68. FERTILIZER FROM BONE MEAL

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I. SUMMARY

This profile envisages the establishment of a plant for the production of Fertilizer from bone meal with a capacity of 1500 tonnes per annum.

The present demand for the proposed product is estimated at 2.1 million quintals per annum. The demand is expected to reach at 3.15 million quintal by the year 2010.

The plant will create employment opportunities for 48 persons.

The total investment requirement is estimated at Birr 7.1 million, out of which Birr 6.44 million is required for plant and machinery.

The project is financially viable with an internal rate of return (IRR) of 13%% and a net present value (NPV) of Birr, 1.6 million discounted at 8.5 %.

II. PRODUCT DESCRIPTION AND APPLICATION

Fertilizer is one of the very important agricultural inputs used to increase production. The three major elements obtained from fertilizer and are needed for plant growth are, Nitrogen, required to promote development of stems and leaves; phosphorous, which stimulates growth and accelerates fruit and seed formation, potash, which is essential to the development of starches, sugars, and fibers and helps to prevent disease and lessens the effects of excessive nitrogen application.

Fertilizer produced from bone meal, normal super phosphate (NSP), is a source of phosphorous to the plant, and is thus believed to replace the imported fertilizer.

III. MARKET STUDY AND PLANT CAPACITY

A. MARKET STUDY

1. Past Supply and Present Demand

Fertilizer is one of the very important agricultural inputs used to increase production. In year 2001/2002, 3.95 million hectares (37.85%) of the total cultivated crop area had been fertilizer applied on it at national level.

Table 3.1
QUANTITY OF CHEMICAL FERTILIZERS APPLIED, BY REGION MEHER SEASON,2000/2001(1993 E.C)

Region	Total Crop Area ('000 Ha)	%	Fertilizer Applied Area ('000 Ha)	%
Tigray	637.5	6.1	244.9	6.2
Afar	29.5	0.3	3.2	0.1
Amhara	3,568.8	34.2	1,027.8	26.0
Oromia	4,387.1	42.0	1,930.8	67.9
Somali	64.3	0.6	3.6	0.1
Benshangul-Gumuz	179.8	1.7	23.0	0.6
SNNPR	1,513.0	14.5	693.4	17.6
Gambela	23.4	0.2	3.2	0.1
Harari	10.6	0.1	6.5	0.2
Addis Ababa	12.1	0.1	10.3	0.3
Dire Dawa	9.3	0.1	2.7	0.1
Grand Total	**10,435.4**	**100.0**	**3,949.2**	**100.0**

The regional distribution of fertilizer application, however, varies from region to region, the main factors contributing for this variation being the difference in the cultivated total land area prevailing among the regions. Accordingly, Oromia, Amhara, and SNNP regions had the highest fertilizer applied farm area, which account for 67.9%, 26% and 17.6%, respectively. These regions, therefore, account for more than 94% of the total fertilizer usage.

In terms of fertilizer usage, an average of 2.1 million quintals of fertilizer, which worth Birr 364 million had been imported to the country annually during the last five years (1999-2003). This volume could, therefore, be taken to represent the current annual demand for the product at national level.

2. Projected Demand

Ethiopia is an agrarian country with more than 85% of the population employed in agriculture. The productivity rate of the sector is one of the lowest in the world by all measures. Its unutilized potential is immense. On this basis, the future of the country is believed to depend on the development of Ethiopia's agricultural sector.

One of the major means of improving the output of agriculture is improving the productivity rate of the land. The use of fertilizer will play an important role in this effort. As shown above, the current utilization rate of fertilizers in Ethiopia is extremely low, despite its rapid rate of growth, estimated at 20% per annum. In view of its pivotal role in improving the productivity of the sector and its current low level of utilization, the use of fertilizer will continue to grow rapidly. Considering these factors, an annual growth rate of 7 per cent, equivalent to the growth rate of the

economy registered in recent years, is considered to project the future demand. The result of the projection is shown in Table 3.2.

Table 3.2
PROJECTED DEMAND FOR FERTILIZER

Year	Demand (Million Quintals)
2005	2.25
2006	2.40
2007	2.57
2008	2.75
2009	2.95
2010	3.15
2011	3.37
2012	3.61
2013	3.86
2014	4.13
2015	4.42
2016	4.73
2017	5.06

At present, Ethiopia imports two kinds of fertilizers – Urea and DAP (nitrogen and phosphate). Fertilizer produced from bone meal (MNS) is a direct substitute for these fertilizers. The production of bone meal fertilizer domestically is, thus, believed to replace a substantial size of the growing demand for fertilizer. Hence in this project profile, a market share of 10 per cent of the total projected demand is envisaged.

3. Pricing and Distribution

The marketing of fertilizer is liberalized since 1992 and this permitted the private sector to engage in the importation and distribution of fertilizer. The envisaged project can consider the private firms or the state owned Agricultural Input Supply Enterprise (AISE) for the distribution of its products.

The price of fertilizer fluctuates from time to time depending on world market trend and its country of origin. The CIF price of urea imported from Saudi Arabia in June 2004 was Birr 2,000 per tonnes. Since other costs like land transport cost, duty tax, bank charges and profit margin for distributors will be added on the CIF price, the price to the farmer is much more higher. Hence, for revenue calculation purposes of this project profile a factory-gate price of Birr 3,000 per tonne is recommended.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

Based on the market study, availability of fresh bone in the region and minimum economies of scale, the envisaged plant is proposed to have a capacity of 1500 tonnes of normal supper phosphate annually. The plant will also produce 83.5 tonnes of fat and 83.5 tonnes of bone glue as a by-product.

2. Production Programme

The plant will start its operation at 75% and progressively grow to 85% and 95% of its rated capacity in the first, second and third year, respectively due to the problem in collection of raw material, skill development and market penetration. The plant will reach at full capacity in the fourth year and thenafter. The plant will operate 300 working days a year and a single shift of 8 hours each in a day.

IV. MATERIALS, INPUTS AND UTILITIES

A. MATERIALS & INPUTS

The direct raw materials that goes into the product (NSP) are fresh and deserted bones and sulfuric acid. The indirect raw materials used for the smooth and economical operation of the envisaged plant are gasoline for extraction of fat, carbon steel drums for packing fat, polypropylene sacks for packing NSP fertilizer and polyethylene bags and cartons for packing bone glue.

Fresh and deserted bones can be collected from the existing abattoirs and butcheries in the main towns of the region. Sulphuric acid can be obtained from Awash Melkasa Aluminum Sulphate and Sulphuric Acid Share Company. Packing materials can be obtained locally.

The detailed annual raw materials requirement and their cost at full capacity operation is depicted in Table 4.1 below. The estimated annual cost of raw materials is Birr 2,165,610.

Table 4.1
ANNUAL RAW MATERIALS AND INPUTS REQUIREMENT AND COST AT FULL PRODUCTION CAPACITY

Sr. No.	Description	Unit of Measure	Qty	Cost '000 Birr
1	Bones, fresh	Tonnes	835	417.5
2	Sulfuric acid, 520BC	Tonnes	650	1,625
3	Gasoline	Liters	3353	15.76
4	Steel drums*, 200 lt	Pcs	45	9
5	PP sacks 50 kg	Pcs	30,000	90
6	PE bags, 10g	Pcs	1,670	1.67
7	Cartons	Pcs	1,670	6.68
	Total			**2,165.61**

** Drums for packing the fat are recyclable, the annual cost stated in the table is 10% of the total demand i.e., 450 to compensate any damage and loss during handling and transpiration*

B. UTILITIES

Utilities required for the production of NSP and the associated by-products are electricity, fuel oil and water for cooling, drinking and washing. 55,500 kWh of electricity, 5000 m^3 of water and 110,000 lt of furnace oil is required by the envisaged plant at full capacity. The total cost of utilities is estimated at Birr 366,307.

V. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Production Process

The production of NSP starts with bone crushing by an appropriate grinder; then follows extracation of fat with the help of a solvent (the common solvent is gasoline).

The next operation after the fat is extracted is Ossein extraction by boiling the bone in steam having a pressure of 1.5 to 2 bars.

The final operation is transformation of the tri-calcium phosphate of the bone into normal super phosphate with the help of sulfuric acid, according to the following chemical equation.

$$Ca_3(Po_4) + 2H_2SO_4 + 5H_2O \longrightarrow Ca\,(H_2PO_4)_2.\,H_2O + 2CaSO_4.\,2H_2O$$

The NSP, so obtained is packed in 50 kg pp sacks. The other by-product are also packed in appropriate containers. Glue slabs are first wrapped in moisture proof polyethylene bag and then packed in carton boxes. The fat is packed in carbon steel drums.

2. Source of Technology

The technology of fertilizer manufacturing can be obtained from European and Asian countires such as Germany, China, India, and South Korea. Possible suppliers of machinery and equipment are:

a) Chambal Fertilizers and chemicals ltd.
Devika Tower, 2nd Floor
6, Nehru place
New Delhi- 110019- 91-11-6462162
Fax 91-11-6465218;

b) Machinen Fabrik Gustar Eirich Gmbh & Co. Kg
Post fach 1160, D-74732 Hard heim
Internet: http; 11 WWW.eirich. de
E-mail eirich@ eirich-de.

B. ENGINEERING

1. Machinery and Equipment

The list of machinery and equipment required for the production of NSP and other by-products is given in Table 5.1. The total cost of machinery and equipment is estimated at Birr 5.9 million, out of which Birr 4.72 million is required in foreign currency.

Table 5.1
LIST OF MACHINERY AND EQUIPMENT

Sr. No.	Description	Qty. (No.)
1	Bone washer, drum type	1
2	Bone crusher	1
3	Storage silo	1
4	Fat separator	2
5	Fat storage	1
6	Autoclaves	2
7	Filter	1
8	Evaporator	1
9	Plastic tray cooler	1
10	Auto-claves, steam jacketed	2
11	Ball mill	1
12	Hopper	1
13	Tanker	2
14	Mixer	1
15	Scraper	1
16	Boiler	1
17	Conveyor	1
18	Mobile grab bucket	1
19	Packing and filling machine	1

2. Land, Building and Civil works

The envisaged plant requires an estimated total area of about 2000 m^2, out of this 750 m^2 will be a built up area. The cost of building, assuming construction cost of Birr 1200 per m^2, is estimated at Birr 900,000. Total value of land, assuming land lease value of Birr 1.5 per m^2 for 70 years of land holding period, is estimated at Birr 210,000. The total cost of land, building and civil works assuming that the total land lease cost will be paid in advance is estimated at Birr 1.11 million.

3. Proposed Location

The plant can be located in an area where there is raw materials availability (fresh bone) and center for market to produce the product at a reasonable and competitive

price. So, the proposed location for bone meal fertilizer plant will be at Assosa zone considering its cattle, sheep and goat potential as well as availability of infrastructure.

VI. MANPOWER AND TRAINING REQUIREMENT

A. MANPOWER REQUIREMENT

A total of 48 employees is required for the envisaged plant. The total annual cost of manpower including fringe benefits is estimated at Birr 423,750. The detailed manpower requirement at full operation capacity of the plant is shown in Table 6.1.

Table 6.1
MANPOWER REQUIREMENT AND ANNUAL LABOUR COST (BIRR)

Sr. No.	Description	Req. No.	Monthly Salary	Annual Salary
1	General manger	1	2,000	24,000
2	Production & technic man.	1	1,500	18,000
3	Personnel	1	900	10,800
4	Purchaser	2	1,800	21,600
5	Accountants	2	1,800	21,600
6	Sales persons	1	900	10,800
7	Secretary	4	2,400	28,800
8	Production supervisor	1	900	10,800
9	Production operators	6	3,600	43,200
10	Un skilled workers	10	3,000	36,000
11	Mechanics	2	1,200	14,400
12	Electrician	2	1,200	14,400
13	Chemist	2	2,400	28,800
14	Junior chemist	2	1,200	14,400
15	Store keeper	2	900	10,800
16	Cashier	1	450	5,400
17	Driver	2	600	7,200
18	Guard	6	1,500	18,000
	Sub-total	**48**		**339,000**
	Employees benefit			84,750
	Grand Total			**423,750**

B. TRAINING REQUIREMENT

Training will be provided by the machinery supplier to production operators, supervisor, chemist, mechanic, and electrician on production process, quality, operation and maintenance of machinery and equipment for two weeks during erection and commissioning period. The training cost is estimated at Birr 30,000.

VII. FINANCIAL ANALYSIS

The financial analysis of the Fertilizer from bone meal project is based on the data presented in the previous chapters and the following assumptions:-

Construction period	1 years
Source of finance	30 % equity
	70 % loan
Tax holidays	3 years
Bank interest	7.5 %
Discounted cashflow	8.5 %
Repair and maintenance	3 % of the total plant and machinery
Accounts receivable	30 days
Raw material, local	30 days
Raw materials, import	90 days
Work in progress	5 days
Finished products	30 days
Cash in hand	5 days
Accounts payable	30 days

A. TOTAL INITIAL INVESTMENT COST

The total initial investment cost of the project including working capital is estimated at 7.1 million, of which 66.9 per cent will be required in foreign currency.

The major breakdown of the total initial investment cost is shown in Table 7.1

Table 7.1
INITIAL INVESTMENT COST

Sr. No.	Cost Items	Total ('000 BIRR)
1	Land lease value	210
2.	Building and Civil Work	900
3.	Plant Machinery and Equipment	4720
4.	Office Furniture and Equipment	60
5.	Vehicle	550
6.	Pre-production Expenditure*	409
7	Working Capital	203.6
	Total Investment cost	**7052.7**
	Foreign share	**66.9**

** N.B Pre-production expenditure includes interest during construction (Birr 374 thousand), training (Birr 30 thousand), and (Birr 5thousand) costs of registration, licensing and formation of the company including legal fees, commissioning expenses, etc.*

B. PRODUCTION COST

The annual production cost at full operation capacity of the plant is estimated at Birr 4.1 million (see Table 7.2). The material and utility cost accounts for 53.3 per cent while repair and maintenance take 2.4 per cent of the production cost.

Table 7.2
ANNUAL PRODUCTION COST AT FULL CAPACITY ('000 BIRR)

Items	Cost	%
Raw Material and Inputs	2165	53.3
Utilities	366	9
Maintenance and repair	97	2.4
Labour direct	339	8.3
Factory overheads	85	2.1
Administration Cost	30	0.7
Total Operating Costs	**3082**	**76**
Depreciation	650	16
Cost of Finance	328	8.1
Total Production Cost	**4061**	**100**

C. FINANCIAL EVALUATION

1. Profitability

According to the projected income statement, the project will start generating profit in the second year of operation. Important ratios such as profit to total sales, net profit to equity (Return on equity) and net profit plus interest on total investment (return on total investment) show an increasing trend during the lifetime of the project.

The income statement and the other indicators of profitability show that the project is viable.

2. Break-even Analysis

The break-even point of the project including cost of finance when it starts to operates at full capacity (year 4) is estimated by using income statement projection.

$$BE = \frac{\text{Fixed Cost}}{\text{Sales} - \text{Variable cost}} = 70\%$$

3. Pay-Back Period

The investment cost and income statement projection are used to project the pay-back period. The project's initial investment will be fully recovered within 6 years.

4. Internal Rate of Return and Net Present Value

Based on the cash flow statement, the calculated IRR of the project is 13 % and the net present value at 8.5% discount rate is Birr 1.6 million.

D. ECONOMIC BENEFITS

The project can create employment for 48 persons. In addition to supply of the domestic needs, the project will generate Birr 0.2 million per annum in terms of tax revenue when it starts to operate at full capacity. Moreover, the Regional Government can collect employment, income tax and sales tax revenue. The establishment of such factory will have a foreign exchange saving effect to the country by substituting the current imports.