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## Poverty-Environment Interaction through Participatory Forest Management in Bangladesh: An Evidence of Poverty Reduction

A paper by

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## Summary

Poverty is an obstacle in the process of socio-economic development of Bangladesh. Majority people of the country live in the rural area where subsistence income generating activities are mainly related to exploring natural resources. A high population and its basic needs, thus, cause overexploitation of resources. Forest resources are one of the most overexploited resources in the country. Presently the forest cover is 13.36% of the total land that is alarming for the environmental sustainability. In order to protect forest resources from such overexploitation, participatory forest management approach was followed by the Forest Department involving rural poor. They were provided 1ha of degraded land for plantation and in a few cases 0.5 ha for homestead area. The objective of such initiative was to develop a strong interaction between the over-exploiters and their involvement in protecting forest. The study was conducted in the sal (*Shorea robusta*) forest of Bangladesh with a sample size of 120. Using non-parametric statistics, the standard of living was examined. A list of opinions was sought for assuming the change in environment due to the participatory management. BCA approach was applied to estimate the distribution impact and poverty reduction impact. The findings of the study reported that there was a significant change in livelihood as well as conservation measurement. The distribution impact analysis showed that the poor people were benefited substantially. The PIR (0.95) gave the positive indication of poverty reduction impact. It was found that the involvement of rural poor could be a process of poverty-environment interaction. The approach of participatory management is useful to increase the interaction between rural poor and resource management towards environmental sustainability.

**Key words:** participatory forest management; distribution impact Analysis; poverty reduction impact; poverty impact ratio; agroforestry program

## Introduction

The sal (*Shorea robusta*) forest is a plain land tropical forest spreading over the central and northern region and comprised of 120,255 ha of notified forests (104,616 ha are located in the central region and 15,639 ha in the northern region). It is potential to meet the demand of non-timber forest products (NTFPs) as well as timber. Moreover, the sal forest is important for the environment. The produces of these forests are consumed as fuel wood, construction materials, furniture and cottage building materials. A few decades ago the forest was densely wooded but presently overexploited seriously. The encroachment and denudation was usually led by the local poor and illegal timber traders. The poor living in and around the forest were induced by these traders to join the illegal felling activities instead of bribe. In addition, scarcity of dwelling places of the migrated poor people from flood affected area and unplanned urbanization caused further destruction to the forest and forest products.

The Bangladesh Forest Department (FD) realized that centralized management regime was lesser-successful in protecting and maintaining the forest because of its high transaction costs. Lesser-control over the encroachers, defective forest guarding system also deteriorated the effectiveness of the centralized management. In order to meet the situation, the FD reformed centralized management to participatory management by involving the encroachers and local poor. There has been no participation of the local people in forest management before. However, the objective of implementing participatory management was sustainability of resources as well as resettling the encroachers as protector of the forest along with better livelihood. A survey report on Thana (Sub-district) Afforestation and Development Project revealed that participatory approach increases the net annual income of the participants from Tk. 14,187 to 21,834 per male participant and from Tk. 11,555 to 16,766 per female participant (Anon, 1995). Another study by Safa (1998) reported that the net annual on-farm income of the farm household increased from \$348.48 to \$1194.59 by 766.4% per annum by implementing participatory approach for managing sal forest. The findings of these studies reported that the participatory forestry management is successful to increase farm income but did not focus on the standard of living, poverty reduction, benefit distribution and conservation measurement. As the studied program has three entities namely, government (Forest Department), participants and consumers that were benefited directly or indirectly, it is necessary to examine the level of net economic benefit received by each. In addition, as the landless people were involved in the program, it is also necessary to investigate whether there was any poverty reduction impact. The study further examined the conservation issues opinioned by the settlers based on observation. In a word, the study attempted to examine the poverty-environment interaction through participatory forest management of degraded sal forest.

## **Description of the program**

The settlers were provided 1 ha of land for agroforestry. A total of 1100 to 1200 seedlings were planted per hectare. Forest species like *Eucalyptus camaldulensis*, *Acacia auriculiformis*, *Acacia mangium* and *Terminalia arjuna* had been planted in the forest under the program. Pineapple, winter vegetables, aurum, gourd, rice and so on were planted in agroforestry system as annual crops. The direct benefit realized due to plantation is mainly timber. The benefit was shared between the Forest Department and the participants according to the agreement. The distribution of the final benefit was divided into three parts such as, 45% was for the Forest Department, 45% was for the participants and 10% was for the tree farming fund (TFF). This tree farming fund is a financial source to support participant's further activities regarding plantation. In the analysis, the benefit had been considered as a whole for the program ignoring the sharing arrangement. Initially all sorts of major costs such as establishment costs, labor costs were borne by the Forest Department. Since the year of establishment, for another successive two years Forest Department provided maintenance cost for the farming activities.

## Materials and methods

### Sampling and survey

The studied forest area was situated over the two administrative districts namely Tangail and Gazipur of the central region (Dhaka Division) and about 150 km north of the capital city, Dhaka. The study area was selected purposively based on the maturity of the first rotation of plantation. The sampling frame of the study was the list of the participants of agroforestry program. The survey was conducted from October to November, 2002.

### Analytical Framework

#### Price and discount rate adjustment

Inflation factor is an important issue in benefit-cost analysis. The magnitude of net present value and other indicators fluctuate due to an increase or decrease in discount rate. In forestry, mostly the discount rate is a little bit higher because of long production cycle. Moreover, sometimes in community forestry it is markedly high because of tenure insecurity. The current analysis has been conducted using 12% discount rate. In order to adjust the market interest rate (nominal rate) the discount rate was converted to its real value by following the equation (1) (Boardman, 1996). The BCA was carried out using the value in constant price, 2001. The real discount rate used in the analysis was 5.7 % that was derived using the equation 1. For converting nominal price to constant price the CPI was used as a deflator.

$$r = (i - m)/(1 - m) \dots \dots \dots (1)$$

Where,

r = real discount rate, m= inflation rate (estimated 5% on average through out the 11 year of program), i = nominal discount rate (12 percent)

#### *Statistical descriptive analysis*

Non-parametric mean comparison tests (Kruskall-wallis test) were used to examine the difference of socio-economic attributes between different income groups. The Mann-Whitney non-parametric comparison test was used to examine the difference of the standard of living indicators between participants and non-participants. The reasons for joining the program were ranked based on frequency distribution. Mean statistics was used for the conservation measures.

#### Distribution impact analysis

The primary task of conducting distribution analysis is to carry out financial and economic analysis to calculate the incremental net benefit. The financial and

economic analysis was carried out based on with-without approach. The participant group was analyzed as “with” and the non-participant group was analyzed as “without”. The encroachers who were not enlisted by the Forest Department were considered as “without”. Net incremental benefit is the difference between the net benefit of “with” and “without” situation. In the analysis, three entities were considered for receiving the net economic benefit namely government (FD) by receiving revenue, participants by receiving wage and consumers by consuming the major and secondary product of the program. Regarding the distribution impact analysis, a number of applications are to be found in the literature of which Asian Development Bank (ADB) (1999), ADB (2001), ADB (2002a), ADB (2002) and Safa (2004a) are reputable work.

The steps were followed for estimating the distribution impacts are as follows (ADB, 1999):

- (i) Both the economic and financial values were changed to its present value. The costs were classified into four major groups to estimate the distribution efficiently because the participants received a large portion of benefit by employing their labour.
- (ii) The differences between the economic and financial values were obtained to classify the net economic benefit.
- (iii) Finally the differences were distributed among the entities involved in the program.

Equation (1) employed to estimate the distribution of gains and losses is as follows (ADB, 1999):

$$NEB = ENPV - FNPV = \sum_{i=1}^n \text{Distribution of gains and losses} \dots\dots (1)$$

Where,  
 NEB = Net economic benefit, ENPV = Economic net present value, FNPV = Financial net present value

### Poverty impact analysis

Poverty Impact Ratio (PIR) is an effective tool to focus on poverty impact reduction of the program. A poverty impact ratio (PIR) is the proportion of the net economic benefits accruing to the poor, compared to the total economic benefits of a project or program. The ratio compares an estimate of the poverty index of the participating entities with that of the local poor population to determine whether there is any impact on poverty (ADB, 2001). A greater PIR than the prevailing local poverty line indicates that the program has a positive poverty impact. The information generated in distribution impact analysis was used to calculate the PIR of the program. The proportion of the benefit of the government to the poor, the proportion of benefit of the participants to themselves and the proportion of the benefit to the consumers were assumed and applied. In this study, the proportion of government expenditure to the settler was assumed to be 50%. The settlers were paid wages for their labour

employment in the program at the initial stage, the full (100%) benefit of which is assumed to accrue to them. In addition, consumers (settlers and locals), were assumed to receive 100% of the timber, crops and other by-products produced by the program, and these products are considered to meet fully the demand of the area. A number of applications of the PIR methodology are to be found in the literature of which Asian Development Bank (1999), ADB (2001), ADB (2002), ADB (2002) and Safa (2000b), Safa *et al.* (2004c) are reputable work on PIR. The poverty impact ratio is defined as (ADB, 1999):

$$PIR = \frac{\sum_{i=1}^n B_i P_{B_i} + B_2 P_{B_2} + B_3 P_{B_3} + \dots + B_n P_{B_n}}{\sum_{i=1}^n B_1 + B_2 + B_3 + \dots + B_n} \dots \dots \dots (2)$$

Where,  $i$  (= 1 to  $n$ ) indicates the number of stakeholders,  $B_i$  is the net benefit in benefit category  $i$ , and  $P_{B_i}$  is the proportion of benefit in benefit category  $i$  that goes to the target group of poor. The calculated PIR was compared to the local poverty index<sup>1</sup> to determine whether there was any poverty reduction impact due to participatory forestry program.

## Results and discussion

### Socio-economic attributes of the participants

Table 1 presents the socio-economic attributes of the respondents. Based on income – low, medium and high – three groups were examined for the living standard according to income. Kruskal wallis test<sup>2</sup> was used to examine the difference among the income groups (Safa, 2004b). Family size, financial asset, food and medical care were found significantly different from each other at 5% level whereas tobacco and fuel were significant at 10%. The rest of the variables are insignificant across the groups implying that the variables are not influenced by the income level. Age variable was different from each other at a little difference in terms of magnitude and found statistically insignificant. Mean family size was similar for three groups. Physical assets variable presents interesting result by showing that among the three groups the mean value of physical assets was lower than the medium income group. It is because they invested or deposited their money into bank than spending for buying physical assets. In case of beverage, medium group’s expenditure is higher than the high income group because of using beverage as a common entertainment item.

**See table 1**

<sup>1</sup> The poverty index of Dhaka Division estimated by the Information Ministry using ‘Cost of Basic Need Method’ was compared to the calculated PIR (BBS, 2000). The local poverty line has been considered 0.52 in the study area (BBS, 2000).

<sup>2</sup> Non parametric ANOVA described by Norusis 1999, Coakes and steed, 2001 and Easton and McColl, 2003

## Reasons for participation in the rehabilitation activities

Table 2 shows the opinions given by the respondents regarding the participation into the program. The information was ranked giving priority as 1<sup>st</sup>, 2<sup>nd</sup> .....8<sup>th</sup>. 95% of the settlers opinioned on employment opportunity and income of the forest activities were the major reason for joining the program at first place. At second place 87.5 % choose the reason rights to collect intermediary forest products for own use. At third place 91.2 % reported the reason of access to forest land for cultivation. At 4<sup>th</sup> place, 85.7 said that they were interested to protect the environment and regenerate the forest. At 5<sup>th</sup> 98.1 % stated that it was because of promised sizable benefits from the tree plantation. At 6<sup>th</sup> and 8<sup>th</sup> place, all the settlers gave opinion on participating in the program to have the land title and empowerment. At 7<sup>th</sup> place, 91.9% of the settlers opinioned on improved standard of living. The analysis of reasons to join the program shows that the settlers were hopeful for the better livelihood by joining the program as well as contributing to the environment by protecting the forest resources.

**See table 2**

## Living standard of the settlers

A number of indicators were chosen to assess the living standard of the settlers (Table 3). By carrying out Mann-Whitney test between settlers and non-settlers, the statistical significance was examined in terms of living standard. Most of the indicators were found significant at 1% level implying that the standard of living is significantly different between the two groups. In case of quality of drinking water “not ok” option was significant at 5% level implying that settlers and non-settlers have different opinion.

**See table 3**

## Conservation measurement

A simple query was made to examine the change in few conservation factors such as forest cover, Fuel wood, soil erosion and wildlife. Table 4 reveals the change in conservation factors. Most of the participants (94.9%) opinioned that forest cover was increased in terms of replanting that helped to reduce encroachment of natural forest (*Shorea robusta*). 91% of the non-settlers agreed that forest cover increased , too. In case of fuel wood both groups gave almost same opinion. Overall comment on soil erosion was replanting activities helped to reduce soil erosion by increasing vegetative cover whereas a few of them (about 6%) opinioned that because of new plantation at the beginning there was soil run off at the basal area of the plants. Most of the participants agreed that wildlife also changed due to plantation activities whereas a few of them disagreed with the opinion.



Table 5 shows a list of the facts that cause a decrease in forest cover, fuel wood and wildlife but an increase in soil erosion. The responses are extremely small in numbers that hardly make some sense. The facts mentioned by the respondents that cause a decrease in forest cover were mainly 'overexploitation', illicit felling and poor protection by the guards. In case of fuel wood and soil erosion 'poor silvicultural management' and 'encroachment for agriculture' was reported only. The causes identified for decreasing wildlife reveals some meaningful information. The highest number of respondent stated that 'over-exploitation' and 'weak law and order' are the major reasons for decrease in wildlife. In addition, setting cluster village in the forest disturbed wildlife was mentioned by the settlers, too.

**See table 4**

**See table 5**

### **Distribution impact of woodlot program**

The distribution impact analysis classifies the costs in a number of groups such as the operating cost, other costs (fertilizer and materials, fuel and power, construction, land acquisition and development, electrification or gas or water supply, vehicle, equipment, training and fellowship, staff salaries and miscellaneous cost) and the opportunity cost of the program. The net economic benefit was calculated by deducting financial benefits and costs from the economic benefits and costs (ENPV-FNPV). The net benefit was distributed among the three entities of the program. Table 6 shows that government's loss is Tk. 7680.00 per ha respectively. Consumers and participants gain Tk. 7080.00 and Tk. 394000.00 per ha. Among the three entities, the consumers were the most benefited entity of the program.

**See table 6**

### **Poverty reduction impact of the program**

Table 7 shows the result of poverty impact analysis of the program. The information appeared in the Table was derived from the distribution analysis. Proportion of the poor represents the share of net economic benefit of each entity goes to the poor. In case of government it was assumed that 50% of the public expenditure was utilized for poverty reduction. As settlers were paid for their labor 100% labour wage was received by the settlers as benefit. By consuming the output of the program, the settlers and the locality had been benefited. The share of benefit to the consumers was assumed 100%, too.

The PIR of the program estimated 0.96. It was compared to the poverty line of the study area to determine whether there was any poverty reduction impact.

The PIR was found larger than the prevailing poverty line (0.52)<sup>3</sup> indicating a poverty reduction impact of the participatory management. The assumption of the proportion of net economic benefit to the poor that was made in the earlier section could be flexible based on national policy and other factors. Thus, the study carried out a sensitivity analysis on the flexibility of PIR to the proportion of net economic benefit to the poor. By using different proportions of the net economic benefit to the poor, the PIR found to be greater than the prevailing poverty line in most of the cases. If consumer-proportion of the net economic benefit was considered about 0.50, the PIR decrease substantially (Appendix). Table 8 reports the result of sensitivity analysis for PIR.

**See table 7**

**See table 8**

## **Conclusions**

Participatory management option is successful in terms of poverty reduction and environmental sustainability. The forest products and non-forest products produced by the program sufficiently met consumers demand. In distribution analysis consumers were found to be highly benefited. Besides, the enhancement of livelihood was found positive based on PIR. Sensitivity analysis showed that PIR was sensitive to the flexibility of the proportion of benefit goes to the poor. Based on the findings of the study it is to be recommended that the government may replicate the same approach to the other degraded forest land of the country.

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<sup>3</sup> According to the "Cost of Basic Needs Method" the upper poverty line of this division (Dhaka) is 0.52 (BBS, 2002).

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**Table 1:** Socio- economic attributes of different income groups

<i>Variables</i>	<i>Income groups (Mean)</i>			<i>Chi-square statistics</i>	<i>Sig</i>
	Low (Tk. 36743)	Medium (Tk. 68677.8851)	High (Tk. 118398.667)		
Age	54	49	52	1.384	.501
Family size	7	7	7	6.964	.031**
Financial asset	1350	4450	9300	9.838	.007**
Physical asset	667.5	7641.25	1428.75	1.258	.533
Food	16033	23750	28500	6.184	.045**
Beverage	750	1050	925	2.741	.254
Tobacco	666.66	775	581.71	5.304	.071*
Fuel	1382.05	2275	3250	5.296	.071*
Clothing	2750	2625	3625	12.269	.002**
Medical care	350	525	700	0.642	.725
Education	750	1025	450	2.803	.246
Construction	800	3075	1125	0.786	.675
Travel	1250	850	925	2.658	.265
social	3500	2375	3750	1.805	.406

\*Significant at 10% level; Significant at \*\*5% level

**Table 2** Reasons for joining the participatory forestry program

<i>Reasons</i>	<i>1st</i>	<i>2nd</i>	<i>3rd</i>	<i>4th</i>	<i>5th</i>	<i>6th</i>	<i>7th</i>	<i>8th</i>
Employment opportunity and income from forest activities	82 (95.3)	1 6.3	1 2.9	1 (4.8)	-	-	6 (6.1)	-
Rights to collect intermediary forest products for own use	2 (2.3)	14 87.5	-	2 (9.7)	-	-	1 (1.0)	-
Improved standard of living	2 (2.3)	-	-	-	-	-	91 (91.9)	-
Promise of sizeable benefits from the tree plantation	-	1 6.3	2 (5.9)	-	53 (98.1)	-	-	-
Access to forest land for cultivation	-	-	31 (91.2)	-	-	-	-	-
Protect the environment, trees and regenerate the forest	-	-	-	18 (85.7)	-	-	-	-
Get land title eventually	-	-	-	-	1 (1.9)	13 (100)	1 (1.0)	-
opportunity to be empowered	-	-	-	-	-	-	-	38 (100)

**Table 3:** Living indicators of the settlers

<i>Living indicators</i>	<i>Mann-Whitney statistics</i>	<i>Probability</i>	
Lighting facilities	Kupi (Indigenous oil-lamp)	-13.964	0.000**
	Harican (Lamp) (Electricity)	-11.916	0.000**
		-5.196	0.000**
Sleeping on	Floor <sup>4</sup>	-6.403	0.000**
	Bed	-13.784	0.000**
Drinking water source	Own tube-well	-12.207	0.000**
	Public tube-well	-3.317	0.001**
	Others tube-well	-7.416	0.000**
Quality of drinking water	Ok	-14.071	0.000**
	Not ok	-2.449	0.014*
Type of latrine	Septic	-8.888	0.000**
	Pit latrine	-10.247	0.000**
	Indigenous	-8.775	0.000**
Subsidies received for latrine	No	-9.110	0.000**
	Public(DPHE)	-5.831	0.000**
	NGO	-7.616	0.000**
Medicare	Religious	-10.775	0.000**
	Village Quack	-6.834	0.000**
	Homeopath	-9.110	0.000**
	Trained Doctor	-11.136	0.000**
	MBBS	-11.662	0.000**
	Healthcare center	-5.745	0.000**

**Table 4** The change in conservation measurement due to participatory management

<i>Staus</i>	<i>Forest cover</i>		<i>Fuel wood</i>		<i>Soil erosion</i>		<i>Wildlife</i>	
	AF	NS	AF	NS	AF	NS	AF	NS
Increasing	112 (94.9)	91 (91)	83 (70.3)	85 (85)	8 (6.8)	5 (5)	112 (94.9)	67 (67)
Decreasing	2 (1.7)	3 (3)	7 (5.9)	3 (3)	76 (64.4)	63 (63)	3 (2.5)	25 (25)
No change	4 (3.4)	6 (6)	9 (7.6)	10 (10)	8 (6.8)	6 (6)	3 (2.5)	8 (8)
No answer	-	-	19	2	26	26	-	-

<sup>4</sup> No arrangement like bed or something better than just sleeping on the floor

**TABLE 5:** Causes identified based on the respondents opinion conservation measurement

<i>Causes</i>	<i>Forest cover</i>	<i>Fuel wood</i>	<i>Soil erosion</i>	<i>Wildlife</i>
	Decreasing	Decreasing	Increasing	Decreasing
Overexploitation	1 (0.5)	----	----	7 (3.2)
Illicit felling	1 (0.5)	----	----	----
Encroachment for agriculture	----	----	6 (2.8)	3 (1.4)
Poor protection by the guards	3 (1.4)	----	----	----
Weak law and order	----	----	----	7 (3.2)
Conversion of natural forest	----	----	----	5 (2.3)
Poor silviculture management	----	10 (4.6)	----	----
Location and establishment of cluster village	----	----	----	6 (2.8)
No answer	8 (3.7)	19 (8.7)	19 (8.7)	3 (1.4)

**Table 6:** The distribution of the net economic benefit of the program (Tk'000, present values at 12% discount rate)

<i>Item</i>	<i>FNPV</i>	<i>ENPV</i>	<i>ENPV-FNPV</i>	<i>Govt.</i>	<i>Participants</i>	<i>Consumers</i>	<i>Total</i>
Benefit	231.09	858.52	627.43	----	----	627.43	627.43
Labour	33.91	13.11	-20.80		20.80	----	20.80
Operating cost	12.24	0.17	-12.07	-12.07	----	----	-12.07
Other cost	55.69	0.72	-54.98	-54.98	----	----	-54.98
Opportunity cost	0.04	0.90	0.86	-0.86	----	----	-0.86
Total cost	101.89	14.90	-86.99		----	----	0.00
Net benefit	129.20	----	----	----	----	----	129.20
Gains and losses	----	----	----	-67.91	20.80	627.43	709.52

**Table 7:** Poverty reduction impact of the Agroforestry program ((Tk'000, present values at 12% nominal discount rate)

Item	Govt./economy	Participant	Consumers	Total
Benefit	61.29	20.8	627.43	709.52
Proportion of poor	0.5	1	1	2.2
Benefit to poor	30.645	20.8	627.43	678.875
Poverty impact ratio			0.9568	

TABLE 8 *Sensitivity analysis of Poverty Impact Ratio (PIR)<sup>5</sup>*

Government share	Participants share	Consumer	PIR (Poverty Impact Ratio)
0.5	1	1	0.9568
0.75	0.5	0.5	0.5200
0.75	0.5	0.75	0.7427
0.5	1	1	0.9568

## Appendix

### Poverty impact ratios for various benefit proportions to governments, participants and consumers

#### Case I

Item	Govt./economy	Participant	Consumers	Total
Benefit	61.29	20.8	627.43	709.52
Proportion of poor	0.75	0.5	0.5	2.2
Benefit to poor	45.9675	10.4	313.715	370.0825
Poverty impact ratio			0.5216	

#### Case II

Item	Govt./economy	Participant	Consumers	Total
Benefit	61.29	20.8	627.43	709.52
Proportion of poor	0.75	0.5	0.75	2.2
Benefit to poor	45.9675	10.4	470.5725	526.94
Poverty impact ratio			0.7427	

<sup>5</sup> The description of Poverty Impact Ratio (PIR) of different cases are shown in the appendix



### Case III

Item	Govt./economy	Participant	Consumers	Total
Benefit	61.29	20.8	627.43	709.52
Proportion of poor	0.5	1	1	2.2
Benefit to poor	30.645	20.8	627.43	678.875
Poverty impact ratio			0.9568	