

**77. PROFILE ON PRODUCTION OF FUEL
BRIQUETTE**

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I. SUMMARY

This profile envisages the establishment of a plant for the production of fuel briquette with a capacity of 7,000 tonnes per annum.

The present demand for the proposed product is estimated at 21,631 per annum. The demand is expected to reach at 36,017 tonnes by the year 2020.

The plant will create employment opportunities for 30 persons.

The total investment requirement is estimated at Birr 2.87 million, out of which Birr 800,000 million is required for plant and machinery.

The project is financially viable with an internal rate of return (IRR) of 22% and a net present value (NPV) of Birr 1.49 million discounted at 8.5%.

II. PRODUCT DESCRIPTION AND APPLICATION

Scarcity in availability of conventional fuels created a need to search for alternative fuels for cooking and other applications. Conversions of wastes like agricultural residues from fields, solid municipal waste, waste from agro-industries, etc., into useful fuel is a necessity from economy & pollution point of view.

These materials can continuously be fed to briquette units to produce combustible fuel briquettes mainly for household use. The agro-based briquettes are expected to have calorific values ranging from 3,000-4,500 kilocalories/kg depending on the type of agro-waste used. The use of agro-based briquettes is economical and convenient; briquettes can easily be packed, transported and stored.

The briquette's dimensions depend on the machinery and process used and normally they are manufactured with 45-80 mm diameter and 50-250 mm length. Agro-briquettes do not emit any smoke with sulphur or phosphorus or generate fly ash.

III. MARKET STUDY AND PLANT CAPACITY

A MARKET STUDY

1. Past supply and Present Demand

In SNNPRS energy sources are dominated by traditional forms of energy that are derived from biomass. Biomass is often the only source of energy in the rural areas and the major source of energy in urban centers too. Firewood is the most important among biomass sources, contributing to about 97% of total domestic energy in SNNPRS. Distribution of households by type of fuel they use for cooking purpose is shown in Table 3.1.

Table 3.1
DISTRIBUTION OF HOUSEHOLDS BY TYPE OF FUEL ENERGY
USED FOR COOKING PURPOSES IN SNNPRS

Sr. No.	Type of Fuel	No. of households	%
1	Firewood/Charcoal	2,459,149	97.36
2	Animal dung/crop residue	59,026	2.34
4	Gas	6,852	0.27
5	Electricity	893	0.04
	Total	2,525,920	100.00

Source:- CSA “Welfare Monitoring survey” 2004

As population grows, consumption of firewood and charcoal is likely to increase since the supply of alternative sources of energy are limited. This phenomena will in turn aggravate deforestation; thus calling for alternative sources of energy. One of those is fuel briquette which could be made available cheaply for low income households.

According to CSA projection as of 2007 there are 243,716 households in SNNPRS. As mentioned earlier, about 97 % of households in the region use firewood and charcoal to

meet their energy needs. The number of urban households which use firewood and charcoal would, hence, be about 236,405.

Low income households are assumed to consume, on average, 2.5 kg of firewood per day. On this assumption, total annual consumption by all urban households in a year would amount 216,310 tonnes. Assuming that about 10% of the demand will be covered by fuel briquette, effective demand for fuel briquette in the region is estimated at 21,631 tonnes.

2. Projected Demand

The future demand for fuel briquette is projected on the basis of the urban population growth rate of 4%; and the result, as shown in Table 3.3, ranges from 12,320 tonnes by the year 2005 to 22,510 tonnes by the year 2019.

Table 3.3

PROJECTED DEMAND FOR FUEL BRIQUETTE

Year	Projected Demand (Tonnes)
2008	22,496
2009	23,396
2010	24,332
2011	25,305
2012	26,317
2013	27,370
2014	28,465
2015	29,604
2016	30,788
2017	32,019
2018	33,300
2019	34,632
2020	36,017

3. Pricing and Distribution

The current retail price of charcoal, which is the closest substitute for fuel briquette in the region, is birr 20 per 20 kg (Birr 1 per kg). Thus, it would be both profitable and socially sound if the envisaged plant sells the product at Birr 0.4 /kg.

The product can be distributed directly to end-users by establishing its own small outlet, or by using agents and charcoal traders.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

A small briquetting unit has a production capacity of 0.75tonnes/hour. To run a commercially viable briquetting plant, it is recommended that two such units shall be operated with a combined capacity of 1.5 tonnes/hour, which will be operated three shifts of 8 hours per day.

Due to high wear and tear in hammer mills and the associated routine maintenance requirements, hammer mills must not be operated for more than 20 hours per day. Assuming 300 working days per annum, the plant will have an annual capacity of 7, 650 tonnes/annum. Of this, the flash dryer is expected to consume 650 tonnes per year for drying purposes. On this basis, the annual saleable production is 7,000 tonnes per year.

2. Production Programme

The envisaged production programme is given in Table 3.4 below. The schedule is worked out in consideration of the time required for gradual build-up in market, labour productivity and fine-tuning of machinery. Production starts at 75% of plant capacity in the first year of operation and reaches full-gear in the 3rd year of operation and then after.

Table 3.4
PRODUCTION PROGRAMME

Year	1	2	3-10
Capacity Utilization [%]	75	85	100
Production [Tonnes]	5,250	5,950	7,000

IV. MATERIALS AND INPUTS

A. RAW MATERIALS

The required raw materials are agro wastes from fields like rice husk, sawdust, bagasse, groundnut shell, coffee husk, tobacco and tea stems, etc. To produce one tonnes of briquette, about 1.1 tonnes of these materials is required; 10% is allowed for moisture and wastage.

The finished briquettes are supposed to be packed in 50-kg PP-bag, which is distributed by wholesalers to retailers who then can re-pack the product in cheap PE sachets or sell it in bulk to consumers.

The major agricultural residues that could be obtained in the southern nations and nationalities peoples Regional State include: coffee husks, maize stalks & cobs and other related materials.

Table 4.1 shows annual raw material requirement and associated cost at full production capacity. The total annual cost of raw materials is estimated at Birr 1,512,200.

Table 4.1**ANNUAL MATERIALS REQUIREMENT AND COST**

Sr. No.	Description	Unit of Measure	Qty	Unit Cost (Birr)	Total Cost ('000 Birr)
1.	Agro-waste	tonnes	8,000	150.00	1,200.00
2.	PP bags	pieces	140,000	2.23	312.2
	Grand Total				1,512.20

B. UTILITIES

Electricity and water are the two major utilities required by the plant. Table 4.2 below shows annual requirements and associated costs at full production capacity. The total annual cost of utilities is estimated at Birr 200,058.

Table 4.2**ANNUAL UTILITIES REQUIREMENT AND COSTS**

Sr. No.	Description	Unit of Measure	Qty	Unit Cost (Birr)	Total Cost ('000 Birr)
1.	Electricity	kWh	405,000	0.4736	191.808
2.	Water	m ³	1500	5.50	8.25
	Grand Total				200.058

V. TECHNOLOGY AND ENGINEERING**A. TECHNOLOGY****1. Production Process**

The fuel Briquettes are made out of loose agro-wastes into a compressed form to increase its specific weight, thus increasing the fuel efficiency (combustion efficiency) as compared to its loose condition.

Previously, employed technologies required binders in the production of briquettes from agro-waste. Currently available technologies, however, use the BINDERLESS technology, which is found to be very economical. Due to existence of solid form lignite in the agro-waste, which acts as a natural binder, there is no need to add chemicals or any other foreign substance to the process. Therefore, the technology has come to be known as "Binder less Technology". Briquettes, thus, produced are easy to store & pack and hygienic to handle.

There are two different types of briquetting machines available in the market, screw type and ram type. On account of its suitability for organic agricultural wastes, the screw press is recommended, which involves the following operations:

- Screening to remove undesirable materials by means of a vibratory screen;
- Pulverizing to small particle size, i.e. 6-8mm particle size and 10-20% fines by means of hammer mills;
- Drying of raw material to about 12-15% moisture content by using flash driers;
- Charging into intermediate storage bin;
- Briquetting by means of a screw extruder;
- Cutting to required length;
- Cooling in a conveyer belt;
- Storage; and
- Packing.

Fuel briquettes production does not result in any adverse impacts on the environment.

2. Source of Technology

The manufacturing technology and machinery for the production of briquettes from agro-waste can be obtained from suppliers in Europe and Asia. SREE Engineering Works from India are renowned manufacturers and exporters of Briquetting machines and plants. Their address is:

SREE Engineering Works,
 26 A, Ferozguda, Bowenpally (P.O), Hyderabad - 500 011,
 A.P., India
 Phone: 0091-40-27751841;
 Fax: 0091-4027751841.

B. ENGINEERING

1. Machinery and Equipment

The list of machinery and equipment required to manufacture fuel briquettes is given in Table 5.1 below. On this basis, total cost of machinery and equipment is estimated at Birr 800,000, out of which Birr 640,000 is required in foreign currency.

Table 5.1
LIST OF MACHINERY AND EQUIPMENT

Sr. No.	Description	Qty. No.
1	Screw feeder	1
2	Hammer mill	2
3	Flash drier	1
4	Silo with feeder	1
5	Screw conveyer, main	1
6	Return feeder	1
7	Preheater	2
8	Heater	2
9	Cooling conveyer	1
10	Furnace	1
11	Fluid system	1
12	Fume exhaust	1
13	Storage bins	3
14	Auxiliaries	Set

2. Land, Building and Civil Works

Total land requirement of the project is estimated at 1,500m², out of which 500m² is built-up area. Cost of building construction at a unit cost of Birr 1800 per m² is estimated at Birr 900,000. Total land lease cost, for a period of 80 years land holding and at a lease rate of Birr 0.10 per m², is estimated at Birr 12,000. Thus, the total investment cost for land, building and civil works assuming that the total land lease cost will be paid in advance is estimated at Birr 912,000.

3. Proposed Location

The availability of raw material is a key factor for the determination of location of the plant. The other factors are availability of market and infrastructure. Considering the above factors, the location of the envisaged plant is proposed to be in Dalocha woreda.

VI. MANPOWER AND TRAINING REQUIREMENTS

A. MANPOWER REQUIREMENT

Total manpower requirement, including skilled and unskilled labour, is 30 persons. Correspondingly, total annual labour cost, including fringe benefits, is estimated at Birr 234,750. Table 6.1 below shows the list of manpower required and the estimated annual labour costs.

Table 6.1**MANPOWER REQUIREMENT AND ANNUAL LABOR COST**

Sr. No.	Description	Req. No.	Monthly Salary [Birr]	Annual Salary [Birr]
1.	General Manager	1	1,800	21,600
2.	Accountant	1	600	7,200
3.	Sales person	1	600	7,200
4.	Purchaser	1	500	6,000
5.	Clerk	1	350	4,200
6.	Secretary	1	600	7,200
7.	Production head	1	1,400	16,800
8.	Production supervisor	3	2100	25,200
9.	Chemist	1	700	8,400
10.	Operator	4	1600	19,200
11.	Mechanic	2	1200	14,400
12.	Electrician	2	1200	14,400
13.	Unskilled labour	6	1800	21,600
14.	Guard	3	600	7,200
15.	Diver	2	600	7,200
	Total	30	15,650	187,800
	Worker's Benefit = 25% of Basic Salary			46,950
	Grand Total			234750

B. TRAINING REQUIREMENT

An on-site training programme can be arranged for key production, maintenance and quality control personnel in consultation with the machinery and technology supplier. The training can be best carried out during commissioning and performance testing of the factory. The cost of such training is estimated at Birr 20,000 and will take about two weeks.

VII. FINANCIAL ANALYSIS

The financial analysis of the fuel briquette 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
Raw material, 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 investment cost of the project including working capital is estimated at Birr 2.87 million, of which 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 Cost (‘000 Birr)
1	Land lease value	12.0
2	Building and Civil Work	900.0
3	Plant Machinery and Equipment	800.0
4	Office Furniture and Equipment	125.0
5	Vehicle	450.0
6	Pre-production Expenditure*	297.9
7	Working Capital	292.9
	Total Investment cost	2,877.8
	Foreign Share	9

* *N.B Pre-production expenditure includes interest during construction (Birr 147.90 thousand) training (Birr 20 thousand) and Birr 130 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 2.39 million (see Table 7.2). The material and utility cost accounts for 71.37 per cent, while repair and maintenance take 4.17 per cent of the production cost.

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

Items	Cost	%
Raw Material and Inputs	1,512.20	63.03
Utilities	200.06	8.34
Maintenance and repair	100	4.17
Labour direct	70.42	2.94
Factory overheads	46.95	1.96
Administration Costs	93.9	3.91
Total Operating Costs	2,023.53	84.35
Depreciation	257.5	10.73
Cost of Finance	117.99	4.92
Total Production Cost	2,399.02	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.

$$\text{BE} = \frac{\text{Fixed Cost}}{\text{Sales} - \text{Variable Cost}} = 33 \%$$

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 5 years.

4. Internal Rate of Return and Net Present Value

Based on the cash flow statement, the calculated IRR of the project is 22% and the net present value at 8.5% discount rate is Birr 1.49 million.

D. ECONOMIC BENEFITS

The project can create employment for 30 persons. In addition to supply of the domestic needs, the project will generate Birr 1.15 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.