251. PROFILE ON ARTEMISIA PLANT PROCESSING FOR MALARIA & HEMORRHOID MEDICINE

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I. SUMMARY

This profile envisages the establishment of a plant for Artemisia plant processing for malaria and hemorrhoid medicine with a capacity of 75 tonnes per annum.

The present demand for the proposed product is estimated at 64 tonnes per annum. The demand is expected to reach at 114 tonnes by the year 2020.

The plant will create employment opportunities for 37 persons.

The total investment requirement is estimated at Birr 6.17 million, out of which Birr 2.98 million is required for plant and machinery.

The project is financially viable with an internal rate of return (IRR) of 15 % and a net present value (NPV) of Birr 2.13 million discounted at 8.5%.

II. PRODUCT DESCRIPTION AND APPLICATION

Artemisia annual is used to cure the potentially fatal fevers of malaria. The active ingredient, artemisinin acts by turning the malaria parasite's food in to poison. When the chemicals in artemisinin come in contact with the iron, a toxin is created that kills the parasite there by curing the malaria. The vivax strain, which occurs in the liver and the falciparum strain in the brain.

Currently used medicine for malaria are mostly synthetic derivatives of quinine, to which the parasite has become resistant. Medicine formulated from Artemisia is affective and with no side effect as compared to the synthetic one. Since Ethiopia is highly affected country by malaria, the medicine developed from Artemisia plant will have potential market, locally. Prevention by using valline is a more economical approach to control infections diseases than curative measures.

The major raw materials for the formulation of malaria medicine is leaves of Artemisia tree. The tree can be grown in the region.

III. MARKET AND PLANT CAPACITY

A. MARKET STUDY

1. Past Present Demand and Supply

Malaria stands as the leading cause of morbidity and mortality in Ethiopia, where nearly 48 million people live in malaria risk areas. Three quarters of Ethiopia's total landmass is regarded as malarious.

More than 4 million clinical cases are reported yearly from health facilities and communities, reflecting the magnitude of the problem. Clinical malaria accounts for 10 - 40% of all outpatient consultations, with corresponding proportional morbidity among children under 5 years being 10%-20%. An average of 4-6 hundred thousand confirmed malaria cases are treated every year. Clinical cases in areas where no microscopes are available is estimated at 3-4 folds. In addition a significant number of people do not have access to health services. Therefore, the overall annual number of malaria cases is estimated in the range of 4-5 million.

Malaria also accounts for 13%-26% of all inpatient admissions in the various health facilities; it remains a major cause of mortality, with proportional mortality rates of 13% - 35% in health facilities. Generally, it accounts for 30% of the disease burden in all age groups.

Currently medicine used for malaria is mostly synthetic derivatives of quinine, to which the parasite has become resistant. An alternative to synthetic medicine for malaria is

medicine formulated from Artemisia which is effective and with no side effect as compared to the synthetic one.

Artemisia annua, also known as Sweet Wormwood, Sweet Annie, or Chinese wormwood, is a common type of wormwood that grows throughout the world. It has fern-like leaves, bright yellow flowers, and a camphor-like scent. It averages about 2 m tall and has a single stem, alternating branches, and alternating leaves which range 2.5-5cm in length.

Global demand for Artemisia based medicines has increased dramatically in recent years because the malaria parasite has developed resistance to traditional single-drug treatments such as chloroquine. A shortage of artemisinin has arisen, leading to an increase in its price of up to five-fold since 2004.

There is no data regarding the country's consumption of malaria treatment drugs. However, opinion of knowledgeable persons indicates that 10% of the total drugs and medicines imported in to the country accounts of medicines for treatment of malaria. Accordingly, considering that during the period 2003 2006 on average the county has imported a total of 6,354 tonnes of drugs and medicines annually the share of malaria treatment medicines is estimated at 635 tonnes. Conservatively assuming that medicine formulated from Artemisia will replace 10% of the total malaria treatment medicines imported the present (2007) effective demand for the product is estimated at 64 tonnes.

2. Projected Demand

Climatic changes, recurrent drought, large-scale population movement; and wide spread multi-drug resistant falciparum malaria are some of the major factors that contribute to the worsening malaria situation. In projecting the demand for medicine formulated from Artemisia an average annual growth rate of 4% which is equivalent to population growth rate is used (see Table 3.1).

Table 3.1

DEMAND PROJECTION (TONNES)

Year	Projection
2008	69
2009	71
2010	74
2011	77
2012	80
2013	84
2014	87
2015	90
2016	94
2017	102
2018	106
2019	110
2020	114

3. Pricing and Distribution

Taking the price of substitute products an ex factory price of Birr 30,000 per ton is recommend. The product can be sold directly to the end users i.e. mainly to the chemical industries.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

The market study on Artemisia medicine indicates that the demand for the medicine in 2008 will be 99 tonnes, while the demand will grow the 130 tonnes and 159 tonnes in 2015 and 2020, respectively. Accordingly, it is proposed that the envisaged plant will

have annual production capacity of 75 tonnes. The plant will operate double shift 16 hours a day and 300 days a year.

2. Production Programme

Production will start at low capacity to give provision for skill development and develop adequate market outlets both inside and outside the country. It will therefore be appropriate to operate the plant at 75% of capacity at the first year of production. Production will then rise to 85% and 100% in the second and third year of operation.

IV. MATERIALS AND INPUTS

A. RAW AND AUXILIARY MATERIALS

The major raw material required is the Artemisia tree leaves. Resource Potential Assessment of SNNPRS (Nov. 2005) indicates that the region is endowed with plantation of Artemisia trees. Thus, the raw material can be harvested and applied for medicine production. The tree can be planted, and usually requires at least a two- year lead time to cultivate the plant. Sustainable production of the medicine can be maintained by ensuring continuous supply of raw material. Studies indicate that Artemisia plant needs five to six months to mature. Annual requirement of raw material at full capacity production is 200 tonnes.

Table 4.1

RAW AND AUXILIARY MATERIALS AT FULL CAPACITY PRODUCTION

Sr. No.	Description	Qty	Cost ('000 Birr)		
			LC	FC	TC
1	Raw, dried Artemisia leaves (and flowers) (kgs)	10,100	200	-	200
2	Packaging materials	Reqd.	50	-	50
	Total	**-**	**250**	**-**	**250**

B. UTILITIES

Electricity, water, fuel oil, solvent (petroleum other or benzene or alcohol) are utilities required in the extraction process of Artemisia leaves. The details of annual requirement of utilities are shown below.

Table 4.2

ANNUAL UTILITY REQUIREMENT AND COST

Sr. No.	Description	Qty	Cost ('000 Birr)
1	Electricity (kHW)	20,000	9.48
2	Water (m^3)	10,000	100
3	Fuel oil (litres)	15,000	81.15
4	Solvent (litres)	5,000	39.05
	Total		**229.68**

V. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Production Process

As indicated above, after the seed is sown in the farm, Artemisia plant roughly takes five to six months to mature. The envisaged plant can supply contracts to farmers or farmers associations to farmers or farmers associations for the production of Artemisia plant. The manufacturing plant can supply seeds that are proved to be well adapted to the region. The harvested leaves can be dried at the farm level.

Two major processes are involved, namely processing of crude extract and final purification.

The construction of adequate extraction and purification facilities is an expensive and challenging task. Experiences of some African countries like Kenya, Uganda, Tanzania and South Africa indicate that a more logical approach is to establish an extraction facility at the initial stage of Artemisia medicine production, and later on embark onto purification operation.

Like the African countries indicated above, the crude extract can be exported to countries like Kenya, South Africa, UK, India and China for further purification. Botanical Extracts Ltd is a company in Kenya that has developed both Crude Extraction and Purification Processes, and is at present believed to have developed the skill and experience well accepted by WHO and UNICEF at international level.

The extraction process is carried out by on the dried leaves of Artemisia plant. A solvent extractor of multi-stage contact is employed. Mixers and settlers are widely used at each stage of extraction operation. Fresh solvent and feed water enters at apposite ends of a series of extraction stages. Extract and raffinate layers pass continuously and counter currently from stage to stage through the system. Any number of stages may be employed, the more common number being three to six. The system may be composed of a series, of some form of tray column may be used. The finished extract from each settler is collected into a common storage tank.

The crude extract is then separated from the solvent by Desolventizer.

2. Source of Technology

The technology required by the envisaged plant can be acquired from the following company;

B/R Instrument Corporation
E-mail: br.service@brinstrument.com
Fax. 4108208141

B. ENGINEERING

1. Machinery and Equipment

The list and cost of machinery and equipment required for solvent extraction of Artemisia leaves are shown in Table 5.1 below.

Table 5.1

LIST OF MACHINERY AND EQUIPMENT AND THE CORRESPONDING COST

Sr. No.	Description	Qty	Cost ('000 Birr)		
			LC	FC	TC
1	Raw material handling equipment	Reqd	-	650	650
2	Mixers	3	-	450	450
3	Settlers	3	-	450	450
4	Storage tanks	2	-	150	150
5	Auxiliary equipment, piping, measuring devices, pumps, columns, etc	Reqd	-	750	750
6	Boiler	1 set	-	285	285
				2735	2735
	FOB price				
	Freight, Insurance, Bank, Customs, etc.		250	-	250
	CIF landed cost	**-**	**250**	**2735**	**2985**

2. Land, Building and Civil Works

The Artemisia medicinal plant requires land for administration and production buildings. Land is also required for future expansion of the plant. The total built-up area is estimated 1200 m^2. Total land area required will be 2000 m^2. Thus, at land lease rate of Birr 1.0 per m2 for 80 years, and at the rate of Birr 2000 per m^2 for buildings, the total investment for land, building and civil works will be Birr 2.56 million.

3. Proposed Location

Location of a plant is determined on the basis of proximity to raw material, availability of developed infrastructure and nearness to market out lets. Moreover, consideration is given to fair distribution of projects among the SNNPRS woredas. Accordingly, Yem Special Woreda and Dunna Woreda are identified of these Yem special woreda is selected. It is therefore decided that the envisaged medicinal plant will be established in Fofa town.

VI. MANPOWER AND TRAINING REQUIREMENT

A. MANPOWER REQUIREMENT

Production manpower required includes chemical engineer (process engineer), chemist and skilled workers for production equipment, boiler operation and mechanics. Administrative staff is also required to perform managerial activities. The details of manpower are given in Table 6.1.

Table 6.1

MANPOWER REQUIREMENT WITH MONTHLY AND ANNUAL SALARIES

No.	Job Title	Req. Nos.	Monthly Salary (Birr)	Annual Salary (Birr)
	A. Administration			
1	Plant manager	1	2,000	24,000
2	Secretary	1	800	9,600
3	Personnel	1	1,000	12,000
4	Cashier	1	600	7,200
5	Salesman	1	800	9,600
6	Store man	1	700	8,400
7	Clerk	1	450	5,400
8	General services	8	350	4,200
	Sub total	15		80,400
	B. Production			
1	Production head (chemical engineer)	1	1,500	18,000
2	Chemist	1	1,200	14,400
3	Operators	8	600	57,600
4	Laborers	10	250	30,000
5	Mechanic	2	750	18,000
	Sub total	22	-	138,000
	Workers' benefit (25% of BS)			54,600
	Grand Total	**37**	**-**	**273,000**

B. TRAINING REQUIREMENT

Specialized training on process technology, quality control and raw material selection is required for a period of two-weeks. A total of Birr 10,000 is required to execute the training programme.

VII. FINANCIAL ANALYSIS

The financial analysis of the Artemisia plant processing 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	30 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 investment cost of the project including working capital is estimated at Birr 6.57 million, of which 27 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	160
2	Building and Civil Work	2,500.00
3	Plant Machinery and Equipment	2,985.00
4	Office Furniture and Equipment	100
5	Vehicle	250
6	Pre-production Expenditure*	497.49
7	Working Capital	78.29
	Total Investment cost	**6,570.8**
	Foreign Share	27

** N.B Pre-production expenditure includes interest during construction (Birr 347.49 thousand) training (Birr 10 thousand) and Birr 140 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 1.77 million (see Table 7.2). The material and utility cost accounts for 27.09 per cent, while repair and maintenance take 6.49 per cent of the production cost.

Table 7.2

ANNUAL PRODUCTION COST AT FULL CAPACITY ('000 BIRR)

Items	Cost	%
Raw Material and Inputs	250.00	14.12
Utilities	229.68	12.97
Maintenance and repair	115	6.49
Labour direct	163.8	9.25
Factory overheads	54.6	3.08
Administration Costs	109.2	6.17
Total Operating Costs	922.28	52.09
Depreciation	521.5	29.45
Cost of Finance	326.86	18.46
Total Production Cost	**1,770.64**	**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.

$$BE = \frac{\text{Fixed Cost}}{\text{Sales} - \text{Variable Cost}} = 44\ \%$$

3. Payback 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 15 % and the net present value at 8.5% discount rate is Birr 2.13 million.

D. ECONOMIC BENEFITS

The project can create employment for 37 persons. In addition to supply of the domestic needs, the project will generate Birr 1.32 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.