203. PROFILE ON ALCOHOL EXTRACTION FROM YAM TARO, YAM AND CASSAVA

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I. SUMMARY

This profile envisages the establishment of a plant for the extraction from yam taro, yam and cassava with a capacity of 10,000 HL per annum.

The present demand for the proposed product is estimated at 19,472 HL per annum. The demand is expected to reach at 57,486 HL by the year 2015.

The plant will create employment opportunities for 57 persons.

The total investment requirement is estimated at Birr 14.45 million, out of which Birr 11.16 million is required for plant and machinery.

The project is financially viable with an internal rate of return (IRR) of 26% and a net present value (NPV) of Birr 9.63 million discounted at 8.5%.

II. PRODUCT DESCRIPTION AND APPLICATION

Taro, Yam and Cassava are all root crops, which have considerable amount of extractable Starch. Yam (commonly known as sweet potato) is the most common root crop in Ethiopia. The starch in the roots and tubers of yam is large in particle and easily settles, and moreover the fat and protein existing with starch is small in quantity, and thus good starch can be extracted comparatively easily. The starch then can be hydrolyzed, fermented and then distilled to produce Ethanol.

Alcohol (Ethanol) is second only to water in solvent value and is employed in nearly all industries. In addition, it is the raw material for making hundreds of chemicals, such as acetaldehyde, ethyl acetate, acetic acid, ethylene dibromide, glycols, ethyl chloride, all ethyl esters. Recently, ethanol is more and more being used as a motor fuel.

III. MARKET STUDY AND PLANT CAPACITY

A. MARKET STUDY

1. Past Supply and Present Demand

Demand for alcohol (ethanol) in Ethiopia is met mainly through domestic production. Imported items of the product are few and of insignificant volume. Table 3.1 shows local production during the period 1991 – 1997.

Table 3.1

DOMESTIC PRODUCTION OF ALCOHOL (HL)

Year	Production
1991	17,224
1992	14,575
1993	17,541
1994	19,982
1995	12,878
1996	7,211
1997	6,605

***Source**: CSA, Survey of the Manufacturing and Electricity Industries, Annual Issues.*

Scrutiny of Table 3.1 above reveals that production during the period 1991 – 1994 was high compared to the other years in the data set. However, decrease in the production of alcohol during the years 1995 and up wards was the result of shortage of molasses which is the major raw material for the production of alcohol by current local producers. Therefore, considering the supply of the product during the last three years (1995 – 1997) as an apparent consumption will lead to underestimation of the actual demand for the product as there was a suppressed demand during those years. Accordingly, taking the average of the normal years (1991 – 1994) as the demand level of 1997 and applying average growth rate of 6 % which is equivalent to the growth rate of annual production

during the normal periods is assumed to realistically reflect the current (1999) demand for the product. Accordingly the present effective demand for the product is estimated at 19,472 HL.

2. Projected Demand

The future demand for alcohol is a function of income, urban population growth and growth of end user industries. After considering all the above factors, the demand for the product is forecasted to grow at a rate higher than the growth of the urban population in order to take account of effects of growth in income and other demand determining variables. Accordingly, an annual growth rate of 7% is deemed to be a reasonable growth rate to project future demand, with the result depicted in Table 3.2.

Table 3.2

PROJECTED DEMAND

Year	Projected Demand	Existing Capacity	Projected Demand Gap
2000	20,836	17,331	3,505
2001	22,294	17,331	4,963
2002	23,855	17,331	6,524
2003	25,525	17,331	8,194
2004	27,311	17,331	9,980
2005	29,223	17,331	11,892
2006	31,269	17,331	13,938
2007	33,457	17,331	16,126
2008	35,799	17,331	18,468
2009	38,305	17,331	20,974
2010	40,987	17,331	23,656
2011	43,856	17,331	26,525
2012	46,926	17,331	29,595
2013	50,211	17,331	32,880
2014	53,725	17,331	36,394
2015	57,486	17,331	40,155

3. Pricing and Distribution

The factory-gate price of alcohol is Birr 4 per half litter. This price could, therefore, be used as a reference to evaluate the financial viability and profitability of the envisaged plant.

Distribution of the product is best undertaken through a channel structure at the top of which is territorially based agents, connected to a wide network of wholesalers and retailers.

B. PLANT CAPACITY AND PRODUCTION PROGRAM

1. Plant Capacity

The plant is envisaged to produce 10,000 HL/year, in 300 working days and operating 24 hours per day covering 50 % of the projected demand in the market study.

2. Production Programme

The production programme is shown in Table 3.3. The production programme is set by considering just 300 working days per annum.

Table 3.3

PRODUCTION PROGRAMME

Year	1	2	3	4
Capacity utilisation (%)	70	80	90	100
Production programme (HL)	7,000	8,000	9,000	10,000

IV. MATERIALS AND INPUTS

A. RAW MATERIALS

Yam (commonly known as sweet potato) is the basic raw material as a source of starch for the fermentation. The annual material requirement of the plant is shown in Table 4.1 below.

Table 4.1

ANNUAL RAW MATERIAL REQUIREMENT

Sr. No	Raw Material	Unit	Annual Consumption	('000 Birr)		
				FC	LC	Total
1	Yam	ton	125		219	219
2	Bottle	pcs	350,000		1,750	1,750
3	Plastic Crate	"	17,500		875	875
	Total				**2,844**	**2,844**

B. UTILITIES

Utilities such as oil, water and electricity are required by the plant. The annual consumption is shown in Table 4.2 below.

Table 4.2

ANNUAL CONSUMPTION OF UTILITIES

Sr. No	Utility	Unit	Annual Consumption	('000 Birr)		
				F.C	L.C	Total
1	Furnace Oil	m^3	30	-	162	162
2	Water	m^3	5,700	-	31	31
3	Electricity	KWH	220,000	-	105	105
	Total			**-**	**298**	**298**

V. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Production Process

Yam tubers shall first be mashed (grounded) to a particle size of about 5mm.The mash will then be cooked by steam in a continuous cooker. After boiling, it shall then be cooled down to 60^0 C, adjust the PH and reduce the starch molecules into sugar molecules by the action of enzymes.

Fermentation is carried out on industrial scale by cultivating the yeast culture in yeast vessels and preferment. The desirable liquid mass of yeast culture is then pumped into fermentation vessels containing the sugar solution.

The sugar solution is then charged into steel tanks and fermentation is started by addition of yeast. Fermentation is a process by which sugar converts into alcohol and carbon dioxide. The resultant product is often referred to as wash (beer).

The ethanol is then separated from the beer in three stage distillation process. Distillation at its simplest is the separation of water from alcohol through heat based upon the lower boiling point of alcohol (78 ^{o}C) as against water (100 ^{o}C).

The first distillation is in a beer still followed by, a second distillation in purifying distillation column and finally the third distillation in a rectifying distillation column, where the alcohol is brought to full strength (95 to 95.6% Ethanol).

Absolute alcohol (100% ethanol) can then be produced by solvent extraction method after distillation.

2. Source of Technology

The technical data and information are compiled from book entitled Shreve's Chemical Process industries.

B. ENGINEERING

1. Machinery and Equipment

The machinery and equipment required by the plant are listed in Table 5.1. The total cost of these machinery and equipment is estimated at about Birr 11,160 thousands out of which Birr 9,300 thousands will be required in foreign currency.

2. Building and Civil Works

The total land requirement is close to 1,000 m^2. The built up area is estimated at 500 m^2 while the remaining part is for open space and for future expansion. The lease cost for 99 years lease holding will be Birr 79,200. The total cost of building and civil works is estimated at Birr 1,250,000.

Table 5.1

LIST OF MACHINERY AND EQUIPMENT

Sr. No	Item
1	Weighing Scale
2	Separator
3	Washing machine
4	Grinder
5	Continuous Cooker
6	Furnace oil Storage tank
7	Ethyl alcohol storage tank
8	Fermentation Tank
9	Overheads tank
10	Yeast culturing machine
11	Dilution tank
12	Wash tank
13	Fractionating column
14	Rectifying column
15	Condenser separator
16	Scrubber
17	Compressor
18	Boiler
19	Sterilizer
20	Heat exchanger
21	Transfer pump
22	Miscellaneous tools and Equipments

3. Proposed Location

The proposed location for the plant is Walayita Sodo town in Sodo Zuria woreda, Walayita Zone.

VI. MANPOWER AND TRAINING REQUIREMENT

A. MANPOWER REQUIREMENT

The manpower requirement of the plant and the monthly and annual salary expenditure are shown in Table 6.1.

Table 6.1

REQUIRED MANPOWER

Sr. No	Manpower	Req. No.	Monthly salary (Birr)	Annual Salary (Birr)
1	General manager	1	3,000	36,000
2	Admin. & Finance head	1	2,000	24,000
3	Secretary	1	700	8,400
4	Accountant	1	1,500	18,000
5	Sales men	2	2,000	24,000
6	Purchaser	2	2,000	24,000
7	Production head	1	2,000	24,000
8	Operators	10	6,000	72,000
9	Laborers	30	9,000	108,000
10	General service	8	2,400	28,800
	Sub-Total	**57**	**30,600**	**367,200**
	Benefit (25% BS)		7,650	91,800
	Total		**38,250**	**459,000**

B. TRAINING REQUIREMENT

The technical personnel of the plant should be trained by qualified engineers of the machinery supplier. The cost of training shall be Birr 50,000.

VII. FINANCIAL ANALYSIS

The financial analysis of the alcohol extraction project is based on the data presented in the previous chapters and the following assumptions:-

Construction period	1 year
Source of finance	30 % equity
	70 % loan
Tax holidays	3 years
Bank interest	8%
Discount cash flow	8.5%
Accounts receivable	30 days
Raw material local	30days
Raw material, import	90days
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 investment cost of the project including working capital is estimated at 14.45 million, of which 11 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 Cost ('000 Birr)
1	Land lease value	79.2
2	Building and Civil Work	1,250.00
3	Plant Machinery and Equipment	11,160.00
4	Office Furniture and Equipment	75
5	Vehicle	200
6	Pre-production Expenditure*	941.39
7	Working Capital	752.03
	Total Investment cost	**14,457.6**
	Foreign Share	11

** N.B Pre-production expenditure includes interest during construction (Birr 791.39 thousand), training Birr 50 thousand and Birr 100 thousand 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 is estimated at Birr 5.79 million (see Table 7.2). The material and utility cost accounts for 54.18 per cent, while repair and maintenance take 2.59 per cent of the production cost.

Table 7.2

ANNUAL PRODUCTION COST AT FULL CAPACITY ('000 BIRR)

Items	Cost	%
Raw Material and Inputs	2,844.00	49.05
Utilities	298	5.14
Maintenance and repair	150	2.59
Labour direct	220.32	3.80
Factory overheads	73.44	1.27
Administration Costs	220.32	3.80
Total Operating Costs	**3,806.08**	**65.64**
Depreciation	1256	21.66
Cost of Finance	736.6	12.70
Total Production Cost	**5,798.68**	**100**

C. FINANCIAL EVALUATION

1. Profitability

According to the projected income statement, the project will start generating profit in the first 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 life-time 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 operate at full capacity (year 3) is estimated by using income statement projection.

$$BE = \frac{\text{Fixed Cost}}{\text{Sales} - \text{Variable Cost}} = 30\%$$

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 4 years.

4. Internal Rate of Return and Net Present Value

Based on the cash flow statement, the calculated IRR of the project is 26 % and the net present value at 8.5% discount rate is Birr 9.63 million.

D. ECONOMIC BENEFITS

The project can create employment for 57 persons. In addition to supply of the domestic needs, the project will generate Birr 1.21 million in terms of tax revenue. The establishment of such factory will have a foreign exchange saving effect to the country by substituting the current imports.