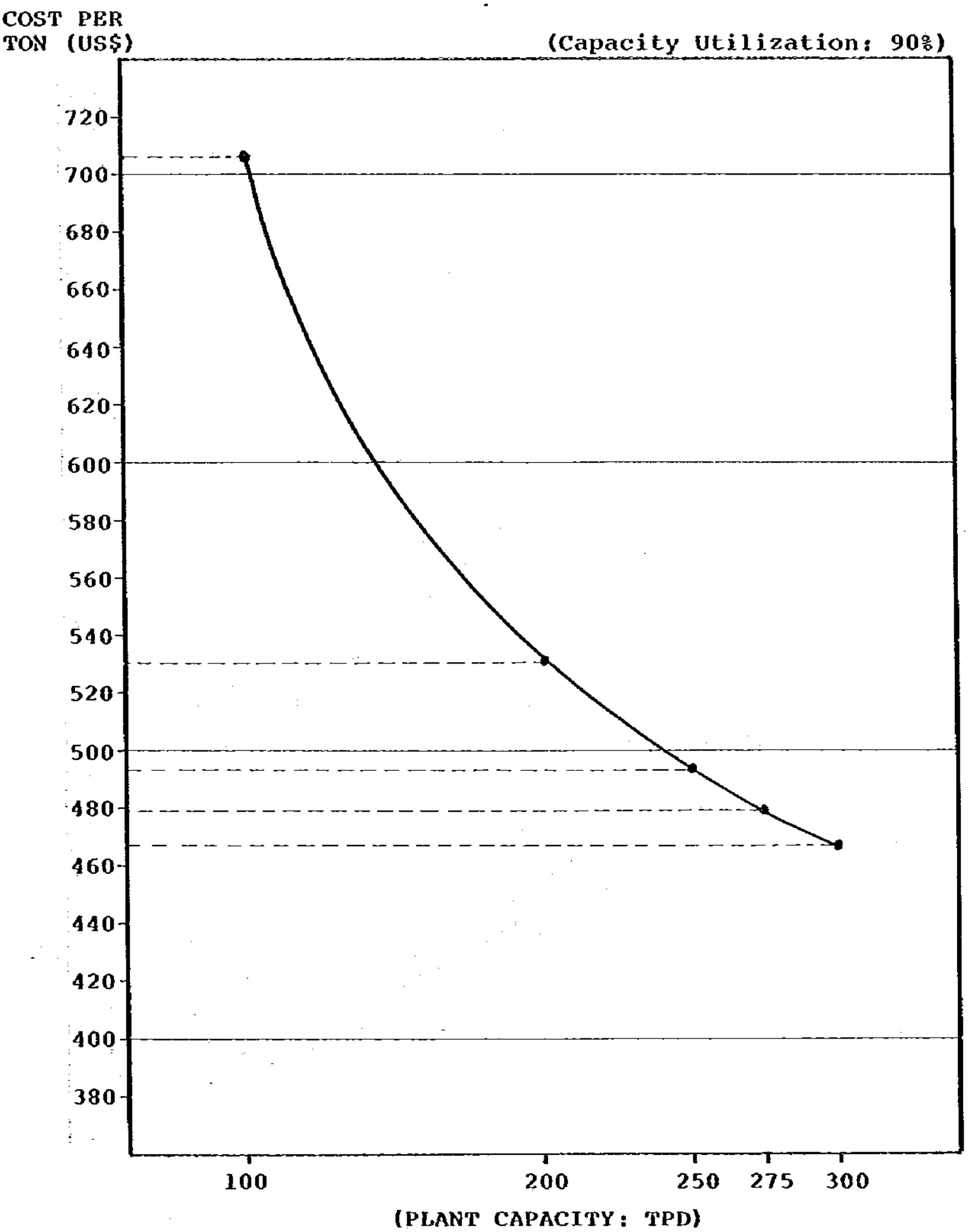
Table IV-4(10) · ESTIMATED PRODUCTION COST OF UREA (BAGGED)
(1997: Current Price)

Process: Partial Oxydation of Fuel Oil
Capacity: 250 TPD

Items	Particulars	Annual Costs (US$'000)	Cost Per Ton (US$/ton)
1. Variable Cost			
1.1 Fuel Oil	@US$240/ton2/ x 1.07^{13} x 0.675ton/t	28,986	390.39
1.2 Electric Power	@US¢3.56/kWh2/ x 1.06^{13} x 0.3 x 1,055kWh/t	1,786	24.05
1.3 Catalysis & Chemicals	@US$1.22/t2/ - urea x 1.06^{13}	193	2.60
1.4 Bags	@US¢37.5/bag2/ x 1.06^{13} x 21bags/t	1,247	16.80
Sub-total		32,212	433.84
2. Direct Fixed Cost			
2.1 Personnel Cost	US$227,333/year x 1.05^{13}	429	5.78
2.2 Maintenance Cost	US$110.04 million x 0.03 x 1.06^{6}	4,683	63.07
2.3 Insurance	(US$118,350 - US$78,886) x 10^{3} x 0.01175	464	6.25
Sub-total		5,576	75.10
3. Depreciation and Amortization			
3.1 Plant and Facilities	US$93.00 million x 1/10	9,300	125.25
3.2 Buildings	US$12.28 million x 1/20	614	8.27
3.3 Preoperation Expenses	US$4.04 million x 1/10	404	5.44
3.4 Interest during Const.	US$7.90 million x 1/10	790	10.64
Sub-total		11,108	149.60
4. General Admn. Expenses	US$429,000 x 0.7	300	4.04
5. Interest on Long Term Loan	US$126,760 x 10^{3} x 0.7 x 9/15 x 0.05	2,662	35.85
Total Cost		51,858	698.43

Notes: 1/ Assuming 90% capacity utilization (i.e., 250 TPD x 300 days x 0.9 = 74,250 TPA)
2/ 1984 prices

Figure IV-4(1) ESTIMATED PRODUCTION COST OF UREA (BAGGED)
(1997: Current Price)



Process: Water Electrolysis
Loan Interest: 5% p.a.

Figure IV-4(2) ESTIMATED PRODUCTION COST OF UREA (BAGGED) BY CHANGES IN CAPACITY UTILIZATION

(1977: Current Price)

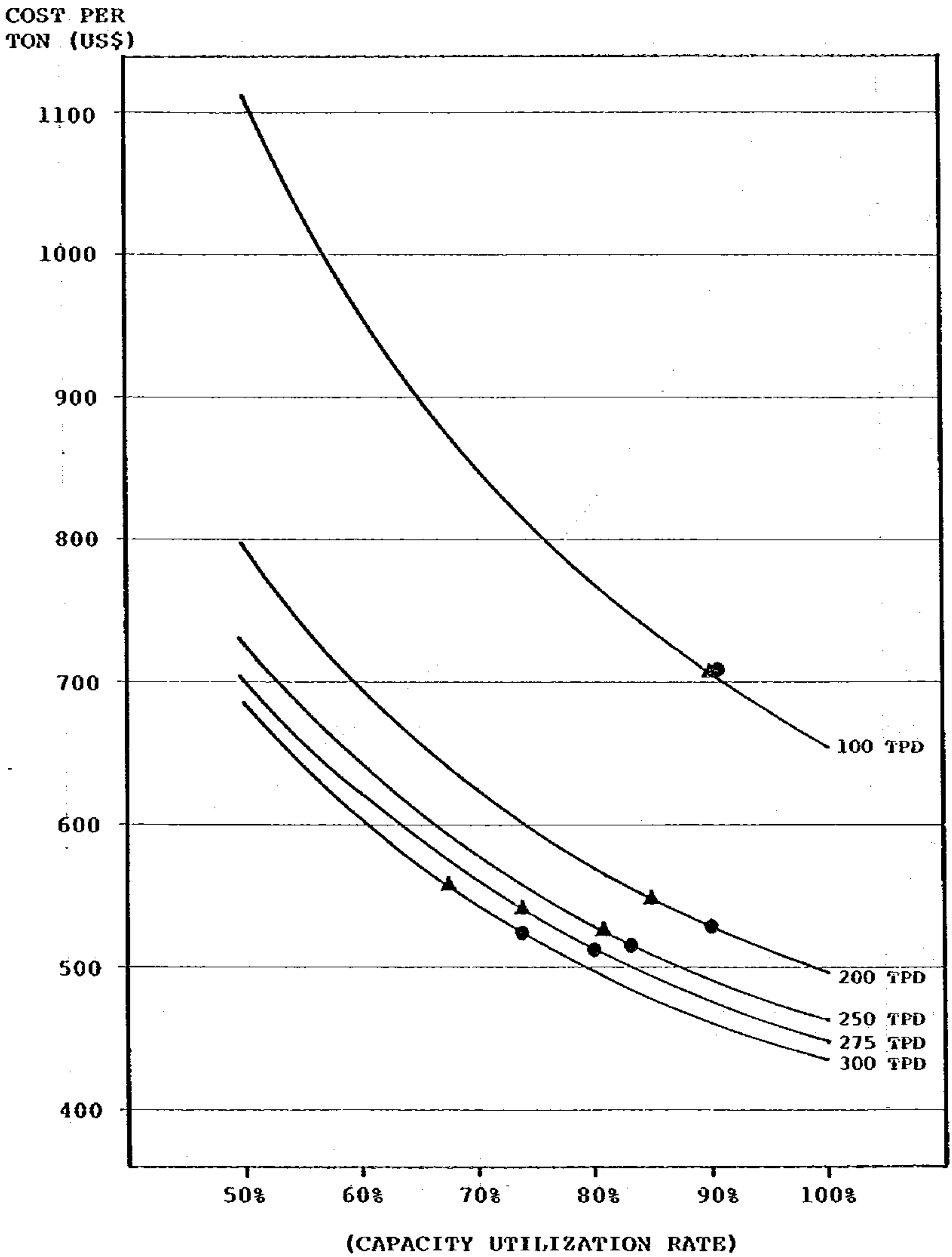
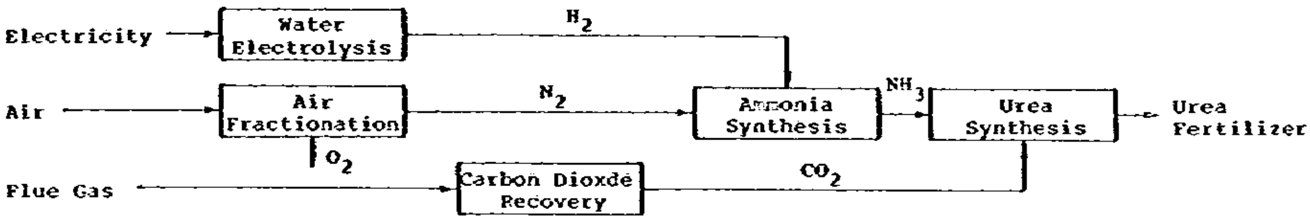


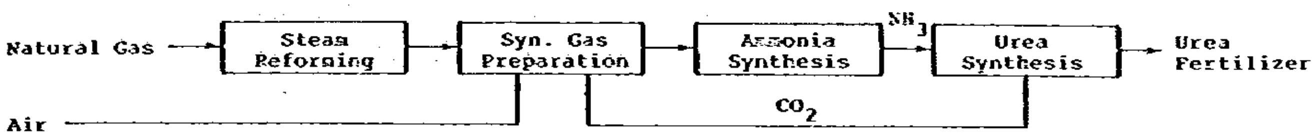
Figure IV-4(3) PROCESS SCHEME AND FEEDSTOCK FOR UREA FERTILIZER PRODUCTION

Feedstock | Process Scheme | Product

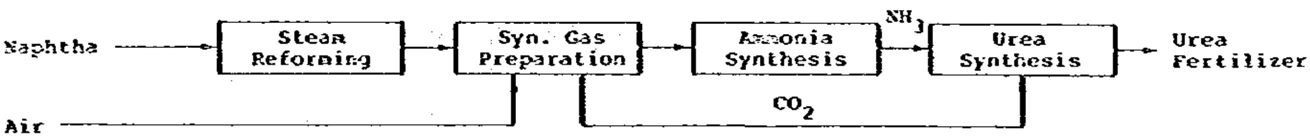
(1) Electricity



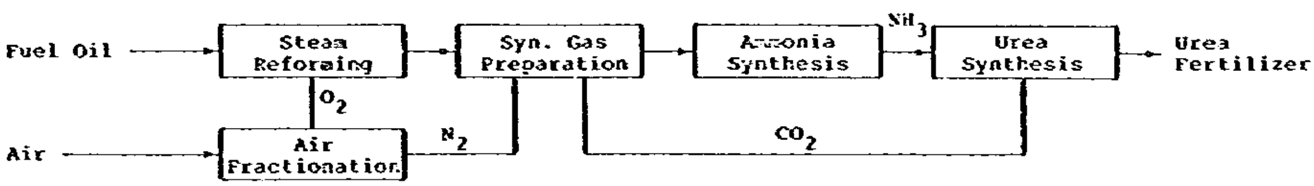
(2) Natural Gas



(3) Naphtha



(4) Fuel Oil



(5) Coal