88. PROFILE ON PLACER GOLD RECOVERY

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I. SUMMARY

This profile envisages the establishment of a plant for the production of 45 kg of gold per annum.

The present demand for the proposed product is estimated at 2,568 metric tonnes and it is projected to maintain the same level for the next ten years.

The plant will create employment opportunities for 25 persons.

The total investment requirement is estimated at Birr 1.95 million, out of which Birr 344,520 is required for plant and machinery.

The project is financially viable with an internal rate of return (IRR) of 62% and a net present value (NPV) of Birr 8.59 million, discounted at 10.5%.

II. PRODUCT DESCRIPTION AND APPLICATION

Gold appears to be the first metal known and used by man. It occurs in nature as a highly pure metal and is treasured because of its colour, its extraordinary ductility, and its resistance to corrosion. Gold is characterized by high density, high electrical and thermal conductivity, and high ductility.

Besides its use for monetary reserves, gold is used in the private sector principally for investment and fabrication, jewelry. In the electronics industry, gold used as fine wires or thin firm coatings and frequently in the form of alloys to economize gold consumption and to impart properties such as hardness. In dentistry, gold is used for a variety of restorations. Other uses of gold are as optical coatings, electrical contacts and contactors; brazing alloys for high temperature applications; instrumentations, spinnerets for rayon manufacture, corrosion-resistant materials in chemical industries and as catalysts and for medicinal purposes.

III. MARKET STUDY AND PLANT CAPACITY

A. MARKET STUDY

1. Past Supply and Present Demand

Gold is used in jewelry and coin fabrication, electronic products and most of other products. Due to its superior electrical conductivity and resistance to corrosion and other desirable combination of physical and chemical properties, gold is an essential industrial metal. It performs critical functions in computers, communications equipment, space craft and jet aircraft engines.

Throughout human history, gold retains a unique status among all commodities as a long-term store of value. It is an excellent hedge against inflation and protects earnings for the future.

To economize gold base metals, clad with gold alloys are widely used in electrical/electronic products and jewelry to maintain high-utility standards with lower gold content. However, most of fabricated gold goes to jewelry.

The estimated ever mined gold in the world is 145,200 tonnes, of which 15% is thought to have been lost, used in dissipative industrial uses, or otherwise unrecoverable or unaccounted for. Of the remaining 123,000 tonnes, central banks hold an estimated 32,000 tonnes as official stock, and about 51,000 tonnes is privately held as coins, bullion and jewelry.

Total world resources of gold are estimated at 100,000 tonnes, of which 15% to 20% is a by-product resource. South Africa has about half of all world gold resources, and Brazil and the United States have about 9%, each.

The world mine production in 2002 was 2,550 metric tonne. Ethiopia’s share from the world production is only 0.2%. World mine production and domestic production are presented in Table 3.1 and Table 3.2, respectively.

Table 3.1
WORLD MINE PRODUCTION (METRIC TONNES)

Sr. No.	Country	Year					
		1998	**1999**	**2000**	**2001**	**2002**	**2003**
1	South Africa	165	151	431	395	399	450
2	Australia	310	301	296	285	273	275
3	United States	366	341	353	335	298	266
4	China	178	173	180	185	190	195
5	Russia	115	126	143	153	170	180
6	Indonesia	124	127	125	166	135	175
7	Canada	166	158	156	159	138	150
8	Peru	94	128	133	138	138	150
9	Other Countries	982	765	773	784	798	760
	World Total	**2,500**	**2,570**	**2,590**	**2,600**	**2,550**	**2,600**

***Source**: USGS.*

Table 3.2
DOMESTIC PRODUCTION OF GOLD IN KG

Year	Gold Production (Kg)	Value (Birr '000)
1995	112.0	9,041
1996	799.0	70,230
1997	755.0	51,235
1998	242.0	14,463
1999	3,291.0	233,565
2000	3,206.2	245,443
2001	4,641.0	369,870
2002	3,451.0	257,870

***Source**:- CSA.*

The domestic production of gold on average was 2,062 kg in the period 1995-2002. The domestic supply shows a significant growth attaining 3,600 kg for the last four years against 477 kg maintained in the first four years. The export of gold on the other hand shows that gold is entirely an export product. Exported gold is presented in Table 3.3.

Table 3.3
EXPORTED GOLD

Year	Exported Gold (MT)	Birr ('000)
1999	3	174,300
2000	5	260,044
2001	3	234,890
2002	5	300,715
2003	5	361,026

***Source**: NBE.*

2. Projected Demand

The current demand for gold is estimated based on the six year supply of gold in 1998-2002. The supply of gold to the world market during this period was on average 2,568 metric tonnes ranging between 2,500 and 2,600. The demand is expected to maintain the same level for the next ten years. The share of Ethiopian supply to the world market being a negligible, 0.2%, there is a wide possibility of growing Ethiopian gold supply.

3. Pricing and Distribution

The average gold price in 2003 was 350 USD per troy ounce or 11,254 USD/kg. The main gold price drive is the up and down movements in the US dollar. The expiry of the Central Bank Gold Agreement I (CBGA) in September 2004 and the Swiss National Bank continued selling 1,300 tonnes of gold (one half of its reserves) joined by lesser selling from other central banks will affect the price. Concern about central bank gold sales, prospects for more consolidations within the gold mining sector, will tend to keep gold prices depressed. In this study, however, Birr 60/gramme of gold is adopted.

The target market for gold being the export market, the product will be directly delivered to the customer.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

Each mining areas in the region has specific characteristics like type of deposit, mineralization, size, hydrography, etc. Basing on the market study and the data from the resource potential study by Hasse (1930), in the gravels of the Shogel and Nogel rivers (7 g/b), the envisaged small scale placer gold recovery plant is proposed to have annual capacity of 45 kg of gold. The plant will have a capacity of 3 t/h. (ore) working 8 hours a day & 300 days in a year.

2. Production Programme

Considering time required for technical skill development the plant is assumed to start production at 80% of its rated capacity in the first year, and raise its capacity to 90% in the second year and reach full capacity in the third year and thenafter.

IV. MATERIALS AND INPUTS

A. MATERIAL

The plant uses the ore with the placer gold in it as the main raw material. Mercury is the other raw material used for final concentration after gravity separation. But now-a-days, this mercury is 100% recycled by retorting the amalgam. So, the cost of this raw material is neglected. Therefore, the cost of raw material will be annual rentals to be paid and the royalty of 5%.

B. UTILITIES

The utilities necessary for the smooth operation of the plant are water for the gravity separation of gold from ore and fuel to run the generator and which inturn run the machinery of the plant water. 10,000m^3 of water and 30,000 lt of diesel is approximately consumed by the envisaged plant, annually. The total cost of utilities

assuming a rate of Birr 2 per m^3 for water and Birr 5.00 per litre for diesel is estimated at Birr 170,000.

V. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Production Process

There are two types of technologies to recover gold from ore, i.e., leaching using sodium cyanide and the gravitational separation. The latter method, gravitational separation and using mercury that can be recycled completely for final concentration of fine gold is adopted for the envisaged plant. Sodium cyanide has an adverse effect on the environment as well as the personnel working for the plant.

The production process involves:

- Milling with a hammer mill (100% less than 1mm);
- First concentration in spiral concentrator;
- Second concentration in a sluice using fine carpeting (alternate feeding to twin channel so as to facilitate timely washing of the carpets);
- Amalgamation of the concentrates in amalgamator drums;
- Retorting of the amalgam to separate the gold and recapture the mercury for later use; and
- Sorting of the clean tailings in a water reservoir, this at the same time serving to clarify the re-circulating water.

The recovery rate can be increased using finer milling and successive separators. The fact that almost all the mercury used will be recovered is crucial point here, it doesn't have adverse impact on the environment.

2. Source of Technology

U-TECH GRAVITY CONCENTRATOR SOLUTIONS provides a wide range of engineered products for the metallurgical and mineral processing industry. Further information can be obtained through the following address.

U-TECH Engineering and manufacturing,
website www. Gold Equipment. com.
E-mail Info@gold equipment. com.

B. ENGINEERING

The machinery and equipment required by the envisaged project are shown in Table 5.1. The total cost of machinery and equipment is estimated to be Birr 344,520, out of which Birr 275,616 is required in foreign currency.

Table 5.1

LIST OF MACHINERY AND EQUIPMENT REQUIRED

Sr. No.	Description	Quantity
1	Spiral concentrator	2
2	Sluice box	2
3	Generator	1
4	Pump	1
5	Hammer mill	1
6	Retort	1
7	Amalgamator tank	1
8	Feed hopper	1

2. Land, Buildings and Civil Works

The envisaged plant requires a total area of 1500 m^2 for the buildings, machinery and equipment and open area for future expansion. The built-up area is estimated at 500m^2. The plant also requires about 20,000 m^2 of mining area with a placer gold deposit. The land lease value, at a rate of Birr 1.2 per m^2 for 70 years of holding, is Birr 126,000. The total building cost, assuming construction rate of Birr 2000 per

m^2, is Birr 600,000. The total cost of land, building and civil work assuming that the total land lease cost will be paid in advance is estimated to be Birr 726,000.

3. Proposed Location

The plant should be located near the placer gold deposit and good, dependable and plentiful water supply. There are many deposit areas in the Metekel and Assosa zones but for the envisaged plant, SHOGEL (SHANGUL) area, which is studied by Hasse (1930) and reported to have placer gold of values 6.0 to 7.0 g/m^3 in the gravels of shogel and Nogel rivers is proposed as a location.

VI. MANPOWER AND TRAINING REQUIREMENT

A. MANPOWER REQUIREMENT

The proposed project will require 25 workers. The annual labour cost is estimated at Birr 135,750. The list of manpower required together with the corresponding salary payment is presented in Table 6.1.

Table 6.1
MANPOWER REQUIREMENT AND LABOUR COST (IN BIRR)

Sr. No.	Description	Req. No.	Monthly Salary	Annual Salary
1	Plant Manager	1	2,000	24,000
2	Secretary	1	700	8,400
3	Chemist	1	1,200	14,400
4	Geologist	1	1,200	14,400
5	Operators	4	600	7,200
6	Laborers	8	250	3,000
7	Mechanic	1	600	7,200
8	Electricians	1	600	7,200
9	Accountant	1	1,200	14,400
10	Driver	2	400	4,800
11	Guard	4	300	3,600
	Sub-Total			**108,600**
	Employees' Benefit (25% of sub-total)			27,150
	Grand Total			**135,750**

B. TRAINING REQUIREMENT

Since the technology chosen is simple, worker directly related with productions, operators, geologist, mechanics, electrician, and chemist need to be given on-the-job training for two weeks by the machinery suppliers. The training cost is estimated at Birr 50,000.

VII. FINANCIAL ANALYSIS

The financial analysis of placer gold recovery project is based on the data presented in the previous chapters and the following assumptions:-

Construction period	2 years
Source of finance	30 % equity
	70 % loan
Tax holidays	6 years
Bank interest	10.5%
Discounted cash flow	10.5%
Repair and maintenance	5 % of the total plant and machinery
Accounts receivable	30 days
Raw material, local	60 days
Work in progress	3 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 Birr 1.95 million, out of which about 14% will be required in foreign currency. Details are indicated in Table 7.1.

Table 7.1

INITIAL INVESTMENT COST ('000 BIRR)

Sr. No.	Cost Items	Foreign Currency	Local Currency	Total
1	Land	-	126.00	126.00
2.	Building and Civil Work	-	600.00	600.00
3.	Plant Machinery and Equipment	275.62	68.9	344.52
4.	Office Furniture and Equipment	-	100.00	100.00
5.	Vehicle	-	200.00	200.00
6.	Pre-production Expenditure*	-	385.25	385.25
	Total Investment cost	**275.62**	**1480.15**	**1,755.77**
7	Working Capital	-	189.97	189.97
	Grand Total	**275.62**	**1,670.12**	**1,945.74**

B. PRODUCTION COST

The annual production cost at full operation capacity of the plant is estimated at Birr 1.04 million (see Table 7.2). The material and utility cost accounts for 59 per cent while repair and maintenance take 4.51 per cent of the production cost.

** Pre-production expenditure include interest during construction (Birr 235,25), training (Birr 50,000) and costs of registration, licensing and formation of the company including legal fees, commissioning expenses, etc.*

Table 7.2

ANNUAL PRODUCTION COST ('000 BIRR)

Items	Year			
	3	**4**	**7**	**10**
Raw Material and Inputs	381.54	420.78	450.00	450.00
Labour direct	55.25	60.93	65.16	65.16
Utilities	139.90	154.29	165.00	165.00
Maintenance and repair	39.85	43.95	47.00	47.00
Factory overheads	23.02	25.39	27.15	27.15
Administration overheads	36.83	40.62	43.44	43.44
Total Operating Costs	**676.39**	**745.96**	**797.75**	**797.75**
Depreciation	146.25	146.25	146.25	76.25
Cost of Finance	136.46	128.10	97.38	55.93
Total Production Cost	**959.10**	**1,020.31**	**1,041.38**	**929.93**

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 the percentage of net profit to total sales, net profit to equity (return on equity) and net profit plus interest to total investment (return on total investment) will show an increasing trend throughout the production life of the project.

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

2. Break-even Analysis

The break-even point of the project is estimated by using income statement projection.

$$BE = \frac{\text{Fixed Cost}}{\text{Sales} - \text{Variable cost}} = 17\ \%$$

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 36 % and the net present value at 10.5% discount rate is Birr 3.49 million.

D. ECONOMIC BENEFITS

The project can create employment opportunities for 25 persons. In addition to supply of the domestic needs, the project will generate Birr 2.17 million in terms of tax revenue. Moreover, the Regional Government can collect employment, income tax and sales tax revenue. The establishment of such factory will have a foreign exchange earning effect to the country by exporting it's product.