SESSION FIVE

INSTALLATION COST AND INANCIAL VIABILITY

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Installation Cost And Financial Viability

5.1 Introduction

In the context of Nepal, biogas is known more as a technology for meeting household energy requirements than its other utilities. Even this limited view of the technology is significant since a large number of population could be benefited by it. Having discussed various utilities of the technology in previous sessions, this session is devoted to the economics of the technology mainly as units for the production of biogas and slurry at the household level. By the end of this session, the participants will be able to:

– explain the concept, terminology and "norms" used to assess financial viability of family size biogas plants:
– explain different factors that affect the financial viability of a biogas plant; and
– assess the financial viability of a family size biogas plant.

5.2 Financial Analysis

Financial analysis is the most commonly used tool that helps to decide whether a user benefits by installing a biogas plant and, if so, by how much. The basic underlying assumption for financial analysis is that people will adopt a new technology only if they expect it to have a positive impact in their financial situation.

In financial analysis, all costs and benefits arc valued from die point of view of the user for whom this is being done. Since this analysis is undertaken before making a decision to install the plant, it is important to ensure that all costs and benefits are estimated as they are most likely to be realized by the user after the plant installation.

Benefits and costs of a biogas plant will vary depending upon the use of inputs and outputs by the particular user. For example, if additional cost is incurred in the use of inputs, such as the need to buy cattle dung or use additional labour for feeding the plant, such cost should also be included in the financial analysis.

The financial analysis should show when the cost and benefit accrue or how they are distributed over the project period. To make the analysis more comprehensive, costs and benefits should be reflected for each year of the project life. It should include all those costs and benefits that arc changed or influenced by the use of the technology. Any change in costs and benefits that are not related to the use of biogas should not be included in assessing the financial viability of a biogas plant.

The major parameters that need to be considered for the financial viability, of biogas plants are discussed below.

5.2.1 Project Life

A fixed dome type plant could last for more than 40 years depending on the quality of construction and the materials used. However, the economic life of a plant is taken as 20 years mainly because any cost or benefit accrued after 20 years will have insignificant value when discounted to the present worth. Hence, in the calculations in Tables 5.1 and 5.2 (for 10 m^3 plant), it is assumed that the plant will become non-functional by the end of 20^{th} years from its first day of commissioning. Similar calculations for a 8 m^3 plant are shown in Tables 5.3 and 5.4.

5.2.2 Benefits and Costs

Benefits or Inflow

Unpriced benefits : All benefits of a biogas plant can not be readily priced or even compared with the price of similar products or services in the market. For example, it is difficult to put a money value for the benefit of cleaner homestead or decrease in the population of harmful pathogens in the slurry.

There are economic tools which can be used to assign money value for such benefits. But they are not only sophisticated to use but are also not free from controversies. To make the financial analysis as simple and comprehensive as possible, all benefits arc generally not included. However, it is worth noting that such benefits do accrue to individual users and should have been accounted for, had there been any simple method. This indicates that even if the financial analysis shows zero net benefit of installing a biogas plant, it should be interpreted as having positive net benefits owing to the unpriced factors.

One of the ways to account for all unpriced benefits is to prepare an exhaustive list of such benefits, assign weightage (some numerical figure) to each category of benefits depending upon their importance as preferred by the family (for financial analysis) and by society (for economic analysis). Such numbers are then processed to arrive at a single number that could be used as an objective basis for the decision making.

Biogas technology also provides additional resource base which opens new opportunity for financial gains in the future. For, example, with the availability of slurry, a farmer may decide to profit from raising pig or fish as the slurry could supplement as high as 30 percent of their feed leading to a substantial decrease in the cost of production. But such "possible benefits" should not be included in the financial analysis until there is a strong reason to believe that such opportunity will actually be realized by the user in a definite time frame in the future.

Indirect Valuation : There arc some forms of benefits of a biogas plant that can be priced by using indirect methods. For example, saving in the use of kerosene and/or firewood due to the use of a biogas plant could be quantified and their prices can be obtained from the local market. In such case, benefit of a biogas plant is realized by the family in terms of the cost avoided in purchasing fuelwood and/or kerosene. Use of biogas in a family may lead to saving in both kerosene and firewood. In such cases, it would be erroneous to price all energy values of a biogas plant with only one of the substitutes.

The indirect valuation for financial analysis should give due considerations to what actually happens to the family for which the analysis is done. For example, if it does not cost anything for a particular farmer to collect firewood, then it would be erroneous to use the price of firewood in the market as benefit or the cost avoided in doing the financial analysis for that particular farmer. In such case, it would be more relevant to calculate only the value of labour saved which otherwise would have been spent in collecting firewood. An analysis on this basis may show that investment in a biogas plant is not a profitable proposition for people who do not buy firewood or get it at a very low price.

Valuation of Lighting Benefits : Biogas is also used for lighting along with its use for cooking. The benefit of lighting could be quantified in terms of cost saved by reducing the use of kerosene or paraffin candles or electricity depending on what was used before the installation of the biogas plant.

Table 5.1
Financial Analysis of a 10 m^3 Biogas Plant (With Loan and Subsidy)

(in Rs.)

Year	1	2	3	4	5	6	7	8 to 20
Benefits								
To Non-Users								
- Forest Conservation								
Unpriced								
- Sanitation/Environment								
- Health								
- Tourism (New Opportunities)								
Indirectly Priced								
- Saving Firewood	5.519	5,519	5.519	5.519	5,519	5,519	5,519	5.519
- Saving Kerosene/Candle								
- Saving In Time/Labour	6,200	6,200	6,200	6.200	6,200	6,200	6,200	6,200
- Saving Feed								
Salvage Value								
Increased Crop Yield								
Loan	17,056							
SUB TOTAL	**28,775**	**11,719**	**11,719**	**11,719**	**11,719**	**11,719**	**11,719**	**11,719**
Costs								
- Investment	17.056							
- Operation								
- Maintenance	700	700	700	700	700	700	700	700
- Loan Repayment		4,629	4,629	4.629	4.629	4,629	4,629	
- Others								
SUBTOTAL	**17,756**	**5,329**	**5,329**	**5,329**	**5,329**	**5,329**	**5,339**	**700**
NET BENEFIT	**11,019**	**6,390**	**6,390**	**6,390**	**6,390**	**6,390**	**6,390**	**11,019**

IRR = Above 50 percent NPV = 51,337 BCR = More than *2*

Table 5.2
Financial Analysis of a 10 m^3 Biogas Plant (Without Loan and Subsidy)

(in Rs.)

Year	1	2	3	4	5	6	7	8 to 20
Benefits								
To Non-Users								
- Forest Conservation								
Unpriced								
- Sanitation/Environment								
- Health								
- Tourism (New Opportunities)								
Indirectly Priced								
- Saving Firewood	5,519	5,519	5,519	5,519	5,519	5,519	5,519	5,519
- Saving Kerosene/Candle								
- Saving In Time/Labour	6,200	6,200	6,200	6,200	6,200	6,200	6.200	6.200
- Saving Feed								
Salvage Value								
Increased Crop Yield								
Loan								
SUBTOTAL	**11,719**	**11,719**	**11,719**	**11,719**	**11,719**	**11,719**	**11,719**	**11,719**
Costs								
- Investment	24,056							
- Operation								
- Maintenance	700	700	700	700	700	700	700	700
- Loan Repayment								
- Others								
SUBTOTAL	**24,756**	**700**	**700**	**700**	**700**	**700**	**700**	**700**
NET BENEFIT	**(13,037)**	**11,019**	**11,019**	**11,019**	**11,019**	**11,019**	**11,019**	**11,019**

IRR = Above 50 percent NPV = 45,303 BCR = More than 2 US$ 1 00 = NRs. 56.00

Table 5.3
Financial Analysis of a 8 m^3 Biogas Plant (With Loan and Subsidy)

(in (Rs.)

Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Rio 20**
Benefits								
To Non- Users								
- Forest Conservation								
Unpriced								
- Sanitation/Environment								
- Health								
- Tourism(New Opportunities)								
Indirectly Priced								
- Saving Firewood	4,415	4,415	4,415	4.415	4,415	4,415	4,415	4,415
- Saving Kerosene/Candle								
- Saving In Time/Labour	6,200	6,200	6,200	6,200	6,200	6,200	6,200	6,200
- Saving Feed								
Salvage Value								
Increased Crop Yield								
Loan	**14,281**							
SUBTOTAL	**24,896**	**10,615**	**10,615**	**10,615**	**10,615**	**10,615**	**10,615**	**10,615**
Costs								
- Investment	14,281							
- Operation								
- Maintenance	700	700	700	700	700	700	700	70U
- Loan Repayment		3,876	3,876	.1,876	3,876	-1.876	3,876	
- Others								
SUB TOTAL	**14,981**	**4,576**	**4,576**	**4,576**	**4.576**	**4,576**	**4,576**	**700**
NET BENEFIT	**9,915**	**6,039**	**6,039**	**6,039**	**6,039**	**6,039**	**6,039**	**9,915**

IRR - Above 5(J percent NPV = 47,1 S3 BCR - 2.64

Table 5.4
Financial Analysis of a 8 m^3 Biogas Plant (Without Loan and Subsidy)

(in Rs.)

Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8 to 20**
Benefits								
To Non-Users								
- Forest Conservation								
Unpriced								
- Sanitation/ Environment								
- Health								
- Tourism (New Opportunities)								
Indirectly Priced								
- Saving Firewood	4.415	4,415	4.415	4,415	4,415	4,415	4.415	4,415
- Saving Kerosene/Candle								
- Saving In Time/Labour	6,200	6,200	6,200	6,200	6.200	6,200	6,200	6,200
- Saving Feed								
Salvage Value								
Increased Crop Yield								
Loan								
SUBTOTAL	**10,615**	**10,615**	**10,615**	**10,615**	**10,615**	**10,615**	**10,615**	**10,615**
Costs								
- Investment	21.281							
- Operation								
- Maintenance	700	700	700	700	700	700	700	70!)
- Loan Repayment								
- Others								
SUBTOTAL	**21,981**	**700**	**700**	**700**	**700**	**700**	**700**	**700**
NET BENEFIT	**(11,366)**	**9,915**	**9,915**	**9,915**	**9,915**	**9,9 IS**	**9,915**	**9,915**

IRR = Above 50 percent NPV = 411,50 BCR = 2.83 US$ 1.00 = NRs 56.00

Biogas lamps provide more reliable lighting than the electricity (in areas suffering from frequent load shedding) and better light than kerosene. However, the value of "such convenience can not be readily priced. As lighting forms very small part of the benefit stream, its value is not included in the analyses.

Salvage Value : The salvage value of biogas plant is not included in the benefit stream of financial analysis because after 20 years of operation, the plant or its parts will not be re-salable.

Value of Cooking Fuel Saved : In the general form of financial analysis, only those items that can be quantified and priced are included in the stream of benefits that accrue over a project or plant operation period. One of the most important uses of biogas for a family is its gas for cooking. Most of the rural households use firewood for cooking. With this assumption, it is the quantity and value of the firewood saved that becomes the benefits of the biogas plant. For a family that used to cook in kerosene stoves prior to the installation of the biogas plant, it is the price of kerosene saved that makes the benefit stream, hi this session, die price of firewood saved is taken as one of the benefit components.

Problems associated with the collection, storage and use of fuelwood are avoided by the availability of gas. These are the most appreciated benefits of the plant also in terms of reducing the drudgery of women who arc responsible for most of these activities. In this session, all firewood saved is valued at Rs 2.00/kg, based on the market price of the Timber Corporation of Nepal (TCN) for the year 1996.

The examples in Tables 5.1 to 5.4 reflect the situation of a user who used to buy firewood from the TCN before the installation of the plant and docs not have to buy any firewood afterwards. Relevance of such assumption should be checked and appropriate value should be used to best reflect the real life situation in a given context.

The relationships between the quantity of gas produced, the amount of firewood saved and the value of such savings for different plant sizes are presented in Table 5.5 based on the following assumptions:

- 6 kg of dung is required per m^3 size of biogas plant
- 0.036 m^3 of gas is produced per kg of fresh cattle dung
- 1 m^3 of gas is equivalent to 3.5 kg of firewood
- The cost of firewood is Rs 2.00/kg

In such calculations, care should be taken to value the quantity of firewood saved and not the value of the total gas produced as equivalent to the cost of firewood. These two values may differ in cases when either all the gas produced is not consumed or occasional use of firewood become necessary due to low production of gas such as in the winter. Preliminary case studies have shown that biogas replaces about 80 percent of the firewood consumption as users generally continue to use firewood for heating animal feed, cooking food in winter when gas production is low (Devkota, 1994). In this session, it is assumed that all gas produced is fully consumed and there is no need to use firewood even in the winter (Tables 5.1 to 5.4).

Valuation of Time Saved : As discussed in Session Two, on an average, biogas household women either spent an additional 15 minutes or gained up to 4.5 hours per day depending on access to forest and water. Another study with 100 biogas households in 16 districts has reported an average net labour saving of 3 10 hours. In all these studies, the availability of firewood and water were the critical factors to determine the extent of labour saved (East Consult, 1994).

Thus the labour time saved can be used for leisure or for other economic activities. Putting money value on leisure requires dealing with sophisticated economic principles. An acceptable alternative way is to assume that the labour saved could be used in other economic activities or could be directly sold in the local labour market. Assumptions that need to be made in doing such valuation should be based on

Table 5.5
Cost Estimation of Firewood in Terms of Gas and Simple Pay Back Period of Family Size Biogas Plants

Plant Size (m^3)	Required Qty of Dung (kg/day)	Gas Produced (m^3/day)	Gas Produced (m^3/yr)	Firewood Equivalent of Gas (kg/yr)	Annual Cost of Gas in terms of Firewood (Rs)	Total Cost of a Plant in the Plains (Rs)	Simple Payback (yr)
4	24	0.864	315.36	1,103.76	2,208	15,610	7.1
6	36	1.296	473.04	1,655.64	3,311	18,049	5.5
10	48	1.728	630.72	2,207.52	4,415	21,281	4.8
15	60	2.160	788.40	2,759.40	5,519	24,056	4.4
20	90	3.240	1,182.60	4,139.10	8,278	30,253	3.7
	120	4.320	1,576.80	5,518.80	11,038	36,286	3.3

existing rate of employment and market wage rate for the unskilled labour, as in shown below assuming 3:06 hours are saved from the installation of a biogas plant:

$$Y = \frac{3.10\,hr \times 365\,days}{7} \times P \quad \ldots\ldots\ldots\ldots \quad (5.1)$$

Where,

Y	=	value of saving in time
3.10 hr	=	gross saving in time for fuelwood collection, cooking and cleaning of utensils (3 hours 6 minutes) expressed in decimals (see Table 2.4).
7	=	working hour per day of female labour {as such works are generally done by the females and the labour wage rates are different for men and women)
P	=	current market wage rate for women (Rs 70/day)

The money value of above calculation comes to be Rs 11,315. If the average employment in agricultural activities for women is about 200 days a year, then the value for 200 days, which is Rs 6,200, should be used for financial analysis.

Valuation of Slurry : Slurry from a biogas plant is known to have better influence on soil and its productivity compared to the use of fresh or composted dung. During the process of anaerobic digestion, some enzymes and vitamins arc produced. Also, bio-chemical composition of some of the nutrients such as nitrogen is changed and becomes more readily available for plants. Because of the cumulative effect of these elements in biogas slurry, its value as feed and manure is enhanced.

The money value of such benefits depends on whether the slurry is actually used and the benefits realized by the particular user for whom the financial analysis is done. For example, if the slurry is not used for feeding pigs, then it is not relevant to include the potential benefit of such use in the financial analysis. Similarly, the manure value of slurry can not be included in the financial analysis if the potential increase in crop yield is not actually realized by the use of slurry. However, it should be noted that slurry has a potential to increase the income or saving of a farmer and needs to be considered whenever it is very likely that the actions will be taken to realize such benefits.

A review of literature shows different ways of putting money value to slurry (APROSC, 1988). One of the commonly used methods is to put money value to the increased amount of N, P and K in the slurry compared to the content in the dung. The market prices of N. P and K in chemical fertilizers arc taken as the basis for such calculation. Based on the same principle, the increased quantity of protein in the slurry could be valued if the slurry is to be used as a part of cattle feed and not as manure. In this approach, there is more degree of uncertainty in realizing the expected benefits (Rubab and Kandpal. 1996).

A more direct approach would be to put the value of incremental benefit from a system in which the slurry is used. For example, if the authentic research data show that the yield of corn is increased by, say. 30 percent with the application of biogas slurry, then this increase could be shown as a part of benefit stream after considering the cropped area and the present yield. This approach is more reliable as it takes account of the process through which the ingredients of slurry are transformed into products that have market price.

Costs or Outflow

Investment Cost : The cost of a digester differs with time, space and so many other factors as shown in Chart 5.1. However, about 40 percent of the cost of a biogas digester remains independent of the digester size in the range of 6 to 20 m^3

Of the total investment cost, the construction cost alone amounts to 71 and 81 percent for plants of 20 and 4 m^3, respectively The most expensive item is cement followed by gas pipes. The general distribution of total investment cost to individual items for a typical 10 m^3 size biogas plant is shown in Chart 5.2.

In the beginning of each fiscal year, all biogas companies publish their quotations for constructing different sizes of plants. These quoted costs vary among companies reflecting their differences in overhead costs. The distribution of overhead cost of GGC in the fiscal year 1991/1992 is shown in Chart 5.3. This cost structure of GGC shows a higher proportion of cost for personnel. This is because, actual construction activities can not be carried out throughout the year due to weather conditions, particularly the monsoon. Some of the staff have still to be retained throughout the year to ensure their availability at the time of need (Gutterer and Sasse, 1992).

The quotations of companies also vary within a year to reflect the change in market prices of construction materials. Therefore, the results of the financial analysis for a particular size of plant will also vary within the year of construction and the company that constructed it. However, Nepal Biogas Promotion Group (NBPG) is considering the possibility of starting a single price quotation (for a given plant size) which is applicable to all companies.

All biogas companies are in the private sector and do not receive any institutional subsidy. All of their institutional cost have to be reflected in the plant cost that<they charge to the users. With the increasing competition among the companies, each company is now pressed to reduce its overhead costs by using part-time staff and curtailing involvement in research, education and extension.

In this session, the installation (investment) costs for different size biogas plants are taken from the quotations of GGC for the year 1996. Generally, the installation costs are different foi plants in the hills and plains (Terai), as the plains is more accessible. The use of biogas is found to be relatively higher in the plains than in the hills. Because of this, prices for the plains are taken in the examples of this session. The cost breakdown of different sizes of biogas plants is presented in Table 5.6.

The investment cost includes :

– cost of unskilled labour to be provided by farmers;
– all overhead costs borne by a biogas company,
– provision for penalty on construction defaults;
– 1 year guarantee on pipes and appliances;
– 6 years guarantee on inlet, digester, dome and outlet;
– 6 years after-sales-services (including yearly visit); and
– participation fee (Rs 500 per plant).

However, transport cost of building materials, pipes and appliances are excluded.

O&M Cost : The O&M cost includes the labour time needed to collect water and mixing of dung which is estimated at 0:39 hrs per day per labour. This cost is already accounted for in the financial analysis when the net saving in time is considered (Activity Nos. 1 and 2, Table 2.4).

In addition to the time spent on O&M, additional cost may accrue in changing gas valves, mantle and glass of lamps, and procuring technical support services from biogas companies. In this session, it is grossly estimated that about Rs 700 is spent to meet other expenses such as changing of mantel and traveling cost to nearby biogas company for technical help. BSP assumes this cost to be negligible.

Table 5.6

Material Requirement and Breakdown of Cost of 4 m\ 6 m^3 8 m^3, 10 m^3, IS ra^3 and 20 m^3 Biogas Plants

Description	Unit	Unit Rate	4 m^3		6 m^3		8 m^3		10 m^3		15 m^3		20 m^3	
			Qty	**Price**	**Qty**	**Price**	**Qty**	**Price**	**Q«y**	**Price**	**Qty**	**Price**	**Qty**	**Price**
A. Construction Materials														
- Cement														
Plains	Bag	280.00	11	3,080	13	3,640	16	4,480	19	5.320	27	7,560	34	9,520
Hills	Bag	280.00	12	3,360	14	3.920	18	5,040	21	5.880	30	8,400	37	10,360
- Bricks or Stones	Piece	2.00	1200	2,400	1400	2,800	1700	3,400	2000	4,000	2400	4.800	2800	5.600
- Sand	Bag	15.00	60	900	70	1.050	80	1,200 .	90	1,350	110	1.650	120	1.800
- Gravel/Aggregates	Bas	12.00	30	360	35	420	40	480	50	600	60	720	70	840
B. Biogas Appliances				2,460		2,805		3,360		3,625		4,215		4.825
C. Pipe and Pipe Fittings				990		1,014		1,071		1.071		1,448		1.821
D. Reinforcement Steel	Kg	30.00	9	270	9	270	13	390	13	390	17	510	41	1,230
E, Labour (unskilled)	MD	60.00	20	1,200	25	1,500	30	1,800	35	2.100	45	2,700	55	3,300
F. Construction and One Year				2,450		3.0J0		3,600		4,100		5,150		5,850
G. 5 Year Guarantee Charge for the Plant				1,000		1,000		1,000		1,000		1,000		1,000
H. Participation Fee				500		500		500		500		300		500
TOTAL Plains:				**15,610**		**18,049**		**21,281**		**24,056**		**30,253**		**36,286**
Hills:				**15,890**		**18,329**		**21,841**		**24,616**		**31,093**		**37,126**

Source : GGC, 1996 US$ 1.00 = NRs 56.00

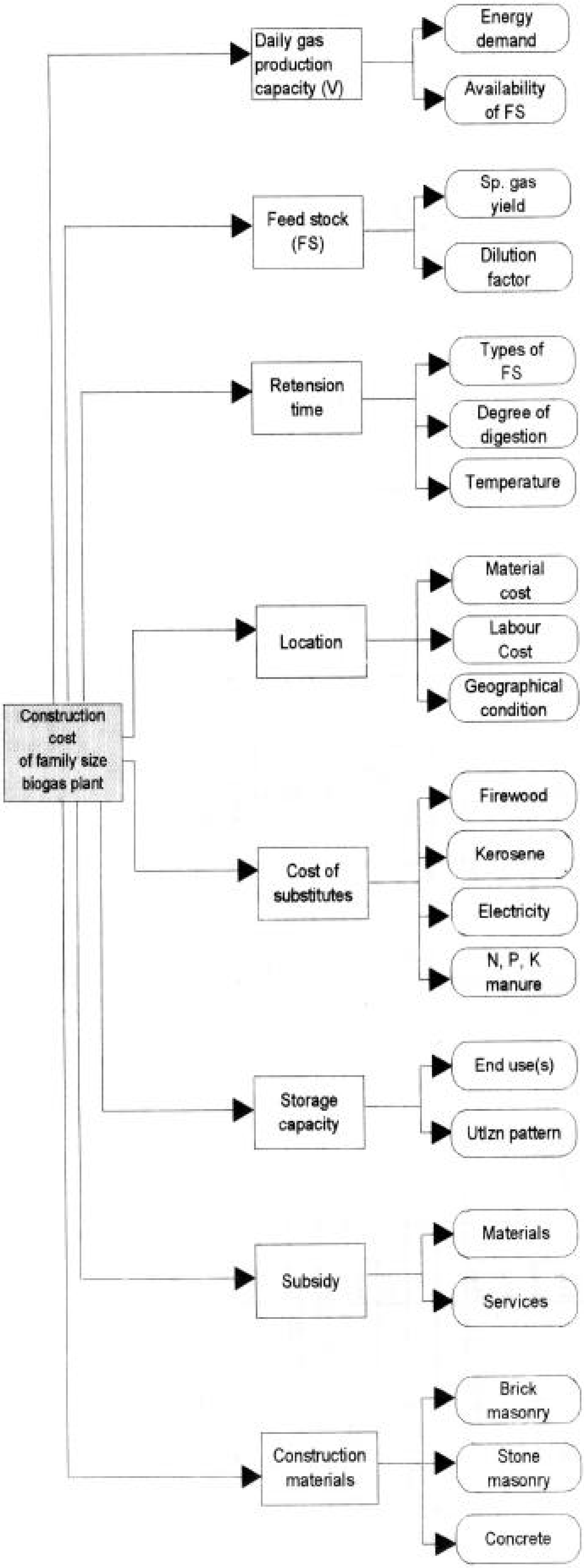

Chart 5.1 Factors Influencing the Financial Viability of a Biogas Plant

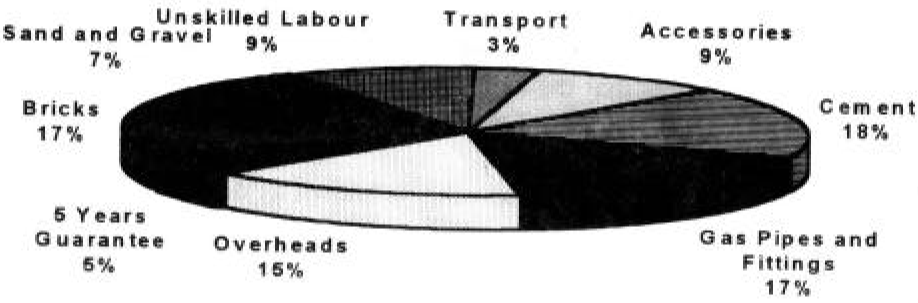

Chart 5.2 Cost Distribution of a Biogas Plant

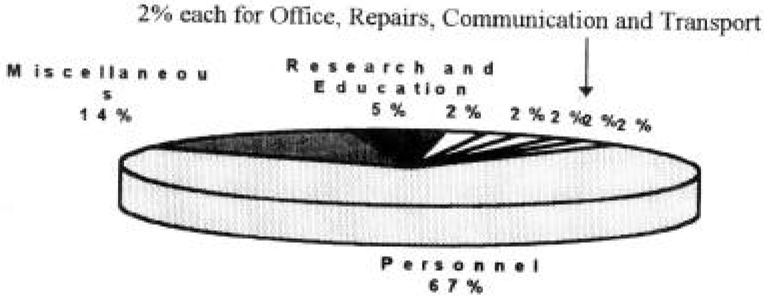

Chart 5.3 GGC Overheads in 1990/1991

5.2.3 Cash Flow Analysis

The basic procedure of a cash flow analysis is to enter all the year-by-year income to be received over the estimated life of the project as *Inflows* Similarly, yearly expenditures are entered in the analysis as *Outflow*. Finally, for each year, expenditure is deducted from the income. The result thus arrived at is the net cash flow or net benefit. Generally, in the initial year(s) of the project, the net cash flow or net benefit tends to be negative, because of the expenditures incurred to meet the establishment costs (Gittinger. 1982).

5.2.4 Time Value of Money and Discount Rate (Factor)

The real value of money changes over time. The reasons for such changes are:

- money of today can be invested to earn a return in the future; and
- people have time preference, i.e. they prefer now to the future.

For example, if Rs 100 is invested today at an interest rate of 20 percent per annum, this will be worth Rs 120 in a year's time, Rs 144 after two years, etc.

5.2.5 Net Present Value

As the costs and benefits *of* a project are spread over the useful years of project life, they need to be expressed in terms of one common denominator to make the comparison possible. Once the annual cash flow of a project is derived, it needs to be discounted so that all values could be compared to the value of a single year. This discounted net cash flow will provide a widely used criterion for measuring the profitability of a project. For this purpose, all future values are discounted to make them equivalent to the present value and is expressed as Net Present Worth (NPW) or Net Present Value (NPV).

The NPV technique measures the worthiness of a project by converting the annual cash flow to a single present value. A positive NPV indicates that the benefits are higher than the costs that accrue over the project life.

The process of relating future amount to the present value is known as discounting and is expressed by the following equation.

$$P = \frac{F}{(1+r)^n} \qquad \text{.......} \qquad (5.2)$$

Where,

P = present sum of money
F = future sum of money
r = rate of interest
n = number of years

Choice of Discount Elate : The commonly used discount rate is the rate of interest that a bank charges on loans and the opportunity cost of capital in situations where private capital is being committed. The on-going interest on biogas loan is 16 percent. Therefore, the NPV and Benefit-Cost Ratio (BCR) are calculated in Tables 5.1 and 5.2 at the discount rate of 16 percent.

5.2.6 Internal Rate of Return (1RR)

IRR, a most widely used measure of project profitability, is defined as the discount rate which makes the NPV of a project zero. In other words, IRR is that discount rate which makes the discounted benefits of a project equal to its discounted costs IRR can also be viewed as the interest rate that the investment pays to the user. Calculation of IRR requires trial and error methods. The NPV needs to be calculated assuming several discount rates until the value is zero. The following equation (based on interpolation) can be used to derive an approximate value of IRR.

$$IRR = \frac{r_1 . NPV_2 + r_2 . NPV_1}{(NPV_1 + NPV_2)} \qquad \text{.......} \qquad (5.3)$$

Where,

r_1 = discount rate of positive value of NPV

r_2 = discount rate of negative value of NPV

NPV_1 = value of positive NPV

NPV_2 = value of negative NPV

The IRR for biogas plants as calculated in Tables 5.1 to 5.4 is above 50 percent in both cases, i.e., with and without subsidy. This indicates that the return on investment made for the installation of a biogas plant is far above the opportunity cost in the capital market which is about 16 percent for loan.

5.2.7 Benefit-Cost Ratio

The benefit-cost ratio (BCR) is another tool for assessing the profitability of a project. If the ratio is greater than unity (i.e. B/C > 1.0), the rule of thumb is to accept the project. In this example, the BCR is above 1.0 in both with and without subsidy cases.

5.3 Discussion on Result of Financial Analysis

The net cash flow of a 10 m^3 biogas plant with subsidy situation is positive in the first year whereas it is negative without the subsidy {Tables 5.1 and 5.2). This indicates that without subsidy, a user has to invest about Rs 13,000 to get a positive return on investment. This is beyond the investment capacity for a general farmer- This further strengthens the argument for the need of subsidy. Furthermore, the present level of subsidy is very near to make the cash flow positive from the first year onwards.

Another factor to notice in the example is the higher benefit of biogas plant use in terms of the labour saved than the saving in firewood. This suggests that the biogas plant may not be viewed as profitable if the labour saved is not used for generating income for the family or in cases where the family attaches no value to all other benefits of the biogas plant such as leisure, clean homestead, and better health. The results in Table 5.1 also reveal that if about 70 percent of the time saved due to the biogas plant is used for income generating activities at the on-going market wage rate, the user will be able to pay the loan component.

The present bank policy requires a user to pay back the loan within seven years in six installments starting from the second year of plant installation. The annual payment of loan is less than the cost saved in firewood. In other words, even if the cost of firewood is reduced by 20 percent, the farmer would still be able to pay back the loan. Furthermore, the profitability of investment in biogas will increase with the increase in the price of firewood in the future.

Considering the generally low le vel of income of farmers and the nature of benefits from biogas which is 'indirect', doubts are expressed whether a majority of biogas loan users can actually repay the loan. The ADB/N's experience in this regard has been very positive as the biogas sector lending has minimum defaulters compared to lending in other sectors. The average percentage of overdue on outstanding loans for the period 1988/89 to I993AH was about 12 percent for biogas loans compared to 35 to 40 percent for all loans of ADB/N (BSP, 1996).

5.4 Financial Viability Assessment as Practiced by ADB/N

It is the staff of nearby ADB/N office who assesses financial viability of an user application for biogas loan. The standard format used for all types of enter prizes seeking loan is also used for assessing the viability of loan for biogas. In practice, the field staff do not undertake an in-depth analysis as discussed in this session.

ADB/N takes the quotation from the concerned biogas company (which the user wants to use for plant construction) as a basis to fix the investment cost required by the user. This cost is taken as one time investment loan.

To assess the benefit, the user is asked about the quantity of firewood and/or kerosene consumed. These quantities arc then multiplied by on-going prices in the local market. Thus calculated annual cost is taken as equivalent to annual benefit assuming that the biogas will replace all of the present consumption of firewood and/or kerosene. This benefit is then multiplied by six or seven years to arrive at total benefit that will accrue within the guarantee period of six years.

Then, the user is asked about other sources of income which will be used to repay the loan. The loan has to be fully repaid with interest within seven years at the most. An annual or bi-annual repayment schedule is fixed in agreement with the user.

5.5 Indicators of Financial Viability of Biogas Plants

ADB/N is the main rural credit agency that provides most of the credit requirement of the biogas sector, In its lending portfolio, biogas ranks the topmost sector for good lending or minimum number of defaulters. In other words, compared to other types of clients, biogas users are able to repay the loan with interest in time.

Before 1993, the subsidy was tied up with the bank loan. People who are willing and able to use their own saving for investment had to go through bank loan in order to receive government subsidy. However, such a mandatory requirement has now been removed. Since 1993, the number of plants constructed by users with their own saving has been increasing every year.

5.6 Economic Analysis

Some of benefits and costs of biogas plants arc not limited to the users. For example, if a large number of biogas plants are installed in a community, the non-users will also be benefited due to a cleaner community and conservation of forest in the area. Such benefits and costs that accrue even outside of the user household is a subject matter of economic analysis and not of financial analysis. A single biogas plant docs not significantly affect the economy as a whole. Therefore, economic analysis may not be relevant for a single plant but is of an immense importance at the community programme level where the impact of the programme on the economy is assessed. Economic analysis measures the effect of biogas programme on the fundamental objectives of the whole economy (van der Tak. 1975).

Many countries are at the initial stage of realizing their potential for biogas installation. Because of this, very little literature is available on the case study of economic analysis compared to case studies on financial analysis.

The accounting system or procedures developed for financial analysis could also be used for economic analysis except that the time of costs and benefits has to be valued in terms of the marginal productivity of resources used by a biogas plant.

Difficulties involved in identifying all items of costs and benefits and adjusting their market prices to reflect social preferences have been the major limitation of the economic analysis. This situation requires some level of generalization, simplification and even some restrictive assumptions.

It should be noted that even if the technology proves to be economically viable, the decision to adopt the technology by a single household may not be guided by national considerations. Also, the implementation of programmes for municipal waste treatment need not necessarily be economically viable because of the greater need of the society to deal with the existing pollution problems.

5.6.1 Economic Valuation of Firewood

Use of firewood for cooking by a family has negative effect on the density of forest area in the locality, which in turn affects the micro-climate of the area and thus the society. Therefore, economic price of firewood has to be higher for the society than to an individual resulting into higher economic rate of return on the investment.

NPC has yet to declare a single value for firewood that would reflect the social cost or benefit of it. The AsDB Report No NEP AP-24 (1980) has treated firewood as non-traded goods and valued it at lower than the financial price, whereas an APROSC study (1986) has valued it at 9 percent higher than the financial price. Another case study conducted by Krishna M Gautam in 1988 for APROSC has taken economic price of firewood as 20 percent higher than the financial price.

5.6.2 Economic Valuation of Kerosene

It is easier to arrive at the economic value of kerosene as it is readily marketed and the money value of subsidy in it can be calculated. Kerosene is imported from India and payment is made in Indian Currency (IC). Assuming that the official exchange rate between Nepalese Rupees (Rs) and IC would fully reflect the true economic value of goods traded with these currencies, the border price paid by Nepal is taken as the economic price of kerosene. About 10 percent is added to this price to reflect the economic cost involved in transportation and handling of kerosene within the country (Gautam, 1988).

5.6.3 Economic Valuation of Labour

The use of biogas results in the saving of unskilled labour time. A wage rate for unskilled labour has to be reduced by a factor that would reflect the cost of subsistence. Gautam used a factor of 0.65 to arrive at the economic wage rate of an unskilled labour.

5.6.4 Value of Slurry

Slurry is valued for its content of soil nutrients, particularly N, P and K As all chemical fertilizers in Nepal are imported, the economic values of N, P and K are calculated at the international market prices of N. P and K fertilizers.

5.6.5 Investment Cost

The guarantee fee and service charge taken by biogas company should be deducted from the total investment as they are only transfer of payments. The subsidy should be included as part of the investment cost. The total expenditure actually incurred for construction activities should be reduced by a factor to reflect the true economic cost of materials and labour used in construction. The weighted average Construction Conversion Factor of 0.76 was used by Gautam in the case study referred above.
It is seen from above discussion that the economic cost of goods and services used for biogas plant installation become lower than the costs used for financial analysis. Also, the benefits of biogas use are valued at higher rate for economic analysis than for financial analysis Therefore, any plant that proves to be financially viable to an individual user will still be viable at higher rate of return form the economic or social point of view.

5.7 Session Plan

Activity No	Topic and Area of Discussion	Time (min.)	Methods of Training	Teaching Aids
1.	Introduction and highlight of the objectives of the session	3	Lecture cum discussion	O/H projector, flip chart
2.	Financial analysis	20	Lecture cum discussion	O/H projector. screen, flip chart
3.	Discussions on the result of financial analysis	5	Lecture cum discussion	Flip chart
4.	Indicators of financial viability of biogas plants	4	Lecture cum discussion	Flip chart
5.	Economic analysis	8	Lecture cum discussion	O/H projector
6.	General discussion	20	Discussion	O/H projector, flip chart
Total Time		**60**		

5.8 Review Questions

- Prepare a list of benefits and costs from biogas use that accrue even to non-users in the area.
- Should one install a biogas plant when the financial analysis shows that the NPV of future benefits is zero?
- How will the profitability of a biogas plant be affected with the rate of change in the prices of its inputs and outputs?
- How important is it to carry out detailed economic analysis for making a decision on whether a family should or should not install a biogas plant, and why?
- What are the new opportunities that a biogas plant provides to a user for additional financial gains in the future?

5.9 References

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