COST-BENEFIT ANALYSIS OF BRAC'S SERICULTURE PROGRAMME

Shantana R Halder

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Research & Evaluation Division, BRAC
75, Mohakhali C/A
Dhaka 1212, Bangladesh

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Executive Summary

The Sericulture Programme of BRAC is one of the most ambitious among BRAC sector programmes. Since 1992 BRAC has gone through a large scale expansion of the plantation programme. Major components of the programme are: a) nursery, b) mulberry plantation, c) rearing of the silkworms, d) reeling, and e) weaving.

The main objective of the study was to measure the efficiency of the programme by doing a cost benefit analysis from the participants' as well as the organizers' point of view. The specific objectives of the study were: 1) to determine employment created by BRAC to measure the opportunity cost of time and BRAC's achievements in this area; 2) to determine the programme costs and returns for calculating the profitability of the different components of the programme; 3) to calculate accounting and economic profit to determine the viability of programme participants; and 4) to identify the socio-economic constraints on programme sustainability.

The study considered four different stages of measuring programme viability. In the first stage the employment generation in each component of the programme was determined to calculate the minimum opportunity cost of time and BRAC's achievements. In the second stage both programme input and output records were used to calculate the total cost of the programme and the revenue it earned. Major components of fixed and variable costs may differ in different programme activities which were also considered. In the third stage participants viability was investigated. Indicators used to measure participants viability were: 1) profit per unit of input; 2) average rate of return on investment =profit/total investment on fixed assets; 3) average rate of return on operating cost =profit/operating cost; 4) yield or value of output per unit of major input; and 5) amount or cost of input per unit of output. The programme is treated as economically viable when the actual rate of return exceeds the market rate of interest.

The fourth stage described the programme viability. Monthly receipts and expenditure statements of sericulture programme were used to evaluate it. The study tried to focus on how to increase the physical output to its maximum level and to reduce costs to its minimum.

Primary data were collected from a random sample of 492 programme participants from 10 AOs including 26 sapling growers and 300 silk worm rearers. Due to the fact that reeling, pedal spinning and weaving were not done in every selected AOs, fifty seven workers from three reeling centres, 64 pedal spinners from five AOs and 45 weavers from three BRAC weaving programme areas were selected.

Major findings

The socioeconomic condition of members involved in different sericulture activities varied. By combining results on dependency, landholding, and education we found that the late age rearers were the poorest and the sapling growers, chawki rearers and weavers were relatively better endowed households. Regarding BRAC membership it was found that 50% of reeling workers and nearly two-thirds of the weavers came from non-BRAC households.

Sapling Cultivation

For this study 26 sapling growers from 10 AOs were investigated. Only 3.8% of the land were owned by farmers. Number and types of crops cultivated in the same piece of land before sapling growing show that only 7.7% of the land used for sapling growing were fallow land. This result indicates that use of crop land for sapling cultivation may have had some negative impact in crop production.

Cost-benefit analysis of sapling cultivation: The economic cost of sapling cultivation is constituted by the cost of ploughing land, chemical fertilizer, irrigation, pesticides, hired and imputed value of household labour, lease value of land, and interest on BRAC and other loans. Lease value of land accounts for 30.4% of the total cost. Cost of hired labour accounts for 24.1%, with imputed value of household labour it constitutes 28.2% of the total. Interest on BRAC loan accounts for another 13.2%, cost of ploughing of lands, chemical fertilizer, irrigation, pesticide together constituted 23.3% of the total cost. The mean total cost of sapling cultivation was Tk. 18,630, i.e., Tk. 11,791 per acre.

Revenue from sapling included price of sapling purchased by BRAC for mulberry plantation and price of saplings sold and consumed within the household as firewood. Results show that involvement of one person day in this activity brought Tk. 10.32 as net economic gain. The rate of return on per taka investment without considering household labour was Tk. 1.15. Investment of one taka as economic cost earned additional income of Tk. 0.11 as net economic gain. The economic profit in each acre of land was Tk. 1,249.

Plantation

Data on mulberry plantation were collected from BRAC AOs. Massive expansion of mulberry plantation started in 1993. Total number of trees planted in 1993 was more than double the number of trees planted in 1992. On an average 79% were planted in new places. Up to 1990, 57% were planted in the homesteads. Homestead plantation reduced gradually and roadside plantation increased up to 1994.

Year-wise distribution of number of living trees shows that in 1998 80% were along the roadside. Mortality rate of homestead plantation was relatively higher for every year. Average mortality after replacement was 47% which was higher than the accepted rate. Among the living trees more than 60% were one year of age implied that majority trees were non-productive. Percentages of productive to total living trees for roadside and homestead plantation were 30% and 20% respectively. Among all productive trees, only 8% produced five and above kg of leaves in a single crop. The mean yield per productive tree was 2.2 kg for roadside and 2.8 kg for homestead plantation.

For rearing 100 DFLs a rearer used leaves of 315 productive trees and produced 16.9 kg cocoon and received Tk. 789.2. It implies that a productive tree in each season produced only 0.05 kg of cocoon value of which was Tk. 2.54. Thus, a rearer can earn maximum Tk. 10.16 from one productive tree considering that leaves of a productive tree can be used maximum four times in a year for silk worm rearing.

Rearing

Since rearing is a home based enterprise, all activities related to rearing were done by the household members in addition to other household works. For *chawki* and late age rearing on an average 6.5 and 8.0 hours per day respectively were spent for different types of activity.

Cost of rearing includes depreciation of fixed cost and total variable costs in a production cycle. Variable costs include cost of DFLs, chemicals used for disinfection of rearing houses, repairing costs of rearing houses and service charge paid to BRAC. Depreciation of fixed cost constituted 46% of the total cost, of which 35.4% was depreciation value of rearing houses. Variable cost accounts for 54% of the total cost. Cost of DFLs and service charge paid to BRAC were the major part.

A *chawki* rearer carried out 4.22 crops in a year while a late age rearer did it 2.56 times. Annual income from the activities was Tk. 5,907 for *chawki* rearer which was 200% higher than that of the late age rearer. Return on investment shows that involvement of one full day in rearing brought an additional income of Tk. 9 and Tk 25.2 respectively for late age and chawki rearer. The net economic gain on per taka investment was Tk 0.16 and Tk. 0.56 respectively for late age and chawki rearers.

Eighty-six percent of income of late age rearing were spent for household necessities, while 80% of chawki rearing income were saved. Proportion of income spent for asset purchase was also more than three times higher for chawki rearers.

Reeling

Reeling is the third component of silk production cycle which is composed of different activities like sorting, boiling and reeling of cocoons and re-reeling of yarns. Average working period of an employee was only 20 months which indicate that reeling is relatively a new activity that BRAC started. Daily income of reeler was highest among other workers in the reeling centre. Helpers received lowest income of Tk. 6.19 per day. Reeling and re-reeling are the activities which require higher skill.

Individual characteristics of the reeling workers shows that around 9% of all workers were the household heads, whose income was a major part of their total household income. Household education level was highest for re-reeler and lowest for helper. Membership in BRAC and other development organizations indicate that among workers only 46% came from BRAC member households.

Charka Spinning

For spinning unreelable cocoon and silk waste pedal *charka* was used. On an average, a spinner reeled 8.89 kg in a month and spent 161 hours on different activities of spinning. Ninety two percent of their time spent for spinning.

Cost of spinning: Since *charka* spinning is done along with other household activities, cost of labour was not considered in this analysis. Among others price of rejected cocoon constituted 88% of the total cost. Pedal spinning is a labour intensive activity which does not require heavy investment. Monthly net accounting profit of *charka* spinning per household was found to be Tk.

240. Net economic profit was found to be negative implying that this is not an economically viable activity.

Weaving

Weaving is a home-based labour intensive activity. Seventy three percent of the total work were done by household labour. Wage rate differs on the types of activities, skill of the worker, and quantity of output produced by the worker. The highest wage paid was Tk. 64.50 to the weavers and lowest Tk. 11.64 to the rollers. A household on an average, produced 171 metres of silk cloth per month i.e. 122 metres per working loom. The cost of production per metre of cloth was Tk. 23.1. Since weaving was carried out in handlooms the labour cost (including household labour) constituted 83% of the total cost. The economic profit of cloth production was Tk 1.39 per metre.

Income earned through sericulture and its use

The annual income from sericulture and its share to total household income show that among all the participant households the contribution of sericulture to total household income was lowest for late age rearer and highest for weavers.

The use of income from sericulture varied widely among different groups. Ninety-five percent of the income from silk weaving were spent to meet household expenses, while less than one percent of *chawki* rearing were spent for this purpose. Percentage spent for debt servicing was highest for pedal spinners (52%) and lowest for weavers (0.6%). Eighty percent of income of chawki rearing were saved. Percentage of income saved was lowest for late age rearer (1.2%). Income used for asset purchase was highest for sapling growers (40%) and lowest for pedal spinners (0.3%).

The use of income from sericulture indicate relative dependence of the household on sericulture activities.

Viability of the programme from the participants point of view: a comparative analysis

Sericulture programme of BRAC made significant contribution in maintaining the household expenses and changing the welfare status of the household. The net economic gain on one person day of employment was highest for *chawki* rearing but it was negative for pedal spinning. Gross output per taka economic cost was highest for *chawki* rearing followed by sapling, weaving and late age rearing.

The cost of services provided by BRAC to the programme participants exceeded many times than the service charges received from the participants. Over time expenditure per participant has reduced gradually, at the same time programme's income has also reduced. The operating costs also exceeded the value of silk yarn produced in the reeling centre.

Conclusion and policy implication

BRAC's Sericulture programme has created employment and an additional income opportunities for its participants. The net economic gain was also found positive for all except *charka* spinners although the amount was negligible.

For BRAC the cost of services was much higher than the service charges received. There was a reducing trend in the cost of BRAC provided services per participants. Findings of this study may have some policy implications. These are: 1) for sustainable involvement of rearers it is necessary to increase income from the activity they are involved in, the latter depends on the supply of quality DFLs and adequate quantity of good quality leaves; 2) for increasing income per rearer the scale of operation could be increased by reducing the total number of involvement; 3) for reducing cost of *charka* spinning either the price of rejected cocoons could be reduced or the price of yarn could be increased; and 4) in the reeling centre the existing recruitment policy should be changed for the retention of workers. The scale of operation of the reeling centre should be expanded.

Introduction

Background

BRAC helps to generate sustainable benefit for the poor through its sericulture programme and to empower them both socially and economically. Cost-benefit analysis[1] would provide the answer to the question "how efficiently do the participants run this programme?" It would also help measure the sustainability of the programme. The term programme sustainability means the ability of a programme to carry out activities and services continuously in pursuit of its objectives.

Programme sustainability depends mainly on programme's financial and economic profitability, and viability of the programme participants. A programme will be financially feasible if it can at least equalize the cost of the programme with its revenue earned. A programme will be economically feasible if it can meet the economic cost with the income/return it generates.

Rationale

BRAC's income generating activities (IGA) and their impact on poverty alleviation has been evaluated extensively inside and outside BRAC. However a limited number of studies were conducted on BRAC sector programmes that investigate the self-sustainability to identify its potentials and constraints.

This study attempts to evaluate the efficiency of sericulture programme that would measure its self-sustainability through investigating the benefits and costs of the programme. The survival and future expansion of the programme will depend on its economic success.

Sericulture programme of BRAC: an overview

Sericulture programme is one of the most ambitious among BRAC sector programmes. The programme started in 1978 in Manikganj Integrated Project area with the help of Bangladesh Sericulture Board (BSB) by establishing homestead and bush plantation on an experimental basis. In 1989 the second phase of the programme began by starting mulberry plantation along the roadside[2]. Since 1992 BRAC has gone through a large scale expansion of the plantation programme. By June 1995 a total of 24.8 million trees were planted along roadsides and homesteads. The Sericulture programme aims to: 1) search for ways to generate income and create employment for landless women; ii) increase silk production of the country; iii) promote afforestation through mulberry plantation; and iv) use fallow land which is unsuitable for cultivation of traditional crops.

Sericulture is an industry that requires several levels of activity. Major components of the programme are: a) nursery; b) mulberry plantation; c) rearing of the silkworms; d) reeling and e)

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[1] *The basic elements in the cost and benefit streams are inputs and output prices and quantities or the economy-wide shadow pricing parameters. Cost-benefit analysis consider the range of possible variations in the values of the basic elements and present clearly the extent of uncertainties attaching to the outcome.*

[2] *Land is a scarce resource in the context of rural Bangladesh. The strategy to plant mulberry trees along roads was based on using marginal land that is not being used for other purposes so that land is being made productive. To look after these mulberry trees during the first three years after plantation BRAC employed landless women as caretakers. Every caretaker is receiving 3 kg of wheat per day as payment under the "Food for Work" programme which is funded by WFP. A total of 1994 21,377 caretakers were employed as of December 1994.*

weaving. The sericulture programme of BRAC starts with the establishment of mulberry plantations. BRAC supplies mulberry cuttings to group members for plantation. The group members are provided with Tk. 10,000 as credit per acre land for sapling raising. After one year of intensive nursing group members sell their saplings to BRAC, which are replanted along roadsides[3] and homesteads.

Mulberry leaves are the only food for silkworms. Trees which provide more than one kg of raw leaves in one crop are considered productive. Generally trees become productive after one year of plantation. A productive tree may give 1-5 kg of leaves in one crop period.

Rearing is the next component of the programme. There are two types of rearers: chawki and late age rearers. *Chawki* rearer receives eggs which they hatch and rear for 10 days. Late age rearers buy second stage worms from the chawki rearers and rear them until cocoon formation.

At the reeling centre cocoons are reeled by the women reelers. BRAC has its own reeling centres in Manikganj, Jamalpur, Sherpur, Kushtia, Atghoria and Taraganj areas. In these reeling centres cocoons of good quality are reeled. Rejected cocoons are reeled by the individual reelers by pedal reeling equipment (*charka*).

The silk yarn is used for weaving fabric by both BRAC member and non-BRAC member weavers. At Gorpara weaving centre in Manikganj, weaving is done by handlooms. BRAC has taken steps to create employment opportunities for unemployed weavers in traditionally cotton-weaving areas. Rural Development Programme (RDP) supplies them silk yarn and receive silk fabrics after weaving. The weaver is paid Tk. 20-25 per metre of fabric weaved depending on the quality of production. Some basic information on BRAC's Sericulture Programme is provided in Table 1.

Table 1. BRAC's sericulture programme at a glance

Items	Years						
	'90	'92	'94	'95	'96	'97	'98
Sapling nurserers (No.)	137	225	1613	129	128	62	-
Cumulative planted trees (Million)	1	6.1	17.9	24.3	24.4	24.5	25.0
DFL reared (million)	0.08	0.19	2.06	4.04	2.85	3.8	2.02
No of rearers ('000)	1.67	2.36	11.99	14.92	20.71	21.41	11.01
Cocoon (mt)	22	32	419	-	455	582	225
Silk production (mt)	-	-	16	20.5	23.1	32	12
No of reeling centres	7	13	6	4	4	4	4
No of reeling basins	54	62	220	284	260	260	260
No of weaving centres	-	-	3	3	3	3	3

Source: RDP Sericulture Programme Report 1998

In the process of implementation the programme has faced different problems. Some of the major problems were:

[3] *BRAC leases the roads from the local government for a period of 20 years and provide group members with sapling to plant.*

1) BRAC's mulberry plantation is fully rain-fed. Lack of irrigation and fertilization facilities negatively affected the quality and quantity of leaf production;

2) low quality of DFLs and leaf, unhygenic rearing houses, limited resources of the rearers, spread of pebrine diseases and decreasing price of silk in the market adversely influence the quantity produced and the profit margins of the rearer;

3) lack of appropriate technology suitable for country's environment is the reason for low productivity in all sectors of the sericulture industry.

To resolve these problems the programme has taken the following plan of action for the year 2000 as outlined in the RDP IV Project Proposal for 1996-2000:

i) to establish 18 seed production centres (grainages) with a capacity of one million DFLs to supply high quality DFLs;

ii) to build 875 chawki rearing centres with good quality gardens;

iii) to provide rearers with loans to update their equipment and rearing facilities;

iv) to arrange training facilities for the programme participants;

v) to build 10 new reeling centres with a total capacity of 150 tones ensuring efficient reeling operations that match the cocoon quality and reeling technology.

Objectives

The main objective of the study was to measure the efficiency of the programme by doing a cost benefit analysis from the participants' as well as the organizers' point of view.

The specific objectives of the study were:

1) to determine employment created by BRAC to measure the opportunity cost of time and BRAC's achievements in this area;

2) to determine the programme costs and returns for calculating the profitability of the different components of the programme;

3) to calculate accounting and economic profit to determine the viability of programme participants; and

4) to identify the socioeconomic constraints on programme sustainability

Some definitions

DFLs (Disease Free Laying) - Small tiny laying grains of eggs of silk moth. One DFL contains 300-400 small grains of eggs or larvae. From one DFL we can get 300-400 larvae.

Chawki rearing (Young age or early age rearing) - Rearing of silk worm larvae is done in two steps. First step is called chawki rearing or young age rearing and the second step is called late age rearing. Hatching larvae from DFL and rearing in the young age by properly controlling temperature, humidity and disinfection is done during chawki rearing. Total chawki rearing

period is 10 days per production cycle (crop). In the early stage of silk worm rearing proper care is a must to make healthy and disease free lots to get future bumper harvest. That is why in silk worm rearing more attention is given in selecting an individual for chawki rearing who is sincere and laborious, experienced and skilled.

Late age rearing - After chawki rearing the larvae are handed over to late age rearers for completing the rest larval period of 15 days to get expected product of silk cocoon.

Cutting -A matured (4 years old) branch of mulberry tree is used as seed for sapling raising.

Saplings - Mulberry seedlings (cuttings) are raised as saplings. For maturity of saplings 10-11 months time is required.

Mulberry tree is the only food plant for silk worm rearing. Mulberry trees can be grown from mulberry saplings. The normal harvest of mulberry leaves started from 2nd year after plantation but full production of leaf can be received from the 5th year of plantation. Each year 4 harvests can be possible. A mulberry plant can be productive up to 25-30 years.

Rearing net is made of cotton thread which is of different size. It is used for bed cleaning. Bed cleaning means cleaning of excreta and urine of larvae and waste leaves from the *dalas* everyday. Another type of net is used for spinning of cocoon which is made of plastic called mountage.

Methodology

Ten BRAC Rural Credit Programme (RCP) areas were selected from different regions which are shown in Table 2. The selection criteria were: 1) the areas should be located in different geographical zones; 2) should be at least eight years old where BRAC's maximum investment matured; and 3) each component of sericulture programme, mainly plantation, had reached at least two years of maturity in December 1994.

The study has considered four different stages of measuring programme viability. In the first stage the employment generation in each sector programme was determined to calculate the minimum opportunity cost of time and to determine BRAC's achievements. There are two types of employment such as a) paid employment; and b) self employment.

Paid employees get salaries either in cash or kind from BRAC. Self-employees are the beneficiaries of BRAC programmes who do not get direct wages. Eight working hours in a day are considered as one full-time person day of employment.

In the second stage two programme records were used. These were 1) cost or input records; and 2) revenue or output records.

There are two kinds of costs - fixed and variable. Fixed costs are those that do not change within a certain period of time such as land, housing, interest on loan and depreciation on fixed assets. Variable costs are those varying with the level of output, programme strategy, geo.-political and socioeconomic situation of area such as labour, operation and maintenance costs. Major components of fixed and variable costs may differ in the different programme activities which will be under observation in this study.

Table 2. List of areas selected for the study and year of programme started

Sl. No.	Region	Area Selected	Sericulture programme started				
			Plantation	Rearing	Reeling	Spinning	Weaving
1	Jamalpur	Jamalpur Sadar	1989	1989	1990	-	-
2	Mymenshingh	Muktagacha	1992	1993	-	-	-
3	Pabna	Atghoria	1988	1990	1991	-	-
4	Rangpur	Taraganj	1991	1992	-	1996	-
5	Manikganj	Manikganj Sadar	1978	1990	1992	1988	-
6	Rajshahi	Bholahat	1993	1993	-	1991	-
7	Kushtia	Kumarkhali	1992	1994	-	-	1993
8	Bogra	Ullapara	1993	1994	-	1994	1994
9	Serajganj	Shahjadpur	1993	1994	-	1994	1994
10	Rajbari	Ahladipur	1989	1990	-	-	-

Output record include the total output with its input prices calculated through cash and credit sales of the products, imputed values of the quantities consumed on the farm, i.e. given away and in-kind payment. Imputed value is estimated by using the current market price of the products.

The profitability (benefit-cost) of the targeted programme was calculated from those records mentioned above. There are two types of benefits; primary and secondary. Primary benefit can be measured by economic and financial viability. In case of financial viability the accounting profit was only measured to check profitability in lump-sum account. In case of economic viability the economic profit was calculated deducting all opportunity costs from the financial profit. The imputed value of household labour was calculated based on the average wage of the similar kind of activities, which were carried out under each of the individual project. For *chawki* and late age rearing and pedal spinning cost of household labour was taken a Tk. 30 per person day employment as of RDP in measuring profitability of the similar activities (RDP Working Manual, 1995). To measure the opportunity cost of additional capital used in the activity other than BRAC loan 15% interest rate was taken as of BRAC's rate of interest.

Secondary benefit is a spillover benefit to other sectors caused by the externalities (if any) of that programme. Spillover benefit may be classified into forward and backward linkages. Increase in output of a programme can facilitate the other sector through forward linkage. On the other hand increase in output of a programme can induce the input supplies to that programme through backward linkage. The main effect of these backward and forward linkages is new employment generation. They increase income which in turn creates new employment opportunity and enhance further through multiplier effect. In this analysis we calculated primary benefits and focused partially on the secondary benefits due to lack of enough data in our data set to measure spillover effect.

In the third stage participants viability was investigated. Indicators used to measure participants viability were:

Profit per unit of input;
Average rate of return on investment = profit/total investment on fixed assets;
Average rate of return on operating cost = profit/operating cost;

Yield or value of output per unit of major input;
Amount of input per unit of output or cost of input per unit of output.

For the analysis of participants viability the rate of return on investment was compared with the market rate of interest. The programme is treated as an economically viable activity when the actual rate of return exceeds the market rate.

The fourth stage describes programme viability. Monthly receipts and expenditure statements of each sector programme were used to evaluate the programme viability. If the expenditure of a programme exceeds receipts, then it needs subsidy for survival. BRAC's target is to minimize the subsidy. The study tried to focus on how to increase the physical output to its maximum level and to reduce costs to its minimum.

Sources of data and sampling method

Secondary data were collected BRAC annual reports and the receipts and expenditure statements of RDP. Field survey was carried out by using special checklists and questionnaires. Primary data were planned to collect from a random sample of 492 programme participants. Twenty sapling growers and 300 rearers from 10 AOs i.e. 3 sapling growers and 30 rearers from each AOs were randomly selected. Since reeling, pedal spinning and weaving were not done in every selected AOs, 57 workers from three reeling centres and 45 weavers from three BRAC weaving programme areas were also selected. Sixty four pedal spinners from 5 sampled AOs were also selected for survey. Data were collected in April-May 1996.

Problems faced in data collection

Some problems were faced in data collection due to non-availability of sufficient sample members in the area. Among sapling growers in four areas we found only two out of three required growers were found who had grown saplings in 1995. In case of reeling workers 57 out of 60 sampled workers were interviewed, others were not available in their working place. A similar problem was faced in case of *charka* spinners. Sixty four out of 75 sample workers could be interviewed. The final sample excluding all non-available cases were 492.

For information on mulberry plantations we had to fully depend on relevant documents which were expected to be prepared regularly and kept in the AOs. Since we need data for the last six years, in maximum cases it took a number of days to collect information from the documents stored in the office. Frequent transfer of staff also created problem. The newly appointed programme assistants (PAs) could not describe the information handed over by his/her colleagues who dealt with plantation before his/her joining. All of these difficulties delayed the whole process of data collection.

Major findings

Household characteristics of different sericulture participants

The socioeconomic condition of members involved in different sericulture activities varied. Average household size of the participant households ranged from 4.5 to 6.2 members. It was highest for weavers and lowest for reelers. Percentage of income earner to household size was highest for reelers and lowest for sapling growers and weavers. Higher percentage indicates the lower number of dependence per income earner and vise versa. The total landlholding status of the households and percentage of households without any cultivable land indicate that all the programme participants except sapling growers and *chawki* rearers belong to the poorer section of the population. Average household education level[4] was highest for the weavers and lowest for late age rearers. By combining results on dependency, landholding and education we found that the late age rearers were the poorest and the sapling growers, *chawki* rearers and weavers were relatively better endowed households.

Regarding BRAC membership it was found that except those engaged in reeling and weaving at least one member from each household had participated in RDP. For reeler and weaver households the rates of participation in RDP were 50% and 38% respectively. It implies that RDP also employed non-members in reeling centres. It also works with non member weavers. Membership in other NGOs indicates that a certain proportion of households of all groups participated in other NGOs.

The per capita annual income of the household was highest for weavers and lowest for reelers. It implies that the reelers were the poorest and the weavers were the relatively better-off households among programme participants (Table 3).

Table 3. Household status of different sericulture entrepreneurs

Indicators	Sapling	*Chawki* Rearing	Late age Rearing	Reeling	Pedal Spinning	Weaving
Average hh education	175	145	110	111	194	215
No. of BRAC members per hh	1.31	1.15	1.21	0.49	1.03	0.38
No. of other NGO members per hh	0.12	0.31	0.16	0.19	0.09	0.27
No. of income earner	2.46	2.9	2.5	2.7	2.92	2.58
Household size	5.88	5.1	5.1	4.5	5.03	6.16
Economic dependency ratio	208	102	147	79	1	172
Homestead land (dec.)	18.5	8	11	13	5.6	12.3
Cultivable land (dec.)	66.5	55	15	14	16.1	21.6
Per capita annual income (Tk.)	7,236	5,487	4,680	4,430	5,030	8,289
% of absolute landless hhs	3.8	4.4	7.1	3.5	1.6	-
% of hhs without cultivable land	38.5	31.1	71.4	73.7	64.1	80.0

[4] *Average household education level is calculated by aggregating the individual level of schooling giving individual scores and dividing it by the number of members in a household with six and above years of age and then multiplying by hundred*

Cost-benefit analysis of different sericulture components

Sapling cultivation

For this study 26 sapling growers from 10 AOs were investigated. Average years of involvement of a farmer in sapling cultivation was found to be 2.8 years. Twenty-seven percent of the farmers did it for the first time with no previous experience. Three farmers (11.5%) were involved in this field for quite a long time (> five years). A farmer, on an average, used 158 decimals of land for sapling growing of which 93.7% were leased. Only 3.8% of the land were farmers' own land. Number and types of crops cultivated in the same piece of land before sapling growing show that only 7.7% of the land used for sapling growing were fallow land. Another 7.7% of land used for sapling had given three, and 39% of the land had given two yields annually. Sixty-two percent of the land under sapling cultivation were used previously for paddy cultivation. This result indicates that use of crop land for sapling cultivation may have had some negative impact in crop production.

Employment: For sapling cultivation in 158 decimals of land 191.3 person days were employed, i.e. 121 person days in one acre of land. Around 75% of them were hired labour. Fifty eight person days (30%) of the labour were employed for weeding. Another 30% were spent for collecting cuttings and the preparation of it for plantation. For plantation of cuttings and its collection at the period of harvesting another 32.6 person days were spent (Table 4).

Table 4. Amount of labour spent for different activities of sapling growing.

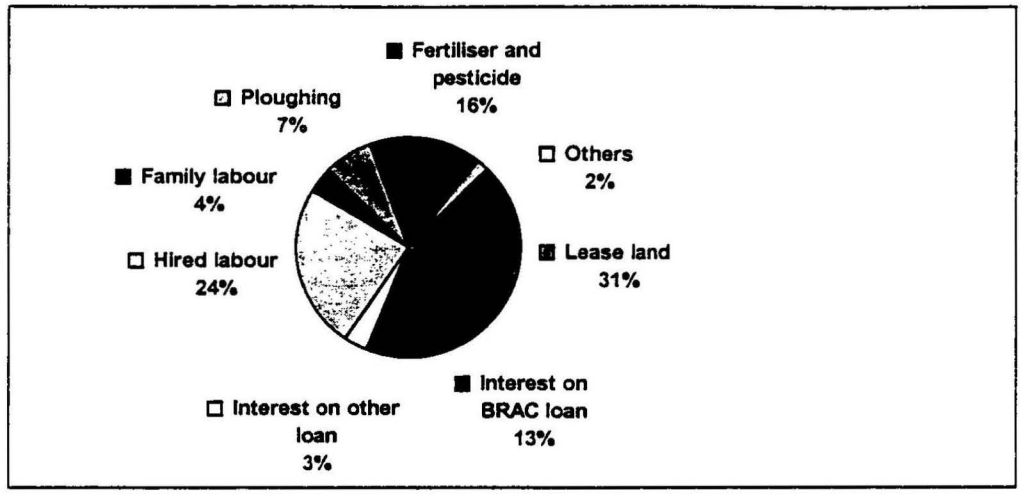
Activities	Total person days	% of hired to total labour
Collection of cuttings and its preparation	57.9	76.5
Cutting plantation	42.8	35.2
Weeding	58.0	76.9
Collection of sapling	21.5	68.6
Others	11.1	33.3
Total labour cost	191.3	74.5

** others included ploughing, irrigation and fertilizer application*

Cost-benefit analysis of sapling cultivation: The economic cost of sapling cultivation is constituted by the cost of ploughing of land, cost of chemical fertilizer, irrigation, pesticide, cost of hired and imputed value of household labour, lease value of land, and interest on BRAC and other loans[5] (Table A.1). Lease value of land accounts for as large as 30.4% of the total cost. Cost of hired labour accounts for 24.1%, with imputed value of household labour it constitutes 28.2% of the total. Interest on BRAC loan accounts for another 13.2%, cost of ploughing of lands, chemical fertilizer, irrigation, pesticides together constitute 23.3% of the total cost (Figure 1). The mean total cost of sapling cultivation was Tk. 18,630, i.e. Tk. 11,791 per acre.

[5] *All the growers had received BRAC loan, the mean amount of which was Tk 16,437. The borrowing amount was sufficient for 16 growers. Seven growers also invested their own money. Two growers borrowed from Grameen Bank and another one borrowed from mohajhan. The mean amount received from different sources was Tk 20490 i.e. Tk 12,968 for one acre of land.*

Figure 1. Share of different components in the cost of sapling cultivation



Revenue from sapling includes price of sapling purchased by BRAC for mulberry plantation and price of saplings sold and consumed within the household as firewood. The mean gross revenue which included zero revenue of four farmers was Tk. 20,604,. These four farmers had fully lost their crops due to a unprecended flood. The revenue could be Tk. 24,241 if these four farmers did not lose their crops and received at least the mean amount of other sampled growers.

The net gain was Tk. 1,974 and Tk. 5,611 respectively with and without considering risk factors. This is the direct monetary benefit received by the sapling growers. But there were some other indirect benefits they received. Almost all the growers stated that the net income they received from this activity was more or less similar to the net income of other crops produced in the same land. But the advantage of this project is that it does not require full time involvement of a person during the production cycle, which allow growers to involve in other activities. Secondly, bearing of investment cost and technical assistance by BRAC, guarantee to purchase the products, and fixed price of the products reduce the risk of production and uncertainty in terms of realization of the products. Thirdly, after harvesting growers can get a substantial amount of money which they can made a larger investment keeping in mind that all growers during production cycle have to pay their loan installment. They stated that although it was not so easy to manage alternative sources for regular weekly installment, they still prefer it due to the advantages mentioned above.

On the question regarding the reasons for cultivating saplings 23 (88.5%) growers stated that profit earning was their main concern. When asked how they decided to get involved in this activity, a majority (88.5%) responded that BRAC field staff convinced them. Regarding their skill and previous experience in this new field 53.8% stated that they received three days formal training on sapling cultivation in BRAC office.

Return on investment: Return on investment from sapling cultivation is shown in Table 5. For this analysis land, labour and capital - the major factors of production were considered. Gross revenue, net accounting and economic profit were considered as output indicators. Results show that involvement of one person day in this activity brought Tk. 10.32 as net economic gain.

Return on per taka investment without considering household labour was Tk. 1.15. Investment of one taka as economic cost earned Tk. 0.11 additional income as net economic gain. By cultivating sapling in each acre of land a farmer received Tk. 13,041 as gross revenue. The economic profit in each acre of land was Tk. 1,249.

Table 5. Returns on investment in sapling cultivation

Indicators	With four missing cases	Without four missing cases
Return on one person day employment		
Net accounting profit per person day of labour spent	14.33	49.33
Net economic profit per person day of labour spent	10.32	29.34
Return on per taka investment		
Revenue per taka economic cost	1.11	1.18
Revenue per taka accounting cost	1.15	1.36
Return per acre of land		
Revenue per acre of land	13,041	15,342
Net accounting profit per acre of land	1,734	4,036
Net economic profit per acre of land	1,249	3,551

Note: This table is computed by using results of Tables 3 and A.1

These results have considered risk factors. Actually loss of all products of four farmers due to flood this year was an incident which in general could not affect every year. The output of each factor of production could be more than two times higher if this incident had not taken place. But even then these results indicate that sapling growing is an economically viable activity.

Household income of sapling growers: Table 6 presents mean gross household income and its sources. Income from different income generating activities[6] and income from crop cultivation were the major sources of income which constituted 34.8% and 27.6% respectively of total income. Wages and salaries stand in the next position. Accounting profit from sapling cultivation constituted only 6.4% of the total income.

Table 7 presents percentage of income from sapling cultivation used for different purposes. Major portion of earnings was spent for asset accumulation (40.4%) and kept as savings (28.4%). For household necessities 24.8% of that income were spent. Only 6.5% of earnings were spent for debt servicing which also includes repayment of BRAC loan. The result indicates that although share of sapling to total income was the highest but only 31% of it was used for household expenditure and debt servicing. It implies that the dependence on income of sapling to meet up the daily necessities was less.

[6] *include small trading, shop keeping, fishing, sewing, and other cottage industries*

Table 6. Sectoral distribution of gross household income of all sapling growers in 1995

Sl No	Sector	%
1	Crop	27.6
2	Livestock	6.6
3	Wage/ Salary	20.6
4	IGAs	34.8
5	Others	4.0
6	Sapling	6.4
	Total (Tk)	42,549

Table 7. Uses of income from sapling

Sl. No	Purpose of use	% to total
1	Debt servicing	6.5
2	Household expenditure	24.8
3	Savings	28.4
4	Asset accumulation	40.4
	Total	100.0

Plantation

Data on plantation were collected from BRAC AOs. Programme documents were mostly used for this analysis. Table 8 describes year-wise plantation of mulberry trees within the territory of 10 sampled AOs. Massive expansion of mulberry tree plantation started in 1993. Total number of trees planted in 1993 was more than double the number of trees planted in 1992. Among the planted trees, on an average, 79% were planted in new places. The other 21% trees were used for replacement of dead trees in the early planted areas. Seventy-two percent of all trees were planted along roadsides. Up to 1990, 57% of the total plantation were made in the homesteads. Share of homestead to total plantation reduced gradually and roadside plantation increased up to 1994. But again in 1995 ninety-two percent of trees after replacement were planted in the homesteads which increased the proportion of homestead to cumulative trees planted in 1995. (Table 9).

Table 10 describes mortality rate of mulberry trees of roadside and homestead plantation by years. Around 51% of trees planted up to 1995 died. The cumulative mortality rate at the end of the calendar year was highest in 1990 and lowest in 1993. Mortality rate of homestead plantation was relatively higher for every year. The cumulative mortality after replacement at the end of each year was reduced gradually except in 1994. Average mortality after replacement was 47% which was higher than the accepted rate. In the planning and implementation methodology for World Food Programme (WFP) assisted afforestation schemes up to 40% mortality rate of trees was accepted to provide food assistance to an NGO.

Table 8. Information on plantation of mulberry trees by years

Years	Planted trees			Ratio of roadside among newly planted
	Total (No)	New (%)	Gap filling (%)	
1990	68,773	97.0	3.0	41.0
1991	110,950	91.0	9.0	73.0
1992	137,554	86.0	14.0	72.0
1993	301,791	93.0	7.0	98.0
1994	451,734	52.0	48.0	99.0
1995	483,825	79.0	21.0	8.0
Average	259,105	79.0	21.0	72.2

Table 9. Information on number of planted and living trees by years

Years	Cumulative planted trees			Number (%) of living trees		
	Total No.	% of roadside	% of homestead	Total No.	% of roadside	% of homestead
1990	107365	43	57	38592	46	54
1991	218315	59	41	112273	69	31
1992	355869	65	35	187441	71	29
1993	657660	80	20	363635	64	36
1994	1103894	88	12	400817	89	11
1995	1587719	77	23	771757	80	20

Table 10. Mortality rate of mulberry trees in roadsides and homesteads by years (%)

Years	Roadside	Homestead	Total	Mortality after replacement
1990	51.1	66.3	64.1	64.1
1991	39.6	61.3	48.6	46.1
1992	42.0	57.1	47.3	42.6
1993	55.9	64.8	44.7	40.1
1994	63.4	65.7	63.7	52.4
1995	49.9	56.5	51.4	37.0
Average	50.3	62.0	53.3	47.1

Note: Mortality rate is calculated by using data from Table 3.2.2.1 & 3.2.2.2. Formula used to calculate mortality rate (M) is : $\frac{(\Sigma \text{of planted trees} - \Sigma \text{of living trees}) \times 100}{\Sigma \text{of planted trees}}$

Among the living trees more than 60% were one year old implied that majority of them were non productive. This also indicates that there were significant additions of tree in recent years. Only 24% of the trees were aged three years and above. According to BRAC field staff, a mulberry tree becomes fully matured after three years of plantation to produce five kg and above raw leaves (Table 11).

Table 11. Distribution of living trees by age as of 1995 (%)

Age of trees(yr.)	Roadside	Homestead	Total
1	46.7	14.0	60.7
2	15.2	0.3	15.5
3	10.6	1.9	12.5
4	4.4	1.9	6.3
5+	3.1	1.9	5.0
Total	80.0	20.0	100

Leaf production: Table 12 shows that in 1995 only 30% of living trees were productive. Percentages of productive to total living trees for roadside and homestead plantation were 30% and 20% respectively. Among all productive trees only 8% produced ≥5 kg. leaves in a single crop. Nearly one third gave one kg leaves. Another one third produced 2 kg in each crop (Table 13). The mean yield per productive tree was 2.2 kg for roadside and 2.8 kg for homestead

plantation. It was assumed that over time with increasing age of living trees proportion of productive to total living trees would be increased. But results did not show any gradual change over time in this regard (Table 12). It might be due to high mortality rate of planted trees for all years and significant additions to tree areas in recent years. As mentioned earlier, volume of cocoon production, therefore, silk production fully depends on cumulative number of productive trees and the productivity of these trees. Therefore, it is not realistic to expect a major change in production without a change in productivity of trees.

Table 12. Distribution of productive trees by locations and years

Years	Total No of productive trees	Ratio of productive to total living trees (%)		
		Total	Roadside	Homestead
1990	26,402	68.4	56.3	78.9
1991	52,020	46.3	30.4	81.6
1992	92,998	46.9	39.6	74.5
1993	213,576	58.7	36.6	93.9
1994	182,003	45.4	38.3	94.9
1995	227,450	29.5	30.1	20.0

Table 13. Percentage of productive trees by amount of leaves produced and locations in a single crop in 1995 by locations

Kg leaves	% of total living trees		
	Total	Roadside	Homestead
1	31.4	34.8	17.5
2	35.5	37.2	29.0
3	14.1	12.2	21.8
4	10.7	9.5	15.6
≥5	8.3	6.3	16.0
Total	100	100	100

Table 14 shows the real output of BRAC mulberry plantation programme in 1995. In this year 733 rearers were engaged in silkworm rearing in 10 AOs. On an average a rearer carried out 2.8 crops[7]. In a single crop a rearer used leaves of 310 productive trees for rearing 99 DFLs and produced 16.9 kg cocoon and earned Tk. 789.2. It implies that a productive tree in each season produced only 0.05 kg of cocoons, the value of which was Tk. 2.54. A rearer from one productive tree can earn maximum Tk. 10.16 if considered that leaves of a productive tree can be used maximum four times in a year for silk worm rearing. The production capacity of leaves indicates that for rearing of 100 DFLs a maximum 719 kg of leaves were available which was much higher than the normative average of 650 kg for 100 DFL rearing (BSB, 1992).

It is also important to note that in addition to monetary return per productive tree a member-rearer also receives at least 3 kg of firewood from each pruning after every rearing cycle i.e. 3x4=12 kg in a year. It means that a rearer receives at least 310x12=3,720 kg firewood annually from trees she uses for rearing. The rearer can earn Tk. 3,720 from the sale of the firewood she

[7] *see section 3.2.2*

receives. Usually a rearer uses it to meet her household needs of firewood. Firewood collection is always a big problem for the poorest landless. That is why this support in addition to the amount they receive allow them to continue their involvement in rearing. There are some arguments that since mulberry trees have a little timber value the plantation of mulberry tree is worthless. Those who need immediate support can not wait for 15-20 years after plantation when trees would mature for sale. Secondly, there is no guarantee that the grower will receive their actual share. Their involvement in sericulture bring them continuous earning. The amount may be little but its contribution in the satisfaction of their immediate needs is much higher.

Table 14. Productivity analysis of mulberry trees in 1995*

Sl. No.	Indicators	
1.	Cumulative number of planted trees up to 1995	1587719
2.	Number of productive trees in 1995	227,450
3.	% roadside to total productive trees	81.3
4.	% homestead to total productive trees	18.7
5.	Number of DFLs reared in each crop	72,176
6.	Number of rearers in each crop	733
7.	Total kg cocoon received in each crop	12,404
8.	No of productive trees per 100 DFLs (total)	315
9.	No of productive trees per rearer (total)	310
10.	No of productive trees per rearer (along roadsides)	252
11.	No of productive trees per rearer (in the homesteads)	58
12.	Kg cocoon per rearer in each crop	16.9
13.	Kg cocoon per 100 DFLs in each crop	17.2
14.	Kg cocoon per productive trees in each crop	0.05
15.	Tk per 100 DFLs reared in each crop	801.4
16.	Tk per rearer in each crop	789.2
17.	Tk per productive trees in each crop	2.54
18.	Kg leaves per 100 DFL rearing	719
19.	Kg leaves per kg cocoon production	41.8

Note. This table is computed by using information from Tables 3.2.2.1-3.2.3.4

Homestead plantation: results of case studies. In addition to information collected from programme documents on plantation enumerators visited households of 28 participants' who received mulberry trees for homestead plantation. The purpose of doing this exercise was to observe the real condition of plantation and to collect information which may complement the present findings. Table 15 presents results of 28 case studies who had planted mulberry trees within their homestead. A member, on an average, had taken 195 trees of which nearly 70% were not found alive at the time of investigation. Only 30% of the trees they had taken were survived at that time. Among the living trees 41.3% were productive, trees which could give more than one kg

Table 15. Information on plantation of mulberry trees in the homestead

Indicators	Manikganj	Ullapara	Atghoria	Ahladipur	Bholahat	Total
No. of respondents	8	5	5	6	4	28
Total trees planted	669	2100	650	1600	450	5469
No. of living trees	185	590	269	580	28	1652
No. of dead Trees	484	1510	381	1020	372	3767
Productive	72	-	58	530	22	682
No. of non-productive trees	113	590	211	50	4	968
Mortality rate	72.3	71.9	58.6	63.7	93.8	69.8
% productive to total living trees	38.9	-	21.6	91.4	78.6	41.3
% productive to total planted trees	0.8	-	8.9	33.1	4.9	12.5

of leaves in a production cycle. The ratio of productive to total planted trees was only 12.5%. The case study results were found consistent with the information collected from survey data.

The main reason behind the low survival of mulberry trees was that the majority of the members did not take the trees willingly. RDP local staff convinced them to plant the trees in their homesteads. In some cases respondents reported that RDP staff put condition that she would not get wheat from her VGD card if she did not buy mulberry trees. Many of the respondents specially from those of Manikganj area, mentioned that they willingly brought trees from the BRAC office. All the respondents stated that the number of trees they brought were higher than their planting capacity. Maximum trees in the study areas were under shadow where the sun could not reach them. All the respondents who planted mulberry trees in their homestead were somehow involved in silk worm rearing.

Rearing

Silk worm rearing is technically divided into rearing of young silkworms and adult silkworms. From the hatching of eggs and brushing of the larvae to the end of the third stage[8], is called rearing of young silkworm (*chawki* rearing). The rest of the period of rearing i.e., from the commencement of fourth stage to end of spinning stage, is called rearing of adult silkworms (late age rearing). In this analysis we are concerned with rearing of both young and adult silkworms.

Table 16 and show detailed information about the number of rearers involved in rearing, number of DFLs reared, production of cocoons, price of cocoons they received, and the total revenue per rearer in each production cycle. In the sample areas a maximum of six crops[9] were harvested.

[8] *The larvae period has five stages of development characterized by four stages. The silkworm stages four times to cast off old skin which is inelastic and develops new skin to accommodate growth and development of interval organs. The active period of growth between each stage is called 'stage'.*

[9] *Traditionally there are four rearing seasons in a year namely Bhaduri (August-September), Agrahayani (November-December), Chaita (March-April) and Jaishta (May-June), according to the names of Bengali calendar which coincides with the rearing season. BRAC has experienced additional two production cycle which are Kartiki (October-November) and Maghi (January-February). Usually organizations including BRAC who are involved in silk worm rearing are received DFLs from BSB. Sometimes supply of DFLs by BSB is inadequate due to increasing demand on DFLs. BSB can not provide sufficient number of DFLs during these traditional period of rearing. To*

The number of rearers involved in different crops was more or less similar (>200) for all seasons except *Kartiki* and *Maghi bondh.* In *Kartiki* and *Maghi bondh* only 10 and 31 rearers respectively were involved in rearing and reared . 85 and 90 DFLs respectively, which were less than the average for other *bondh.*

Table 16. Average productivity of rearing in 1995 by different crops

Name of crops	No. of rearers in each crop	No. of DFLs reared	Quantity of cocoons (kg) received	Price per kg (Tk.)	Total revenue (Tk.)	Kg cocoons per 100 DFLs
Bhaduri	220	111	17.4	41.4	721	15.7
Kartiki	10	85	19.4	70.2	1362	22.8
Agrahani	200	89	16.0	47.2	755	18.0
Maghi	31	90	11.3	45.6	515	12.6
Chaita	211	101	16.3	51.7	842	16.1
Jaistha	236	146	13.3	37.7	501	9.2
Chaita (seed)	198	81	12.3	52.4	644	15.2
Average per crop	158	100	15.2	49.5	763	15.7
Average per rearer in 1995	279	390	58.6		2721	

Number of rearers involved in and number of DFLs reared were higher for *Jaistha* and *Bhaduri bondh.* BRAC's mulberry plantation is fully rain-fed. The maximum rainfall during these two seasons positively contributed in the natural growth of mulberry leaf and, therefore, total number of DFL rearing. But these are the seasons when the incidence of disease is higher than other rearing seasons which might have an impact in the lower cocoon yield. Quantity of cocoons received by each late age rearer and yield of cocoons per 100 DFLs for different *bondh* provide evidences in this regard. Average yield per 100 DFLs rearing was lowest for *Jaistha bondh (*9.2 kg). In *Chaita* and *Agrahayani bondh* results were more or less similar (average 15.7 kg per 100 DFLs). For different *bondh* yield varied from 9.2 to 22.2 kg depending on the influence of differences in the contributing factors.

Price of cocoons per kg received is one of the indicators which partially explains the quality of cocoons and its races[10]. Seasonal factors are also associated with price variation. The price of

reduce the risk in receiving adequate number of DFLs BRAC has decided to extend the rearing with an addition to three or four production cycles by starting each production cycle 15 days earlier or vise versa. Increasing number of crops also reduces the work load of BRAC staff in terms of technical assistance to its programme participants and pressure to buy all cocoon which could be produced in the rearing season and to store it.
Number of crops and volume of silkworm rearing to be undertaken in each season is mainly determined by the availability of leaf. The estimation of mulberry leaf has to be accurate as shortage of leaf during rearing may lead not only to poor crops but also to considerable hardship in rearing. Volume of rearing per rearer also depends on the skill and capacity of the rearer herself

[10] *Mulberry silkworms are of three broad types namely univoltine, bivoltine and multivoltine according to the number of generation they have in a year. The traditional race of silkworms of Bangladesh is of multivoltine known as Nistari which produce cocoon with 50 to 100 percent lower silk content than cocoon produced by uni- and bivoltine silkworms. Under ideal condition cocoon yield of the traditional variety is about 20 kg per 100 DFLs while that of the improved variety about 30-35 kg per 100 DFL (Bakht. Z., 1988).*

cocoon for *Kartiki bondh* was highest. The next highest price was for *Chaita* and *Maghi bondh* - Tk. 52 and Tk. 46 respectively and the lowest for *Jaistha bondh.* Total revenue received by each rearer depended on the yield of rearing, quality and the price of cocoons. Average revenue per rearer was highest for *Kartiki* and lowest for *Jaistha bondh.* Average revenue received by rearing 100 DFLs was also highest for *Kartiki bondh. Agrahayani* and *Chaita bondh* stand in the second and third position respectively. Revenue earned for *Jaistha bondh* was lowest

Productivity of cocoon and its value also depend on races of larvae. As shown in Table 17, 81% of reared DFLs were of F1 varieties. It is an improved variety of Nistary cross-bred with bivoltine. The productivity of F1 is higher than Nistary but lower than the other improved varieties. According to the table, 30.8% of total DFLs reared in *Kartiki bondh* were bivoltine. With seasonal factor high breed of DFLs also positively contributed to the higher profitability in this rearing season. In the last *Chaita bondh* although 25% of bivoltine races larvae were reared but result did not vary much from other seasons because in this season emphasis was given on seed production rather than cocoon. The DFLs were imported and reared on an experimental basis to investigate the adaptability of this variety within our local condition. Since it was an experimental rearing a large proportion of larvae died which explain the relatively low production of cocoon in the last *Chaita bondh.*

Table 17. Varieties of DFL reared by crops

Crops	F1	Bivoltine	Others	Numbers responses
Bhaduri	83.0	13.8	3.2	100
Kartiki	69.2	30.8	-	100
Agrahani	68.5	7.2	24.3	100
Maghi	87.1	3.2	9.7	100
Chaita	88.5	6.6	4.8	100
Jaistha	94.4	0.4	5.2	100
Chaita (seed)	69.2	25.2	5.6	100
Average	81.1	10.3	8.5	100

Figures in the parenthesis indicate percentages

Employment: Since rearing is a home-based enterprise all activities related to rearing were done by the household members in addition to other household work. Table 18 describes daily hours spent for different activities of rearing. For chawki and late age rearing, on an average, 6.5 and 8.0 hours per day respectively were spent for different types of activity. One third of time was spent for leaf collection from roadside. Another one third of total time was spent for feed preparation and feeding. Cleaning of *dalas* had taken about 25% of the time.

Profitability analysis of rearing: For rearing 100 DFLs during a production cycle, on an average, Tk. 159.5 were spent. The cost of rearing included depreciation of fixed cost and total variable costs in a production cycle. Variable costs included cost of DFLs, chemicals used for disinfection of rearing houses, repairing costs of rearing houses, and service charge paid to BRAC. Depreciation on fixed cost constituted 46% of the total cost of which 35.4% are depreciation value of rearing houses. Variable cost accounted for 54% of the total cost. Cost of DFLs and service charge paid to BRAC were the major part. By rearing 100 DFLs in a

production cycle a rearer received Tk. 763. The average net economic profit per crop was found to be Tk. 108. (Table 19).

Table 18. Distribution of daily works and average hours spent for rearing

Sl. No.	Types of work	Hours spent	
		Chawki rearer	Late age rearer
1	Leaf collection	2.2 (33.8)	2.5 (30.8)
2	Feed preparation	0.9 (13.8)	1.2 (15.2)
3	Feeding	1.3 (19.9)	1.3 (15.7)
4	Cleaning of *dalas*	1.6 (24.6)	1.8 (22.5)
5	Cleaning of rooms	0.5 (8.3)	0.8 (9.5)
6	Others	-	0.5 (6.3)
7	Total	6.5 (100)	8.0 (100)

Figures in parentheses indicate percentages

Table 19. Profitability analysis of rearing 100 DFLs in a production cycle

Items	**Cost of rearing**	
	Tk.	**% to total**
Depreciation on fixed cost[1]	**221.5**	**45.9**
DFL/Worm	37.8	23.7
Service charge paid to BRAC	45.0	28.2
Others[2]	76.7	48.1
Total variable cost	**159.5**	**54.1**
Total accounting cost	**295**	**100.0**
Total Revenue	**763**	
Net accounting profit	**468**	
Imputed value of labour	**360**	
Total economic cost	**655**	
Net economic profit	**108**	

[1]. includes depreciation value of trays, mountages, rearing stands, rearing houses and others including leaf chopping knife, leaf chopping board, rearing net and polythene paper. Since only 13% of houses were used only for rearing the depreciation value on houses is calculated by using the next formula: ((current value of house/longevity)X 0.13) X number of crops reared)+(((current value of house/longevity)X 0.87)/365days) X 22 days

[2] include cost of bleaching powder, formaline, paraffin paper/news paper, lime, resin and mustard oil used for disinfection of rearing houses and repairing cost of rearing houses.

Revenue earning of different silk worm rearing: Table 20 illustrates differences of earnings due to differences of skills of the rearer. Generally there are two types of rearers namely *chawki* and late age rearer according to the activities carried out. But in reality none of the chawki rearers did *chawki* rearing only. Those selected for *chawki* rearing had higher skills and were involved in rearing for a longer period. At the end of chawki rearing they kept a portion of their third stage larvae by adjusting the capacity of rearing house and availability of mulberry leaves. It is obvious that earning of this group would be higher than others in each crop period. A *chawki* rearer produced 4.22 crops in the year while a late age rearer did it 2.56 times in the year. Annual income from the activities was Tk. 5,907 for chawki rearer which was 200% higher than that of the late age rearer.

Table 20. Revenue earning of different silk worm rearing

Types of crop	Revenue of pure late age rearing	Revenue of *chawki* + late age rearing	Average revenue
Bhaduri	721(220)	1602(42)	642
Kartiki	1362(10)	1120(2)	1048
Agrahani	755(200)	1667(37)	644
Maghi	515(31)	901(4)	515
Chaita	842(211)	1184(37)	782
Jaistha	501(236)	1159(44)	469
Chaita (seed)	644(198)	1132(32)	597
Average per crop	763	1399	626
Average per rearer in 1995	1952	5838	

Figures in parentheses indicate number of rearers

Return on investment: Table 21 shows that one full day involvement in rearing brought Tk. 9 and Tk. 25.2 respectively additional income for late age and chawki rearer. The net economic gain on per taka investment was Tk. 0.16 and Tk. 0.56 respectively for late age and chawki rearers.

Table 21. Output-input ratio of silk worm rearing

Indicators	Late age	Chawki
Return on labour		
Net accounting profit per person day employment	39	55.2
Net economic profit per person day employment	9	25.2
Return on investment		
Revenue per taka investment	2.59	4.74
Net accounting profit per taka investment	1.59	3.74
Net economic profit per taka investment	0.16	0.56

Note. This computed is created by using information from Tables 3.2.3.4-3.2.3.6

In terms of productivity 78% of *chawki* and 84% of late age rearers stated that they could get higher output from their last crop before the interview. Sixty-seven percent of the late age and 30.4% of the *chawki* rearers reported that shortage of mulberry leaves was the reason for low output. Low quality of DFLs and high mortality of larvae also affected the output. (Table 22). This result contradicts the other findings of this study describing the higher production capacity of leaves than the normative requirements. This contradiction could be explained by the findings of monitoring report on sericulture plantation. The monitoring report also found some gap between official records and the actual situation in the field regarding the number of living trees and its productivity, the former is over reported the situation (BRAC Monitoring Report 1997, pp. 43-47).

Table 22. Reasons of high mortality in the last crop

Reasons	Number of rearers (%)	
	Chawki n=23	Late age n=227
Insufficient leaf	30.4	67.0
Lower quality of DFL	43.5	8.8
Higher mortality of larvae	21.7	21.6
Others	4.3	2.6

Table 23 presents reasons for involvement of BRAC members in silk worm rearing. Although rearing is a non-traditional activity, 62.2% of *chawki* and 3.5% of late age rearers reported that rearing was their family tradition. But more than 90% of all rearers reported that their main concern was to receive additional income considering both primary and secondary reasons for involvement.

Table. 23. Reasons for involvement in rearing

Reasons	*Chawki* n=45		Late age n=255	
	'Cause- 1'	'Cause-2'	'Cause- 1'	'Cause-2'
Family Tradition	62.2	-	3.5	-
Additional income facilities	31.3	62.2	93.7	0.4
Advice of BRAC staff	-	-	-	0.4
Others	6.6	17.8	2.7	51.8
No response	-	20.0	-	47.5
Total	100	100	100	100

Skill of the rearer: Ninety-two percent of the rearers received eleven days of formal training from BRAC on silk worm rearing before starting rearing. The duration of training for a chawki and late age rearer was 15 and 10 days respectively. During the period of rearing, on an average, a rearer participated in five refresher courses to update her skill (Table 24).

Table 24. Skill of the rearer

Indicators	*Chawki* n=45	Late age n=255	Total n=300
% received BRAC training	62.2	97.3	92.0
Average number of days	21	15	16
New	15	10	11
Refresher	6	5	5

Rearing house: Success in rearing is greatly depends on the rearing condition i.e., housing condition of the rearer. Space, ventilation and humidity in the house, construction material of the house, whether the house is used only for rearing, and also several other indicators can be included under rearing condition. For *chawki* rearing of 100 DFLs of multivoltine races a maximum of 5.58 sq. meter of space is required (A.2). For late age rearing the maximum space required is 22 sq. meter. a *chawki* and late age rearer in each crop, on an average, reared 602 DFLs and 100 DFLs respectively. Mean space of rearing houses of the *chawki* and late age rearers was 13.3 sq. meter and 14 sq. meter respectively, both of which were not adequate to

maintain the rearing standard. Around 28% of rearing houses were found without any windows, another 18% had one window each. These indicates poor ventilation system in the rearing houses (Table 25).

Table 25. Description of rearing houses by type of rearers

Indicators	*Chawki* rearer n=45	Late age rearer n=255	Average per rearer
Space (sq. meter)	17.4	13.3	14.0
Height(meter)	3.1	3.1	3.1
Current value of house (Tk)	4595	3860	3970
Average No. of window in a house	2.6	1.7	1.9
No windows (% of houses)	15.6	8232.2	8929.7
One windows (% of houses)	13.3	18.4	18.00
Longevity	9.6	8.0	8.2
% of houses with mud wall	62.2	10.2	18.0
% of houses with straw wall	6.7	22.4	20.0
% of houses with others wall materials	31.1	67.5	61.0
% of houses with tin roof	48.9	60.4	58.7
% of houses with straw roof	13.3	34.9	31.7
Average years of rearing	11.8	3.2	4.5
BRAC loan use for construction of houses (% of houses)	28.9	36.9	35.7

Overall the condition of *chawki* rearing houses was relatively better than the late age ones in terms of their space, number of windows, cost of building and quality of construction materials. To improve this condition, BRAC provided loan to construct rearing houses. Around 36% of rearing houses were constructed with BRAC loan. Average space of rearing houses constructed with BRAC loan was 19 sq. meters which was 3 sq. metre more than that of rearing houses without BRAC loan. Number of windows was also higher for houses constructed by BRAC loan. The larger space of rearing houses contributed in increasing the capacity of rearing. Number of DFLs reared in the last crop was 198 and 178 respectively in rearing houses constructed with and without BRAC loan. But the mortality rate was more or less similar for both types of rearing houses (Table 26).

Table 26. Description of rearing houses constructed with BRAC loan and others

Indicators	BRAC n=107	Others n=193
Number of windows	2.2	1.7
Number of DFLs reared in the last crop	198	117
Number of survived DFLs	164	98
% of houses with tin roofing	79	47
Mortality rate	17.0	16.0
Space (length*width) sq. metre	19	16

Uses of rearing houses at the period of rearing and after rearing are presented in Tables 27-28. During rearing period 43.3% of the houses were used only for silkworm rearing. But around 55% of the houses were used as living space and for rearing at a time. Another 1.3% of the rearing houses were also used for animal keeping. Purposes of use of *chawki* rearing houses were more or less similar to the use of late age rearing houses during the rearing period. During the period in between two *bondh* 91.1% and 77.6% of *chawki* and late age rearing houses respectively were used as living space. Only 7% and 14% of *chawki* and late age rearing houses are kept empty up to the next rearing cycle.

Table 27. Use of houses at the period of rearing

Purpose of use	*Chawki* n=45	Late age n=255	Total n=300
Only for rearing	44.4	43.1	43.3
Rearing + Living house	55.6	55.3	55.3
Rearing + animal keeping	-	1.6	1.3

Table 28. Use of houses after rearing

Purpose of use	*Chawki* n=45	Late age n=255	Total n=300
Keeping empty	6.7	14.1	13.0
Use for living	91.1	77.6	79.7
Use as Kitchen	-	3.1	2.7
For miscellaneous use	2.2	5.1	4.7

Table 29 presents socioeconomic status of the rearer which includes average household education level, number of income earner in a household, size of the household, economic dependency ratio[11], amount of homestead and other cultivable land and membership in BRAC and other NGOs. Findings reveal that the status of a *chawki* rearing household in the society was higher than that of a late age rearer. A *chawki* rearer had owned significantly more cultivable land. The average household education level was also significantly higher for *chawki* rearer. Although size of the household was similar, number of income earner was higher for *chawki* rearer which made an impact in their lower economic dependency ratio. Age of the *chawki* rearer was also relatively less than the age of the late age rearer.

Table 29. Present socioeconomic status of *chawki* and late age rearer

Indicators	*Chawki* n=45	Late age n=255	*Chawki* vs late age rearer (t value)
Average household education	145	110	2.18**
BRAC membership	1.15	1.21	-0.15
Other NGO membership	0.31	0.16	1.26
Number of income earner	2.9	2.5	0.92
Household size	5.1	5.1	0.16
Economic dependency ratio	102	147	-2.02**
Homestead land (dec.)	8	11	-1.67*
Cultivable land (dec.)	55	15	4.46***
Age of the rearer	33.7	36.2	-1.66*

** - significant at 10% level, ** - significant at 5% level , ***significant at 1% level*

[11] *is the ratio of number of dependents to total income earner*

Annual income was also higher for *chawki* rearer (Table 30). Income from rearing constitutes 23% of total household income for *chawki* rearer while for late age rearer it was only 10%. Distribution of income among sectors shows that wage/salary was the major source of income for late age rearer (52%), for *chawki* rearer its proportion was also highest (32%). It implies that late age rearers were economically less well-off, mostly depended on their manual labour. Higher income from IGAs and its share to total household income of *chawki* rearers indicates their higher entrepreneurial capability.

Table 30. Sectoral distribution of gross annual household income in 1995 by types of rearer

No	Sector	*Chawki* rearer		Late age rearer	
		Tk.	% to total	Tk.	% to total
1	Crop	4,775	13.1	3,042	10.1
2	Livestock	1,992	7.4	2,407	10.5
3	Wage/ Salary	7,773	31.7	12,056	51.9
4	IGA	6,723	18.6	3,578	11.8
5	Others	1,488	5.8	1,239	5.7
6	Sericulture	5,838	23.3	1,952	10.0
6	Total	28,589	100	24,273	100

Use of income from silk worm rearing: Table 31 shows that 86% of income of late age rearing were spent for household necessities, while 80% of *chawki* rearing income were saved. Proportion of income spent for asset purchase was also more than three times higher for *chawki* rearers. This result also shows that the *chawki* rearers were less poor households. Income from sericulture did not make significant contribution to their household expenditure, although it influenced in increasing their household assets and savings. On the other hand, for late age rearer the dependency on one taka additional income to meet up the household daily expenses was very high. It indicates that the contribution of the programme in fulfilling the clients satisfaction was significantly higher for late age rearing.

Table 31. Income from silk worm rearing and its uses by types of rearer

Use of income	Chawki n=45	Late age n=255
Debt servicing	6.0	6.2
Household expenditure	0.6	85.6
Savings	80.1	1.2
Assets accumulation	19.3	5.8

Table 32 presents impact of rearing on health. In the process of rearing formaline and bleaching powder were used to disinfect the eggs and rearing houses. It is assumed that use of these chemicals and dealing with larvae may have some negative impact on the skin of the rearer. The rearers were asked the question whether they felt any change of their health condition after being involved in rearing. All the *chawki* rearers stated that they did not feel any change due to rearing. But 80% of late age rearers reported that they faced some problems at the time of rearing.

Around 4% faced itching in their hands, 2.7% got infected by skin ulcer. About 1.2% of late age rearers claimed that for rearing of silk worm they found rash on their skin.

Around 29% of those who faced any such problems received treatment and spent, on an average, Tk. 40 for treatment.

Table 32. Impact of rearing on health of the rarer

Health indicators	*Chawki* n=45	Late age n=255
Ulcer in the skin	-	7(2.7)
Itching in the skin	-	10(3.9)
Rash in the skin	-	3(1.2)
Others	-	1(0.4)
Total	-	21(8.2)
Number received any treatment	-	6(28.6)
Tk spent for treatment	-	40

Reeling

Reeling is the third component of silk production cycle. It is composed of different activities like sorting, boiling and reeling of cocoons and re-reeling of yarns. Three out of four BRAC reeling centres were selected for this survey and 57 workers were interviewed through a structured questionnaire. All types of workers were considered for the study. Number of samples taken for all activities were proportionate to the actual number of workers except the fuel suppliers. All three fuel suppliers from three reeling centres were interviewed.

Table 33 presents detailed information on average working period, time spent in the reeling centre, average daily income and average income in the last month before the interview. BRAC started reeling very recently, so average working period of an employee was only 20 months. A worker worked for 5.12 days per week and 8.07 hours per day in the last month. Number of days involved in depends mainly on the availability of cocoons. The payment for different activities were different. Boiler, reeler and re-reeler were paid by the volume of their output multiplied by normative rate per unit of output. Fuel supplier and helper were paid on daily basis.

Table 33. Employment and income of reeling workers

Types of reelers	No of workers	Average working period (months)	Spending time		Production of yarn gm/day	Average income	
			Hours/ day	Days/ week		Daily	Monthly
Boiler	9	25	7.33	5.67	355.6	7.78	211.11
Reeler	18	27	8.17	4.39	201.4	20.11	379.00
Re- reeler	6	26	7.50	5.67	1083.3	20.00	416.67
Fuel supplier	3	23	6.67	4.67	-	7.33	184.00
Helper	21	10	8.67	5.43	-	6.19	151.67
Total	57	20	8.07	5.12	-	12.35	264

Daily income of a reeler was highest followed by re-reeler. Helpers received lowest income of Tk. 6.19 per day. Reeling and re-reeling are the higher skill activities. The rate of payment was

also based on the technical skill needed for the activities. Monthly income which includes price of wheat received through VGD card[12] was highest for re-reelers (Tk. 417). Helpers received lowest amount of Tk. 152.

Individual characteristics of the reeling workers: Table 34 shows individual characteristics of all sample workers. All the workers in the reeling centres were female. Around 11% of them were below 15 years. Percentage of workers under 15 was highest among boilers and reelers (16.7% in each). Nearly 40% were unmarried, and another 16% were either widowed or separated. Around 9% of all workers were the household heads and their income was the major part to their household income. In 67% of the cases reeling was their primary involvement.

Table 34. Individual characteristics of reeling workers

Types of workers	No. of respondents	Age of the workers	% below 15 years of age	% unmarried	% widowed /separated	IGA as a main occupation (%)	% of hh head
Boiler	9	22	16.7	22.2	33.3	66.7	33.3
Reeler	18	18	16.7	33.3	16.7	83.3	11.1
Re-reeler	6	23	-	33.3	16.7	66.7	-
Fuel supplier	3	33	-	100.0	-	33.3	-
Helper	21	21	9.5	45.0	10.0	85.7	-
Total	57		10.7	39.3	16.1		8.8

Table 35 presents household information of reeling workers. Average household size of the workers was 4.5 persons. Of them 2.7 persons were involved in IGAs contributing to the household resource pool. The dependency ratio and the household education level was highest for re-reelers and lowest for helpers. Average land size including both homestead and cultivable indicate that all the workers came from target group households. Fuel suppliers were relatively poorer households compared to others. Membership in BRAC and other development organizations indicate that among workers only 46% came from BRAC member households.

Table 35. Household information of reeling workers

Types of workers	No. of resp-ts	Hh size	No. of income earner	Econ. dep-cy	Av. hh edn level	NGO membership		Land (decimal)	
						BRAC	Others	Homestead	Cultivable
Boiler	9	4.2	2.1	107	127	0.44	0.56	13	2
Reeler	18	4.3	2.5	82	134	0.44	0.11	13	14
Re-reeler	6	6.5	3.2	99	148	0.67	0.17	15	9
Fuel supplier	3	3.7	2.3	67	125	1.3	0.33	6	5
Helper	21	4.5	2.9	62	71	0.38	0.10	13	22
Average	57	4.5	2.7	79	111	0.49	0.19	13	14

[12] *VGD card offered mainly to the worker at their in-service training stage to retain the minimum level of income.*

Table 36 shows that all the re-reelers received formal skill training on the activities they were engaged in. Around 78% of the reelers and boilers and 23.8% of the helpers received such training on such activities they are involved in. The re-reeler received the highest 45.03 days of training including refreshers followed by reelers (23.8 days), boilers (12.2 days), helpers (7.5 days) and fuel suppliers (1.7 days).

Table 36. Training status of reeling workers

Types of workers	No of resp.	% received training	% received refreshers	Number of days (new)	Total number of days
Boiler	9	77.8	-	12.2	12.2
Reeler	18	77.8	11.1	23.6	23.8
Re-reeler	6	100.0	33.3	39.0	45.3
Fuel supplier	3	33.3	-	1.7	1.7
Helper	21	23.8	-	7.5	7.5
Total	57	57.9	7.0		

Table 37 shows sector-wise distribution of household income and share of reeling to total income of reeling workers. Although average household income was highest for re-reelers, per capita income indicating well-being status of a household was highest for helpers. Reeler households were in the second position. Income from reeling to total household income was highest for reelers (22.5%) and lowest for helpers (8.0%). For re-reelers, boilers and fuel suppliers income from their involvement in reeling centres constituted significant part of their household income. All these imply that involvement in reeling made significant impact in the well-being status of the household of all workers except for helpers.

As shown in Table 38 eighty percent of the income of reeling workers were spent for household necessities, 5% for debt servicing, 9.2% for asset purchase. About 9.2% of their income were deposited as savings. Share of income deposited as savings was highest for re-reelers.

Table 37. Sectoral distribution of gross annual household income of reeling workers (Tk.)

Sector	Boiler n=9	Reeler n=18	Re-reeler n=6	Fuel supplier n=3	Helper n=21	Average n=57
Crop	14.0	11.9	9.2	5.9	6.8	9.4
Livestock	10.9	5.9	5.6	14.0	4.2	7.4
Wage/ Salary	50.1	30.3	48.3	46.5	26.0	39.7
IGA	0.7	24.9	15.3	11.8	49.9	22.5
Others	7.5	4.5	2.9	7.2	5.2	5.1
Reeling	16.9	22.5	18.7	14.5	8.0	15.9
Total	100	100	100	100	100	100
	(14,958)	(20,205)	(26,670)	(15,221)	(22,879)	(19,933)

Figures in parentheses indicate gross annual income in Taka

Table 38. Income from reeling and its uses by different types of reeling workers

Use	Boiler n=9	Reeler n=18	Re-reeler n=6	Fuel supplier n=3	Helper n=21	Average
Debt servicing	11.1	-	-	-	8.3	4.8
Household	69.4	76.4	83.3	81.0	85.3	79.6
expenditure	13.9					
Savings		11.1	16.7	-	4.8	9.2
Assets accumulation	5.6	12.4	-	19.0	1.6	6.4
Total	100	100	100	100	100	100

Impact of reeling activities on health of the workers. After being involved in different activities of reeling 52.6% of workers faced different types of infectious diseases like hand ulcers, itching and rash. Percentage of sufferers to total workers were higher among reelers (88.9%) followed by boilers (44.9%) and re-reelers (16.7%). Among diseases frequencies of hand ulcer was highest (Table 39).

Among the sufferers 75% of reelers and half of the boilers received medical treatment. Thirty-eight percent of the helpers who suffered from skin problems also received treatment. Two out of three helpers who received medical treatment spent Tk. 265. The mean amount for treatment by reeler and boiler was Tk. 55 and Tk. 40 respectively. In addition to such health hazards mentioned above, it was also found that specific type of reeling activities like standing for the whole day by reelers in their working place, boilers putting hands in the worm water by, twisting machine created great noise and so on, made some adverse effect on health of the workers (Akhtar and Rahman, 1998).

Table 39. Impact of reeling on health of the reeling workers

Health indicators	Boiler n=9	Reeler n=18	Re-reeler n=6	Fuel supplier n=3	Helper n=21	Average n=57
Ulcer in the skin	44.4	77.8	-	33.3	28.6	43.9
Itching in the skin	11.1	44.4	16.7	-	19.0	24.6
Rash in the skin	11.1	38.9	-	-	9.5	17.5
Others	-	38.9	16.7	-	9.5	17.5
No. of workers faced health problems	44.9	88.9	16.7	33.3	38.1	52.6
No. received any treatment	50.0	75.0	-	-	37.5	56.7
No. of workers spent money for treatment	2	6	-	-	2	10
Av. Tk spent for treatment	40	55	-	-	265	94

Figures in parentheses indicate percentages

Pedal Spinning

For spinning unreelable cocoon and silk waste pedal *charka* is used.[13] Sixty four pedal spinners were investigated. Fifty-two of them (82%) were full time housewives. They did pedal spinning after doing all household works. Only 8 of them (12.5%) were professional spinners. On how they learnt to do spinning, 51.6% reported that they learnt it from experiences of others. The rest stated that they received 4.61 days of formal training in BRAC. All of them were doing spinning in their houses. They were involved in spinning for 25 days in a month on average. Ninety-seven percent of the respondents reported that they did spinning throughout the year, one respondent did it eight months a year and another one did it ten months a year. On an average a spinner reeled 8.89 kg of cocoons in a month, i.e. for reeling one kg of cocoons 3.56 days were required. Certain preliminary work is needed to prepare cocoons for spinning, such as boiling, washing and drying of cocoons. A spinner spent 161 hours on different activities of spinning. Ninety-two percent of the time were spent for spinning.

Cost of spinning: Since *charka* spinning is done in conjunction with other household activities cost of labour was not considered in this analysis. Among others price of rejected cocoons constituted 88% of the total cost. Cost of firewood and other operational expenses was 11%. Pedal spinning is a labour intensive activity which does not require heavy investment. Pedal *charka* and wooden frame are the only equipment required for spinning of cocoons. BRAC supplied *charka* and wooden frame with rejected cocoons to those VO members who were interested in spinning. Number of *charka* in a household indicates the number of workers involved in spinning. On an average, in a household 1.31 persons were involved in spinning and earned Tk. 511 from spinning. The net accounting and economic profit for the household was Tk. 240 i.e. Tk. 183 for an individual. Net economic profit was negative indicating that this was not an economically viable activity (Table 40).

Table 40. Cost analysis of pedal spinning.

Cost item	Monthly per household		Monthly per *charka*
	Tk.	% to total	Tk.
Depreciation on fixed cost	**3.25**	1.2	2.48
Rejected cocoon	238.4	87.9	182
Other operational cost	10.28	3.8	7.85
Fire wood	19.05	7.0	14.54
Total variable cost	**267.73**	98.8	204.49
Total accounting cost	**271.08**	100	206.87
Total revenue	**511.34**		**390**
Net accounting profit	**240.26**		**183.13**
Imputed value of household labour	**780.0**		**600.0**
Net economic profit	**-539**		**-417**

Return on investment. As shown in Table 41 one full-time employee earned Tk. 9.2 after deducting all costs. The net accounting profit per taka investment was found Tk. 0.88. The net economic gain was found negative implying that the project's income could not cover all costs.

[13] *Pedal charka is a simple foot operated contrivance made of wooden frame and equipped with wooden pedal, gear wheel, fly wheel bobbin and iron spindle and distributor.*

Table 41. Return on investment in pedal spinning

Indicators	Pedal Spinning
Return on one person days employment	
Net accounting profit per person days employment	9.2
Net economic profit per person days employment	-20.9
Return on per taka investment	
Revenue per taka economic cost	0.48
Net accounting profit per taka	0.88
Net economic profit per taka	-0.52

Weaving

Weaving is a process of silk fabric production. All the weavers who were interviewed were professionals who weaved cotton previously. BRAC trained and converted them into silk weavers.

Employment. Weaving is a home-based labour intensive activity. Major processes involved in weaving are degumming of raw silk, dyeing of yarn, winding of yarn, warping and weaving. In doing all the activities, a total of 108.4 person-days were spent to produce 177 metres of cloth, i.e. for per metre of cloth production 0.63 person-days were spent, 42.1% were spent for weaving. Rest of the time were spent for winding (33%), washing and degummimg (7.4%), rolling (6.6%), marketing (4.2%), warping (3.7%) and other activities (Table A.3). Seventy-three percent of the total work were done by household labour. The rest 27% were hired. Wage rate differs on the types of activities, skill of the worker and quantity of output produced by the worker. The highest wage paid was Tk. 64.50 to the weaver and lowest Tk. 11.64 to the roller. Total taka paid for hired labour and the share of each activity to total wages show that 76.4% of the wages were paid for weaving. Rest of the wages were paid for warping (7.4%), winding (9.4%), wefting (4.9%) and warping.

Cost of weaving. Cost of weaving per metre include depreciation on fixed cost, wages of hired labour, imputed value of household labour, transportation cost and other operational expenses. On an average, a household owned 2.7 working looms of which 1.4 were used to produce silk cloth. A household produced 171 metres of silk cloth i.e. 122 metres per working loom. The cost of production per metre was Tk. 23.1. Since weaving was carried out in handlooms the total labour cost (cost of hired labour and imputed value of household labour) constituted 83% of the total cost. Depreciation on fixed cost constituted only 5% of it. A weaver received Tk 24.49 by producing one metre of cloth. The economic profit of one metre of cloth production was Tk. 1.39 (Table 42).

Table 43 shows that cost of production increased proportionately with increasing number of working looms under silk production. Gross return from investment also increased with the increase of looms but rate of return was not proportionate to the number of looms. Input-output ratio indicates that for per taka income Tk. 0.82 were spent in one loom enterprises which was lowest. Cost of production was highest for enterprises with two looms which could not make any economic profit. Weaving is a highly professional activity and it is also found that the

imputed value of household labour need to be considered as part of total cost. The net economic gain was highest for households with single silk working loom. Household information on weaving presented in Table 44 shows that for households with one working loom weaving was done by household's own labour. The efficiency, sincerity and desire to earn higher income played major role in their better performance. Negative result of households with two working loom is difficult to interpret by using this data set unless any in-depth case study is conducted.

Table 42. Cost analysis of per metre cloth production

Cost items	Tk.	% to total cost
Depreciation on fixed cost	1.06	4.6
Wages on hired labour	7.04	30.5
Transportation cost	0.25	1.1
Other variable costs	2.75	11.9
Total accounting cost	11.10	
Gross revenue	24.49	
Net accounting profit	13.39	
Imputed value of household labour	12.00	51.9
Net economic profit	1.39	

Table 43. Monthly cost of silk weaving by number of working looms

Cost items	Cost of weaving by no. of looms (Tk.)			Average
	1 (n=21)	2 (n=15)	3-4 (n=9)	n=45
Depreciation on fixed cost	133	135	373	182
Variable cost	432	1,418	5,,214	1,717
Wage/salary	94	947	4352	1,230
Transport	34	45	54	42
Others	304	428	808	445
Accounting cost	566	1,553	5,586	1.899
Imputed value of household labour	1,492	2,547	2,523	2,050
Total cost	2,058	4,099	8,110	3,949
Total revenue	2,515	4,012	8,383	4,188
Accounting profit	1,949	2,459	2,797	2,289
Economic profit	457	-88	274	239

Income earned through sericulture and its use

In the previous section analysis has been made for different components of the programme separately. From this section onward a comparison among components have been made to show their relative performance. Table 45 presents annual income earned through sericulture and its share to total household income. The weavers received the highest amount and the late age rearer got the lowest. The amount earned by different participants varied because depth of participation (annual ime spent in the activity), kill of the worker and scale of operation of different activities were different. The share of income from sericulture to total income indicates the actual contribution of sericulture activities to total household earning. The amount they received was an

incremental benefit for them. For weavers who weaved cotton previously, results on share of silk weaving to total income (58%) did not show the contribution of silk weaving unless we did not find out their previous income of cotton weaving. Since we did not have enough data on these it is difficult to find out the actual economic gain of silk weaving.

Table 44. Household information of weavers

Sl. No.	Indicators	Number of looms			Average
		1	2	3-4	
1	Number of family members involved in silk weaving	1.0	1.53	1.44	1.29
2	Number of family members involved in weaving (silk+cotton)	2.8	1.9	3.0	1.59
3	No of members doing weaving as main occupation	1.8	1.3	1.4	1.53
4	No of working looms	2.1	2.3	4.7	2.7
5	No of silk looms	0.95	1.4	2.2	1.4

Table 45. Annual sericulture income and its share to household total income

Indicators	Sapling	*Chawki* rearing	Late age rearing	Pedal spinning	Reeling	Weaving
Annual income through sericulture (Tk.)	2,740	5,231	1,544	2,899	3,168	29,652
Share of sericulture to total Hh income (%)	6.4	18.7	6.5	11.6	15.9	58.1

Note: Income earned through sericulture are equal to annual accounting profit after deducting only all variable costs

The use of income earned through sericulture varied widely among groups (Table 46) Ninety-five percent of the income earned through silk weaving were spent to meet household expenses while less than one percent of *chawki* rearing income were spent for this purpose. Percentage spent for debt servicing was highest for pedal spinners (52%) and lowest for weavers (0.6%). Eighty percent of income from *chawki* rearing were saved. Percentage of income saved was lowest for late age rearers (1.2%). Percentage used for asset purchase was highest for sapling growers (40%) and lowest for pedal spinners (0.3%).

The use of income earned through sericulture activities indicate relative dependence of the household on the activities.

Table 46. Use of sericulture income by different participants

Use	Sapling	*Chawki* rearing	Late age rearing	Pedal spinning	Reeling	Weaving
Debt servicing	6.5	6.0	6.2	51.59	4.8	0.62
Hh expenditure	24.8	0.6	85.6	46.53	79.6	94.67
Savings	28.4	80.1	1.2	1.56	9.2	2.56
Assets accumulation	40.4	19.3	5.8	0.31	6.4	2.16
Total	100	100	100	100	100	100

Viability of the programme from the participants point of view: a comparative analysis

Analysis of annual income of the programme, its share to household income and its use for different purposes revealed that the project has made significant contribution in maintaining the household expenses and changing the welfare status of the household. Table 47 presents the comparative feature on the rate of return from different components. Before going into detail certain points should be kept in mind that although unit of analysis was same for all the components, volume of investment, investment pattern, period of involvement and skill of the worker were different for different activities.

Table 47. Return on investment of different components of sericulture programme of BRAC

Indicators	Sapling	*Chawki* Rearing	Late age Rearing	Pedal Spinning	Reeling	Weaving
Return on one person days employment						
Net accounting profit per person days employment	14.33	55.2	39	9.2	12.35	21.1
Net economic profit per person days employment	10.32	25.2	9	-20.9	-	2.2
Return on per taka investment						
Revenue per taka accounting cost	1.11	4.74	2.59	0.48	-	1.06
Net economic profit per taka expenses	0.11	0.56	0.16	-0.52	-	0.06

Results show that net economic gain on one person-day of employment was highest for *chawki* rearing and it was negative for pedal spinning. Gross revenue per taka economic cost was highest for *chawki* rearing followed by sapling, weaving and late age rearing. This rate was lowest for pedal spinning i.e. per taka spent in pedal spinning brought only Tk. 0.48 as gross return. It implies that except pedal spinning all other activities made profit and were viable. But in strict economic sense, an enterprise can be treated as economically viable if net economic profit of the enterprise would at least equalize the market rate of interest i.e.(15%). If so, sapling growing was also found to be an economically non-viable activity.

Viability of the programme from the organizer's point of view

To determine programme viability from BRAC's point of view annual income and expenditure data of the sericulture programme of BRAC were used. Generally AOs provided services to only silk worm rearers since pedal spinning, reeling and weaving were not carrying out in every areas. Reeling was done in BRAC owned reeling centres for which accounts on reeling were maintained separately. For pedal spinning and weaving BRAC supplied only raw materials to the participants for which no separate account was maintained.

Types of services provided to the rearers were supplying adequate number of DFLs for rearing, providing technical support for rearing, monitoring and supervision of the rearing process and training of the rearer. Cost of services provided to the rearer included salary and benefits of

programme staff, traveling and transportation, staff training, and training of the rearers.[14] The establishment cost of plantation was not included since it was implemented with food for work programme of the WFP. Overhead cost of the programme was also not included due to lack of necessary information. Table 48 present programme's income and expenditure for different years. Service charge paid by the rearers was the only source of income for BRAC. For maintenance and capacity development of its clients in 1995, BRAC spent Tk. 1,588 per rearer and received Tk. 262 from each rearer which implied that the programme was subsidized. Over time expenditure per rearer reduced gradually. At the same time programme's income has also reduced. Early discussion on cost-benefit analysis revealed that a late age rearer received Tk. 975 (Tk. 382x2.56 crops) in 1995 as net accounting profit. Annual net economic benefit for the rearer was found Tk. 56 (Tk 22x2.56 crops). On the basis of this result some one can raise a question at what cost the programme is implemented and for what?

Table 48. Income and expenditure statement of sericulture programme for different calendar years

Head's of accounts	1994	1995	1996	1997
Income (Tk.)	1832291	4469554	2475428	3246714
Expenditure (Tk.)	18293122	2706352	17361112	15520386
Number of rearers	11856	17040	20709	21445
Service charge paid to BRAC by each rearer (Tk.)	154.55	62.30	119.53	151.40
Expenditure of BRAC per rearer (Tk.)	543	1588	838	724

Profitability analysis of reeling also shows that cost of production, consisting of only operating costs, exceeds the value of silk yarn produced in the centre (Table 49). The actual cost of production might be higher if depreciation on building and equipment were included in. Silk yarn produced in the centre in many cases were of low quality. The low quality of products was due to lower quality of cocoons reeled and lower skill of the worker. Workers in the reeling centres came from poorer households. They did not have any previous experiences on the activities they were involved in. They received in-service training on reeling in the centre. Average working length of the worker in the centre was less than two years. One of the recruitment policy of the centre was to choose females, aged 15-25 years. It is evidenced from the study that nearly 40% of the workers were unmarried women. As a result a large number of trained workers dropped out after their marriage. Cost of training of new workers and inadequate supply of cocoons for maximum use of centre's capacity were also responsible for higher cost. Marketing of the final products of the centre was another important issue. The centre was opened and worked to meet the demand of Ayesha Abed Foundation. But the Foundation, the main supplier of Aarong products purchased only a part of the total product of the centre due to its low quality and higher price compared to the market. Our observation and discussions with field staff revealed that a significant proportion of yarn produced in the centre were not yet sold. There was an uncertainty

[14]Yearly cost of training of the rearer is calculated by summing up the total cost of training of the rearer divided by probable life time of using knowledge gained throw training, latter is calculated by subtracting present age of the rearer from the upper limit of membership age. .

that all yarn stored in the centres would be sold which could at least recover total cost since storing of yarn will increase cost. At the same time reducing price in the international market may also create further problems.

Table 49. Income and expenditure statement of reeling in three reeling centres in 1995 (in Taka)

Items	Manikganj	Jamalpur	Atghoria	Total
Salaries and benefits	47,177	116,678	139,962	303,817
Variable cost	297,651	1,236,830	812,145	2,346,626
Total cost (fixed+variable)	344,828	1,353,508	952,107	2,6504,43
Total income	236,407	973,958	973,408	2,183,773
Profit/loss (+/-)	-10,8421	-379,550	+21,301	-466,670

Source: Income and expenditure data sheet of reeling centres

CONCLUSION AND POLICY IMPLICATION

BRAC, through its sericulture programme involved a significant proportion of its programme participants and created an employment opportunity for them. Cost-benefit analysis of different components of the programme shows that all the participants earned accounting profit from the activities they were involved in. The net economic gain for all the participants except *charka* spinners was found positive, although the amount was negligible.

RDP spent a significant amount per participant for achieving its main goal i.e., to generate employment and income for rural poor. But the amount it spent was much more higher than the income generated by its participants and that the programme received. All these findings may have some policy implications for BRAC such as:

i) The amount received by the participants may not be adequate to provide sufficient incentives for their sustainable involvement. Since income of rearing depends on the quantity and quality of cocoon production. The latter is closely related with supply of quality DFLs and adequate quantity of good quality leaves, programme should take necessary steps in this regard.

ii) One interesting area of inquiry could be the relative profitability of different scales of operation. If it is found that those who raised more cocoons earned relatively higher profit, then number of rearers could be reduced by enlarging the scale of operation in rearing. In such a case, the income earned from cocoon rearing could form a more significant part of total income and this could have a more positive impact on poverty alleviation. At the same time it could make sericulture relatively a more cost effective enterprise. But the scale of cocoon rearing mainly depends on the availability of sufficient quality mulberry leaves. To ensure sufficient quality leaves BRAC should take alternative policy and reduce the existing dependence on roadside plantation.

iii) Eighty-eight percent of the cost of *charka* spinning consisted of price of rejected cocoons. Since this is a labour intensive activity, there is a limited scope to increase income. Reduction in price of wastage or rejected cocoons is the only way to increase income which can retain the involvement of the participant households.

iv) For retention of workers in reeling, the centre should change its recruitment policy and should not involve adolescent girls or unmarried women. To reduce cost and increase income the scale of operation of the centre can be expanded. For maximum utilization of the capacity of the centre it will be not so realistic to depend only on the supply of cocoons from BRAC's own rearers.

Data for this study collected in April 1995. Since then a number of decisions were made and implemented to improve the programme performance. BRAC has already established a number of grainages for producing good quality DFLs which ultimately reduce the dependence on the DFLs of the Bangladesh Sericulture Board. It has also started bush plantation to supply good quality leaves. To increase income of *charka* spinners the price of yarn produced by the spinners was also increased.

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Table A.1. Profitability analysis of sapling growing

Sl. No	Indicators	Value (Tk)	% to total economic cost
	Lease value of land	5665	30.4
	Cost of hired labour	4485	24.1
1.	Ploughing , fertilizer and pesticide application, irrigation	4338	23.3
5.	Interest on BRAC loan	2466	13.2
8.	Others	302	1.6
	Interest on other capital used	608	3.3
	Total accounting cost	**17256**	
9.	Imputed value of household labour	766	4.1
	Total economic cost	**18630**	**100.0**
	Total revenue (with 4 missing cases)	20604	
	Total revenue (without 4 missing cases)	24241	
	Net accounting profit (with 4 missing cases)	2740	
	Net accounting profit (without 4 issing cases)	6377	
	Net economic profit (with 4 missing cases)	1974	
	Net economic profit (without 4 missing cases)	5611	

Table A.2. Recommended temperature, humidity, and rearing practices

Stage	Duration (days)	Temperature	Humdty	No of feeds	Frequency of bed cleaning	Time of bed cleaning	Type of leaf to be fed	Bed space	
								Local variety	Hybrid
I	2.75-3.25	26-28^0 C	80-90%	11-12	1	-Before moulting	Soft leaves cut into 0.5-2 cm pieces	0.28-0.84	0.37-1.30
II	2.5-3	26-28^0 C	80-90%	10-12	2	-Once after the second feed and the second time before moulting	Slightly mature leaf cut into 2.0-4.0 cm pieces	0.93-2.79	1.40-4.19
III	2-2.5	24-26^{0}C	80%	8-10	3	-After the second feed -Two days thereafter -Before moulting	More mature leaf cut into 4.0-6.0 cm pieces	2.79-5.58	4.19-8.37
IV	3-4	24^{0}C	70%	12-16	1	Once every morning	Mature whole leaf without branches	5.58-11.16	8.37-16.74
V	5-7	23-24^{0}C	70%	20-28	1	Once every morning	Mature leaf with branches	11.16-22.32	16.74-33.48

Source: BSB

Table A.3. Information on labour cost and its productivity in weaving

Types of Activity	Total person days in a month		% of family labour	Wages per hired p/day
	p/days	%		
Washing and degumming	8.0	7.4	100	-
Rolling	7.1	6.6	40	11.64
Winding	35.2	32.5	82.6	12.60
Warping	4.0	3.7	41.0	38.50
Weaving	45.6	42.1	68.8	64.48
Wefting	2.7	2.5	1.13	37.88
Marketing	4.6	4.2	4.56	-
Others	1.3	1.2	0.89	22.2
Total	108.5	100	73.2	31.22*

* indicate average daily wage per hired labour

Glossary

AO	Area Office
BRAC	Present name of organization previously known as Bangladesh Rural Advancement Committee and Bangladesh Rehabilitation Assistance Committee
BSB	Bangladesh Sericulture Board
IGA	Income Generating Activity
NGO	Non-governmental Organization
PA	Programme Assistant (a front-line field level staff of BRAC)
RDP	Rural Development Programme
DFL	Disease Free Larvae
WFP	World Food Programme