

Estimation of fabrication cost for Different size of biogas plants in Chhattisgarh, India

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Abstract:

Total eighteen districts of CG were taken namely Raipur, Mahasamund, Dhamtri, Durg, Rajnandgaon, Kawrda, Bastar, Nararayanpur, Kanker, Daniewada, Bijapur, Bilaspur, janjgir-champa, Koraba, Surguja, Koriya, Raigarh and Jashpur during the years 2006-07 and 2007-08 to collect the data on capacity of biogas, Plants running hours, requirements of constructional material, labor etc. The fabrication cost of 2 m³, 3 m³ and 4 m³ was found Rs14011, Rs16446 and Rs22000, respectively. Total repair and maintenance charge per year for Deen Bandu model of size 2cum is Rs. 315. Total repair and maintenance charge per year for Drum type KVIC model of size 2cum is Rs. 615. Total repair and maintenance charge per year for Deen Bandu model of size 3cum is Rs. 345. Total repair and maintenance charge per year for Drum type KVIC model of size 3cum is Rs. 645. Total repair and maintenance charge per year for Deen Bandu model of size 4cum is Rs. 375. Total repair and maintenance charge per year for Drum type KVIC model of size 4cum is Rs. 675.

Keywords: Biogas, Deen Bandu model, KVIC, Operating cost, Repair & maintenance Charges, Size of biogas plants

Introduction

It is an era worldwide which attracts the attention of scientists, policy makers and the society to discover alternative source of energy which is sustainable and is associated with man, animal and nature. Animal rearing practices are essential component of life where, there is strong interdependent between cow and man in rural India. Cow generates energy not only in the form of nutrients such as milk but also provides bullock energy and dung. It is dung which is source of renewable energy in the form of biogas, dung cake. (Kumar Shailendra and Singh Neelam Kumar, 2019). In production of biogas through anaerobic digestion, animal excreta, human excreta and other agricultural wastes are used. The existing as well as future energy demands of the rural areas can be completed by biogas technology. It is the fourth largest source of energy in the world supplying about 13 per cent (55 EJ/Year), which is equivalent to 25 million barrels of primary energy (Shailendra Kumar¹, 2015). The common needs of the villagers such as organic fertilizers in large quantities, lighting and water supply cannot be met from individual plants as privately owned individual biogas plants are used mostly for cooking and the sludge for fertilizing the fields. It is estimated that some 60 per cent of the world's population live in rural areas of developing countries and rely on agriculture for their livelihood. About one billion people rely on residue as their principal cooking fuel. In many areas, particularly in Asia, the commercialization of bio-residues is a

source of modest income. At the same time it is a burden for poor people. Most often the utilization of bio-residue is associated with a very low efficiency and therefore, it has a high level of smoke emissions and a negative impact on health. Cattle dung is the main raw material used for biogas generation (Shailendra *et al.* 2016).

Material and methods

Survey was conducted with the help of questionnaire to fulfill the requirement of estimation. Cost of material is taken from different shapes and labor wages are used as per government norms. Charges of land are used by asking to the owners of biogas plants. Some assumptions are also taken. Simple calculation is as by using the formula given below-

Depreciation (D) : - It is the reduction in value with the passage of time. It is calculated by straight - line method

$$D = \frac{C - J}{L \times H}$$

C = Initial cost

J = Junk value (10% of the initial cost),

L = average life (year), based on feed back from field investigation

H = Working hours / year

Interest (I): - Interest was calculated by assuming interest rate @ 10 % annually, and calculated by using following formula

$$I = \frac{C + J}{2} \times \frac{i}{100} \times \frac{1}{H}$$

Where, I = Interest, Rs / h

i = Interest rate, %

Table -1 Estimation of fabrication cost for 2 cum size of biogas plant

S.N.	Particulars	Quantity	Rate @ Rs	Amount, Rs
1.	Land	6 m x 4 m	Rs. 42 / m ²	1008
2.	Constructional cost			
i.	Excavation cost	11.55 m ³	Rs 56 / m ³	648
ii.	Cement	16 Bags	Rs 200 / Bag	3200
iii.	Reti	50 ft ³	Rs 7 / ft ³	350
iv.	Gitti	50 ft ³	Rs 19 / ft ³	950
v.	Bricks	1200 Nos.	Rs 2800/1000	3150
vi	Steel Reinforcement	35 kg	Rs 50 / kg	1750
vii.	Meson/labor charge	Lump Sum	At local rate	1500
3	Stove Cost	1 Nos.	Rs 1000 / each	1000
4	Rubber pipe	10 m	Rs 18 / m	180

5	G.I. Socket	1 Nos.	Rs 25 / each	25
6	Bowl	2 Nos.	Rs 100 / each	200
7	G.I. pipe, 1" dia.	1m	Rs 50 / m	50
			Total, Rs	14 011

Calculation for working cost of 2 cum size of biogas plant in the region

Economic of biogas plant was estimated on the basis of hourly Working / operating cost of the plant. It was calculated as below: Following assumptions were made during the calculation.

- i). Installation cost including cost of land, : Rs. 14011= 00
 - ii). working life, as per formers perception : 20 yrs
 - iii). Annual working hours worked out based on survey : 1139 h
 - iv). Junk value considered 10 % of the initial cost
 - v). Interest rate considered 10 % (flat rate annual).
 - vi). Input dung value, into the digester = output dung in form of slurry.
 - vii). Operation cost was assumed as one rupee per 10 kg dung feeding
- Total working cost of biogas plant = Fixed cost + Operational cost

1). Fixed Cost:

a). Depreciation (D) : - It is the reduction in value with the passage of time. It is calculated by straight - line method.

$$D = \frac{C - J}{L \times H}$$

Where- C = Initial cost, Rs 14000 /-(rounded)

Sample calculation, $D = (14,000 - 1400) / (20 \times 1139)$
 $= \text{Rs } 0.55 / \text{h} \text{-----(i)}$

b). Interest

Sample calculation, $I = (14000 + 1400) \times 10 \times 1 / 2 \times 100 \times 1139$
 $= \text{Rs } 0.676 / \text{h} \text{-----(ii)}$

Therefore, Total fixed cost = (i) + (ii) = Rs 1.23 / h-----.....-(1)

II). Operational cost:

a). Repair and maintenance charge: Repair and maintenance charge was determined through personal interview of owners. It is shown in table 4.

As per actual expenditure of farmers / owners and as reported by the them, the annual expenditure in Repair and maintenance for 2 cum plants was = Rs 315

Therefore hourly charge = Rs 315 / 1139 = Rs 0.28 / h -----.....(i)

b) Labor charge: Time was noted in collection of dung, water and other operations. It is assumed that operational charge is 10 kg / Rs.

Labor charge = $(4.7 \times 365) / 1139 = 1.56 \text{(ii)}$

Therefore, Total Operational cost = .28 + 1.56 = 1.76

Total working cost Rs / h = Fixed cost + Operational cost

Total working cost Rs / h = 1.23 + 1.76 = Rs 2.99 / h

Table 2 Estimation of fabrication cost for 3 cum plant

S.N.	Particulars	Quantity	Rate	Amount, Rs
1	Land	6.30x4.30	Rs. 42/ m ²	1137
2	Constructional cost			
i.	Excavation cost	13.02 m ³	56/ m ³	729
ii.	Cement	19 Bags	200/Bag	3800
iii.	Reti	100ft ³	7/ft ³	700
iv.	Gitti	75ft ³	19/ft ³	1425
v.	Bricks	1500	2800/1000	3150
vi	Reinforcement	45 kg	50/kg	2250
vii.	Meson / labor charge		(At local rate)	1800
3	Stove	1	1000	1000
4	Rubber pipe	10m	18/m	180
5	G.I. Socket	1	25	25
6	Bowl	2	100/ Bowl	200
7	G.I. pipe, 1" dia.	1m	50/m	50
	Total			16446

1). Fixed Cost:

a) Depreciation (D): -

$$\begin{aligned} \text{Sample calculation, } D &= (16,500 - 1650) / (20 \times 1566) \\ &= \text{Rs } 0.47 / \text{h} \text{-----(i)} \end{aligned}$$

b). Interest (I): -

$$\begin{aligned} \text{Sample calculation, } I &= (16500 + 1650) \times 10 \times 1 / 2 \times 100 \times 1566 \\ &= \text{Rs } 0.676 / \text{h} \text{-----(ii)} \end{aligned}$$

$$\text{Therefore, Total fixed cost} = (i) + (ii) = \text{Rs } 1.05 / \text{h} \text{----- ..-(1)}$$

II). Operational cost:

a). Repair and maintenance charge:

$$\text{Hourly charge} = \text{Rs } 345 / 1566 = \text{Rs } 0.22 / \text{h} \text{-----...----(i)}$$

b) Labor charge:

$$\text{Labor charge} = (6.3 \times 365) / 1566 = 1.46 \text{(ii)}$$

$$\text{Therefore, Total Operational cost} = .22 + 1.46 = 1.68$$

Total working cost Rs / h = Fixed cost + Operational cost

$$\text{Total working cost Rs / h} = 1.05 + 1.68 = \text{Rs } 2.73 / \text{h}$$

(Shailendra, 2008)

Table-3 Estimation of Fabrication cost for 4 cum plant

S.N.	Particulars	Quantity	Rate	Amount, Rs
1	Land	6.60x4.60	Rs. 42/ m ²	1275
2	Constructional cost			
i.	Excavation cost	16.02 m ³	56/ m ³	907
ii.	Cement	26 Bags	200/Bag	5200
iii.	Reti	125ft ³	7/ft ³	875
iv.	Gitti	100ft ³	19/ft ³	1900
v.	Bricks	2000	2800/1000	5600
vi	Reinforcement	50 kg	50/kg	2500
vii.	Meson/labor charge			2200 (At local rate)
3	Stove	1	1000	1000
4	Rubber pipe	10m	18/m	180
5	G.I. Socket	1	25	25
6	Bowl	2	100/ Bowl	200
7	G.I. pipe, 1" dia.	1m	50/m	50
	Total			21912 = 22000, rounded

Table D-4 Maintenance and repairing charge per year for biogas plants

	Appliances	Service life		Rate		Amount Rs/year
		Repairing	Replacements	Repairing	Replacements	
1	Burner knob	-	3-4 months	-	10	50
2	Burner	3-4 months	-	20	-	70
3	Hose pipe	-	10 years	-	350	35
4	Stove	-	10 years		1000	100
5	Cleaning of digester	5-years	2 m ³	-	300	60
			3 m ³	-	450	90
			4 m ³	-	600	120
			6 m ³	-	800	160
			8 m ³	-	1100	220
6	Drum Only for FD model	Painting with Enamel paint	-	300	--	300
	Total	For FD (2 m ³)				615

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