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Public Sector Microfinance and Rural Wellbeing:Evidence from BRDB

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The paper looks at the impact of public microfinance on rural wellbeing using primary household survey data with microfinance programmes of the Bangladesh Rural Development Board (BRDB) as the main focus. The paper uses propensity score matching (PSM) technique to evaluate the performance of BRDB's programme. The result shows that programme households are better-off compared with the control households in terms of per-capita annual earnings and spending and cultivable land holding. However, the impact of BRDB's microcredit on human capital is weak, as ATTs of spending on health and education, and average years of schooling become statistically insignificant after PSM was performed. The paper constructed composite indexes for human capital, livelihood, non-land asset and women empowerment; and finds that programme households are better-off in terms of all composite indexes except human capital index. Finally, the study looks at the poverty incidence among the programme households and finds that head count poverty rate is 24 per cent among programme households, while the corresponding poverty rate is 35 per cent among control households.

Keywords: Microfinance, Public Sector, wellbeing, Bangladesh
JEL Classification: G21, I3, O1

I. INTRODUCTION

Poverty alleviation is the central objective of the development discourse and policy agenda of the Government of Bangladesh. Despite the progress achieved in reducing the prevalence of income poverty in Bangladesh, the proportion of people still living in poverty and their absolute numbers remain exceedingly high. Bangladesh also has the highest concentration of rural households a large proportion of which is also completely landless. Rural women in Bangladesh also feel the burden of poverty the most. The empowerment of rural women is therefore crucial for the development of rural Bangladesh as well. Bringing

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women into the mainstream development process is, therefore, a major concern for the policy makers.

Since the introduction of microcredit,[1] it has been considered as promising instruments for poverty reduction and rural development. Given the success of non-government microfinance institutions, the government replicated this programme through various departments and ministries of the government including Bangladesh Rural Development Board (BRDB), to promote poverty reduction and rural wellbeing.[2] The BRDB is the successor of the well-known integrated rural development programme (IRDP) of the 1960s, which was founded by Akhtar Hameed Khan. IRDP gained popularity among farmers in rural areas for its two-tier cooperative system which was used to deliver modern agricultural inputs such as high-yielding seeds, fertilisers and credit to the farmers.

Recognising the limitations of the two-tier cooperative system, the government introduced microcredit programme (the RD-12 project) within its cooperative systems. Similar to other existing microcredit programmes, BRDB introduced group-based lending targeting the landless farmers. Over the years, with the experience gained in the implementation of the RD-12 programme and

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[1]There are mainly three types of institutions involve in micro-finance activities in Bangladesh. These are (a) non-governmental organisations (such as Grameen Bank, BRAC, ASA, etc.), (b) Commercial and specialised banks, and (c) Government sponsored micro-finance projects and programmes run through BRDB, BARD, RDA and several other departments and ministries of the government including social welfare, youth and sports, and women and children affairs. Of the government agencies, BRDB's involvement is the highest which covers all over the country and alone accounts for over 60 per cent of the total disbursement. The exclusive focus of the present study is on the activities carried out by BRDB which represent the public sector microfinance fairly well.

[2]Wellbeing is usually understood as a state of health, happiness and/or prosperity. In a broad understanding, wellbeing is living a good life with which one is satisfied. While there is no unanimous definition of human wellbeing, the report by the "Commission on the Measurement of Economic Performance and Social Progress" (The Stiglitz-Sen-Fitoussi Report) identified eight key dimensions that should be taken into account when defining human wellbeing. They include: material living standards (i.e., income, consumption and wealth); health; education; personal activities including work; political voice and governance; social connections and relationships; environment (present and future conditions); and insecurity (of an economic as well as physical nature). The present study focuses on the living standards, health, education and work dimensions of human wellbeing as well as the empowerment of women.

in response to the felt needs of the poor, later several programmes have been introduced by the BRDB. The BRDB under the Ministry of Local Government, Rural Development and Cooperatives (LGRD&Cooperatives) is the largest service-oriented institutional setup of the Government of Bangladesh which is directly engaged in rural development and poverty alleviation activities in Bangladesh. BRDB's main objective is to alleviate rural poverty and ensure improved quality of life for the rural people, especially those living below the poverty line. These objectives are achieved through formulation, development and implementation of programmes relating to various spheres of rural life and activities, from income generation to environmental upgradation.

With its country wide operational reach, BRDB has been able to organise 60,555 cooperatives involving 21,04,911 farmers (small and marginal), 83,132 cooperatives/informal groups covering 22,09,809 poor beneficiaries (both men and women), and provide credit amount to Tk. 4,855.19 crore of which micro-credit accounts for Tk. 3,661.92 crore since its inception till June 2006 (Annual Report of BRDB 2008). Based on the review of the project documents, the projects that have been considered as important for the impact assessment include the following: Rural Poverty Alleviation Program (RPAP), Rural Livelihood Projects (RLP), Women Development, Participatory Rural Development Project (PRDP-2), Palli Pragoti Prokalpa (PPP), Rural Development Project-5 (RD-5), and Integrated Poverty Alleviation Program (IPAP). The above projects cover over 95 per cent of BRDB project beneficiaries. In addition, members of BRDB's two-tier cooperative systems have also been taken into consideration in the evaluation.

It may be mentioned here that the primary cooperatives of BRDB operate with different modes under different programmes and the cooperatives also vary by programmes which are implemented for the BRDB members. Keeping this diversity in perspective, care has been taken in the methodology, analyses and interpretation of the results.

Given the above, the overall objective of the study is to try to assess the impact of BRDB's interventions on poverty and well-being status of rural poor in Bangladesh. This study is intended to explore the changes in physical, financial, human and social assets (e.g., income, employment, savings, assets, health, education, participation, etc. - by types of experimental and control groups) as effects of BRDB's intervention.

The remainder of the paper is organised as follows. Section II reviews current literature on impact assessment of microfinance programmes in

Bangladesh. While section III outlines the research framework and methodology of the study, section IV discusses the data and survey design. Section V presents the results and analyses and finally section VI concludes the paper.

II. MICROFINANCE AND POVERTY: LITERATURE REVIEW

Microfinance has come out as promising instrument for poverty reduction in the literature on the impact assessment of microfinance programmes on a variety of outcomes. However, there are differences in findings from one study to another because of differences in methodologies used in purpose of impact assessment. However, there is a consensus with little disagreement that microfinance affects the poor positively.

Hossain's (1988) early study on Grameen Bank shows that Grameen Bank has positive role supporting the poor in terms of women empowerment, employment generation, income generation and social indicators. Based on the household survey carried out in five program villages and two control villages, the study found that Grameen Bank members had incomes about 43 per cent higher compared to the target groups in the control villages, and 28 per cent higher compared to the target-group non-participants in the programme villages. However, this study had employed direct comparison between programme participants and non-participants without controlling selectivity bias.

Hashemi *et al.* (1996) carried out a study on Grameen Bank and the Bangladesh Rural Advancement Committee (BRAC), two programmes that provide credit to the poor rural women in Bangladesh, with a view to explore the impact of microcredit on the rural poor. The study indicates the beneficial aspects of micro-finance in rural Bangladesh. The paper argues that the programs have significant effects on eight different dimensions of women's empowerment. However, this paper also relies on the simple methodology of impact evaluation as in Hossain (1988).

One of the early and frequently cited study on the poverty impact of microfinance is Hulme and Mosley (1996). This study covers sample from four countries, namely Indonesia, Bangladesh, India and Sri Lanka. The authors used control group approach to assess the benefits of microfinance programmes. The study found that the growth of incomes of borrowers always exceed that of control group (income of borrowers is about 30 per cent higher compared to control group in Bangladesh). However, this study has been criticized for a possible "placement" bias, whereby microfinance programmes may be drawn to

better placed villages so that part of the advantage relative to the control group may be due to this more favourable location.

Among the most cited comprehensive impact assessment studies on microfinance include Khandker (1998), Pitt and Khandker (1998) and Khandker (2003). Earlier two studies followed double difference estimation between eligible and non-eligible households and between programme and non-programme villages; and Khandker (2003) followed panel data estimation approach. These studies were based on the surveys conducted in the 1990s by the Bangladesh Institute of Development Studies (BIDS) and the World Bank.

Using data from BIDS-World Bank survey conducted in 1991/92 covering Grameen Bank, Bangladesh Rural Advancement Committee (BRAC) and RD-12 of Bangladesh Rural Development Board (BRDB), with appropriate controls for sample selection and non-random program placement, Khandker (1998) found that microfinance matters a lot for the very poor borrowers and also for the local economy. The paper found that the programmes help the poor by raising per capita income and consumption and building assets and net worth. The authors argued that micro credit programmes have brought positive impacts at village level in terms of income, employment and production. In terms of poverty impact ,it is estimated that 5 per cent of participant households are pulled above the poverty line annually.

Pitt and Khandker (1998) shed light on the gender perspective of programme impact and found that women are benefited from programme participation and they acquire assets of their own, and they exercise their power in household decision making. They use village level fixed effects to correct for the endogeneity of programme placement.

In subsequent estimates, using panel data that included a re-survey of previous respondents in 1998/99, Khandker (2003) found slightly lower impact compared to earlier estimate. In the earlier survey, it was found that a Tk.100 loan to a female borrower would result in a net consumption increase of Tk. 18, while, in the second survey, the net consumption increase was Tk.10.5. Evidence was also found of positive spillovers non-programme participant in local economies, thereby increasing local village welfare. In particular, this study has found that microfinance helps reducing extreme poverty more than moderate poverty at the village level. Poverty is found to decline by 1 percentage point due to the programmes, while extreme poverty declines by nearly 5 percentage points. However, the aggregate poverty reduction effects are not quite substantial to have large effect on the national poverty reduction drive.

Morduch (1998) conducted a study questioning the use of quasi-experimental method relying on exogenous eligibility conditions as a way of identifying programme effects in Pitt and Khandker (1998). He argued that some of the conditions are restrictive in nature and might not be reliable, for example, the non-enforceability of landholding criterion for programme participation. Morduch (1998) examined the data used by Pitt and Khandker and showed a significant number of programme participants that do not meet the eligibility requirement. Re-estimation using the cleaner data found either nonexistent or very small impacts. Pitt and Khandker (2002), however, carried out an impact assessment using a follow up survey to see the sensitivity of the findings and argued that Morduch (1998) used the wrong method and found that the earlier study underestimates the true impact.

Rahman *et al.* (2007) presented a paper at Australasian Meeting of the Econometric Society on the impact of microfinance on consumption behaviour on the borrowers compared to non-borrowers. This study was based on primary data and covered the beneficiaries of Grameen Bank and BRAC. Instead of straightforward comparison between programme beneficiaries and control households, this study estimated an almost ideal demand system (AIDS) using seemingly unrelated regression (SURE) approach for ten consumable items commonly used in rural Bangladesh. The study found that borrowers are better off in terms of clothing and protein consumption; however, the study found no significant difference in terms of expenditure on health and education.

There has been a plethora of research in assessing the impact of non-government microfinance programmes on a variety of outcomes. However, a comprehensive impact assessment study regarding the public microfinance is virtually absent. Khandker, S. (1998) have drawn samples from RD-12, a project of BRDB, along with Grameen Bank and BRAC, but, the study drew small proportion of its total sample from the RD-12 project of BRDB and provided no separate detail analysis regarding the impact of the RD-12. Due to wide coverage of NGO's microcredit programmes and tons of research studies focusing NGO's microcredit programmes, the activities and implications of BRDB's microcredit programmes remain in dark. Though BRDB replicates microfinance activities of leading NGOs through different programme, targets, approach and focus of those programmes differ widely with that of microfinance activities run by NGOs. Thus, the present paper attempts to have a clear idea about the impact of those BRDB programmes on wellbeing of the beneficiaries.

Against this background, the present paper is an attempt to examine the extent to which public microfinance programmes have been successful in

achieving the positive impact on the rural poor using proper impact evaluation technique. In particular, the study aims to examine the role of BRDB's microfinance activities on income and expenditure, livelihoods improvement, poverty reduction, human development and women empowerment of the participating households.

III. METHODOLOGY

To evaluate the impact of BRDB's microfinance programmes on the well-being of rural poor people, we use Propensity Score Matching (PSM) technique which was first introduced by Rosenbaum and Rubin (1983) and has been used in the field of labour economics. It is now considered as an appealing tool for impact evaluation, as it ensures that treatment and control groups are not only homogeneous in observable characteristics, as well as confirms the individuals' likelihood of participating in the programme that is being evaluated. PSM helps us to choose a set of common homogenous group of participants and control households based on observable characteristics.

Availability of proper baseline data or longitudinal data would be ideal to examine the stated objectives of this study. However, we do not have either proper baseline data or longitudinal panel data for BRDB programmes. Thus we cannot compare households' wellbeing situations before and after BRDB's intervention through the application of difference-in-differences approach. Regression based approach of programme evaluation might be misleading due to the problem of selection bias. As it is possible that only the relatively well-off households are being able to be participant of BRDB's credit programmes, a simple ordinary least squares regression might overestimate the impact of BRDB's programme participation on the well-being of rural people. An instrumental variables (IV) regression could be carried out as a remedy, but it is difficult to obtain appropriate instruments in natural settings. Absence of longitudinal data and appropriate instrumental variables motivated us to use PSM approach which also liberated us from the selectivity problem. Though PSM controls for observed heterogeneity through matching of the propensity scores, it assumes conditional independence from unobserved heterogeneity.

The propensity score (PS) is the conditional probability of an individual to participate in a programme given his/her observed characteristics, Z. In other words

$$PS = P(Z) = P(T=1 \mid Z) \quad (1)$$

In PSM literature, predicted value of logistic regression is commonly used as propensity score. However, choice of covariates as observed characteristics in the estimation of propensity score is crucial and Conditional Independence Assumptions (CIA) should be in consideration during the selection of covariates. CIA requires that the outcome variables must be independent of treatment assignment. Hence, implementing matching requires choosing a set of observable covariates Z which are unaffected by participation in the programme. Besides CIA, a further requirement of common support has to be maintained in propensity score matching.[3] This condition rules out the perfect predictability and it ensures that households with the identical characteristics have a positive probability of being both participants and non-participants to the programme (Heckman, LaLonde and Smith 1999).

Maintaining CIA and common support conditions, estimated propensity score allows us to construct a comparison groups by matching propensity score of programme and control samples. Once each programme sample is matched with a control sample, the difference between the outcome of the programme sample and the matched control sample could be measured and this is defined as "the average effect of treatment on the treated" (ATT).

The PSM estimator of ATT can be obtained as follows:

$$ATT= E_{P(Z)|T=1}\{E[Y(1)|T=1, P(Z)]-E[Y(0)|T=0, P(Z)]\} \quad (2)$$

ATT can be interpreted as the mean difference in outcome over the common support appropriately weighted by the propensity distribution of participants.

However, estimation of propensity score only is not enough to estimate the ATT of interest using equation (2). We need to choose matching techniques to estimate ATTs. There are several matching techniques in PSM literature and we will not discuss the technical details of all methods[4] here, rather we will discuss the three of the most widely used ones. They are: (i) nearest neighbour matching

[3] There are two methods ensuring the assumption of common support. One method, used in Dehejia and Wahba (1999,2002), is based on dropping treated observations whose propensity score is less than the minimum or higher than the maximum propensity score of the control observations. The other one, suggested by Smith and Todd (2005), is based on the notion of trimming where trim imposes common support by dropping a specific per cent of the treatment observations at which the propensity score density of the control observations is lowest. We define common support using both methods simultaneously.

[4] See Becker and Ichino (2002) and Smith and Todd (2005) for more technical details.

(NNM), (ii) radius matching (RM), and (iii) kernel matching (KM), which are summarised as follows:

Nearest Neighbour Matching (NNM)

According to NNM, each treated unit is matched to an untreated unit with the nearest propensity score. NNM is usually applied with replacement, which means that a control sample can be used more than once as a match to a treatment unit. This in turns mean that we normally end up not having one to one matching and this is practical for our case, as the number of samples from control group is less than the number of samples from treatment group. For NNM without replacement technique, the samples from control group must be higher or equal to the sample size from treatment group.

NN matching faces the risk of bad matches if the closest neighbour is far away. This can be avoided by imposing a tolerance level on the maximum propensity score distance which is known as caliper. The use of caliper in NNM ensures the use of all comparison units within a predefined propensity score radius. The prettiness of the use of caliper is that it uses only as many comparison units are available within the caliper. However, a possible drawback of caliper matching is that it is difficult to know a priori what choice for the tolerance level is reasonable (Smith and Todd 2005).

Radius Matching (RM)

Radius matching, suggested by Dehejia and Wahba (2002), is another matching technique that is used as a variant of caliper matching. The radius matching is to use not only the closest NN within each caliper, but all the individuals in control groups within the caliper. Hence, it avoids the risk of bad matches.

Kernel Matching (KM)

Kernel matching (KM)[5] is non-parametric matching estimators where each sample in the treatment group is matched to a weighted some of individuals who have similar propensity scores with greatest weight being given to people with closer scores. Thus, one major advantage of these approaches is the lower variance which is achieved because more information is used. A drawback of these methods is that possibly observations are used that are bad matches. Hence, the proper imposition of the common support condition is of major importance for KM. Some Kernel based matching use all sample in non-treated group (e.g.

[5] For more details, see Heckman, Ichimura and Todd (1998), Smith and Todd (2005).

Gaussian kernel), whereas others only use sample within a certain probability user-specified bandwidth (e.g. Epanechnikov), while choice of bandwidth involves a trade-off of bias with precision. Here, we applied Gaussian kernel, as it is difficult to place appropriate bandwidth.

The question that remains is which matching method to select in practice. In general, this depends on the data in question, and, in particular, on the degree of overlap between the treatment and control groups in terms of propensity score. When there is substantial overlap in the distribution of propensity scores between the control and treatment groups, most of the matching algorithms will yield similar results. To show the robustness of the estimation of ATT, we decided to analyse the effect of BRDB's microcredit programme using all types of matching techniques mentioned above except NNM without replacement, as NNM without replacement is not suitable when the sample from control group is less than that from treatment group.

Under this PSM approach, we have matched households that are programme beneficiary of BRDB and households that share similar characteristics but remained outside of BRDB programmes. Once the matching is made we computed the average effect of treatment on the treated (ATT). In the application of PSM technique, we used STATA 11.0 version using psmatch2 package, a PSM function, developed by Leuven and Sianesi (2009).

IV. SURVEY DESIGN AND DATA

In the absence of credible baseline data, the present evaluation study relied on the "with" and "without" approach to assess the impact of BRDB interventions on its beneficiaries. And in order to do that meaningfully, adequate care has been taken in selecting the control households so that they belong to the same socio-economic and demographic background. In fact, control households were selected from those of the same village who were equally qualified for inclusion in the BRDB cooperatives/groups, but not included because of space limitation. So, the control households can be considered as equal as the programme households, but without being involved in BRDB cooperative/groups. It is, therefore, expected that the difference between the programme and the control households in terms of various outcome indicators will represent contribution of BRDB's intervention.

A household survey has been carried out with a structured questionnaire for the present study in which our sampling framework involved both participant and non-participant (control) group of households in any particular village where

BRDB has been working at least for three years and the sample households were drawn through a multistage stratified random sampling method. The final unit of the survey was household and the study arrived at the household through a systematic process of zeroing down from selection of the districts, then to upzillas and villages and then to the household.

From the review of secondary information, it is clear that BRDB's programme area covers almost whole of Bangladesh, 465 upazillas from 64 districts. Moreover, for the comparison purpose, the study attempted to include non-participant households in the survey as well. Thus, the study determined the sample size taking the total number of households in rural areas of Bangladesh in consideration. According to Household Income and Expenditure Survey 2005, there were 28.64 million households in Bangladesh, with 21.38 million in rural and 7.26 million in urban areas. The derived sample size was based on the population containing 21.38 million households. With 95 per cent confidence interval and 2 per cent level of precision, the required sample size came out as 2,400 using the standard formula for determining the sample size.

Therefore, for this study, 2,400 households were surveyed from 20 upazillas of 20 districts throughout Bangladesh. Out of 2,400, 1,600 households were drawn from BRDB's programme participating households and 800 households were drawn as control households from non-participating households.

Although BRDB's interventions are spread all over the country, some projects are located in selected districts only (e.g., RD-5, PRDP-2). That is why the study selected 20 upazillas from 20 districts both purposively and randomly covering all the important project areas and all the administrative divisions of the country. Two union parishads have been drawn from each upazila such that one is close to the upazilla headquarter and the other is in remote areas of that upazilla. One village has been drawn from each selected union to conduct the survey. From each selected village, 40 BRDB beneficiary households and 20 control households were interviewed with a structured household questionnaire. Control households were selected using the eligibility criterion of participating the BRDB's programmes. Households that were eligible to participate in BRDB's programmes but excluded due to either BRDB's limited membership or some other reasons have been considered as control households in the survey.

V. EMPIRICAL RESULTS

Evaluating BRDB's intervention through propensity score matching requires the estimation of propensity scores. We generate propensity scores using

standard probability model with a binary dependent variable indicating the presence (or absence) of intervention with a number of independent covariates. We use binomial logit model to estimate propensity scores for matching purpose. We generate a set of propensity scores using a binary outcome variable which indicates whether a household is under the BRDB's programme or not. The binary outcome for intervention takes a value one if the household has received credit from any of BRDB's programmes and zero otherwise. The covariates comprised a wide range of demographic, education, religion and wealth variables. Among the variables available in the household survey, we used age and gender of the household heads, household size, religion, schooling years of household heads and homestead land of the household. We also included having electric fan or telephone in a household as independent variable.

The estimation of propensity score was calculated by applying the procedure explained in methodology section. The estimates of the logit regressions for generating propensity scores are reported in Table I. Most of the covariates are statistically significant at conventional 5 per cent level in determining the participation in the BRDB's intervention. Religion and squared years of schooling of household head do not appear significantly in the logit estimation. All significant variables have shown expected signs.

TABLE I

RESULTS OF BINOMIAL LOGIT MODEL FOR GENERATING PROPENSITY SCORE

Dependent Variable: Programme=1, Control=0	Coeff.	Std. Err.	z-value	p>|z|
Constant	-1.482	0.547	-2.71	0.00
Age of Household Head	0.058	0.020	2.87	0.00
Squared Age of Household Head	-0.001	0.000	-2.63	0.00
Years of Schooling of Household Head	0.118	0.042	2.78	0.00
Squared Years of Schooling of Household Head	-0.005	0.003	-1.52	0.13
Gender, Male=1	-0.401	0.237	-1.69	0.09
Having Fan and/or Telephone, Yes=1	0.451	0.096	4.71	0.00
Amount of Homestead Land (Decimal)	0.008	0.004	2.15	0.03
Number of Family Members	0.065	0.027	2.42	0.02
Religion, Muslim=1	0.166	0.132	1.25	0.21
Number of Observations	2315			
Pseudo- R^2	0.314			
Log-likelihood	-1412.27			
Prob>Chi^2	0.000			

Balancing Test for Matching Quality

In order to get unbiased estimate of ATT, matching should balance observable covariates between the treated and control groups. The "balancing test" is the widely used tool to measure the matching quality of the PSM technique. In order to assess the matching quality, "balancing test" has been performed. Before matching, differences in observable characteristics between treated and control households are expected. However, when matching has been performed, differences in observable characteristics between treated and control households should be reduced significantly. Table II presents observable characteristics (e.g. age of household head, parent's education, wealth status, etc.) of both the treated and the control households for before and after matching. Before matching, in all cases, observable characteristics of the households differ between treated and control groups. However, after matching, differences in observable characteristics significantly come down. Thus ATT has been estimated based on the propensity scores of those households who share similar observable characteristics.

TABLE II

BALANCING TEST: SIGNIFICANCE OF MEAN DIFFERENCE (MD) OF COVARIATES BEFORE AND AFTER MATCHING

Covariates	Without Matching		NNM		Radius		Kernel	
	MD	t-stat	MD	t-stat	MD	t-stat	MD	t-stat
Age of Household Head	1.21	2.25**	0.200	0.44	0.09	0.19	0.26	0.58
Years of Schooling of Household Head	0.89	5.60***	-0.08	-0.55	-0.11	-0.78	0.22	1.65*
Amount of Homestead Land (Decimal)	2.80	3.48***	0.32	0.81	0.55	1.37	0.38	0.97
Gender of Household Head (Male=1)	-0.01	-0.91	0.00	0.00	0.00	0.09	0.001	0.45
Having Electric Fan and/or Television(Yes=1)	0.15	6.85***	0.01	0.56	-0.001	-0.12	0.03	1.43
Number of Family Members	0.28	3.30***	-0.07	-0.97	-0.02	-0.30	0.05	0.85
Religious Status (Muslim=1)	-0.01	-0.07	0.01	1.00	0.01	0.81	0.01	0.45

Note:*, **, and*** denote statistical significance at the 10, 5 and 1 per cent levels respectively.

Balancing test also provides reduction of standardised bias and this result is given in Table III. Reduction in standardised bias is much higher for all observable characteristics of the households under consideration. The result of balancing test confirms about the quality of kernel type matching and estimates of ATT are reliable based on the survey data.

TABLE III

BALANCING TEST: PERCENT OF REDUCTION IN STANDARDIZED BIAS[6] (SB)

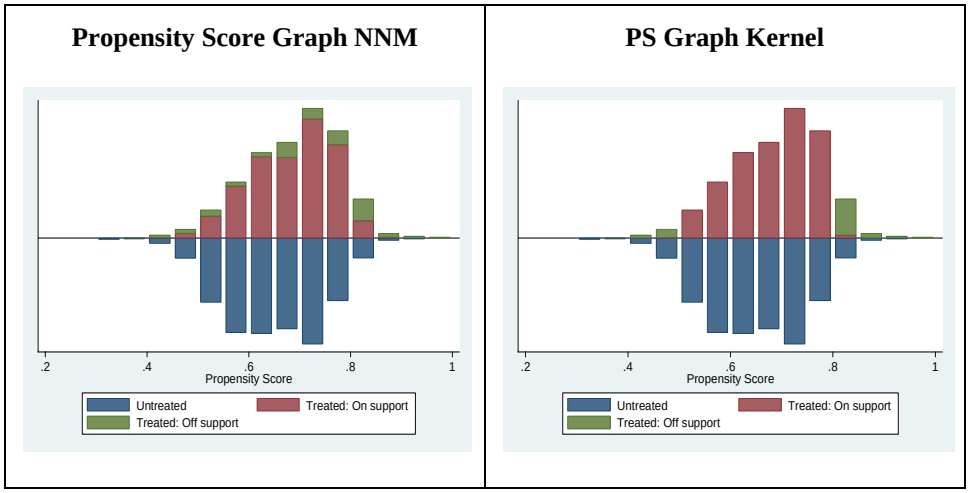
Covariates	Without Matching % Bias	NNM		Radius		Kernel	
		% Bias	% reduct |bias|	% Bias	% reduct |bias|	% Bias	% reduct |bias|
Age of Household Head	9.9	1.6	83.4	0.7	92.9	2.1	78.6
Years of Schooling of Household Head	25.1	-2.1	91.6	-3.0	88.0	6.1	75.7
Amount of Homestead Land (Decimal)	16.4	1.9	88.6	3.2	80.5	2.2	86.4
Gender of Household Head (Male=1)	-4.1	0.0	100	0.3	92.0	1.7	59.2
Having Electric Fan and/or Television (Yes=1)	30.3	2.2	92.9	-0.5	98.5	5.4	82.2
Number of Family Members	14.9	-3.6	75.5	-1.1	92.6	2.9	80.0
Religious Status (Muslim=1)	-0.3	4.1	-1209	3.3	-938	1.7	-449

Note: In most empirical studies a bias reduction below 3% or 5% is seen as sufficient (Caliendo and Kopeining 2005).

[6] For details of Standardised Bias, see Rosenbaum and Rubin (1983).

After generating the propensity scores, we move forward to estimate the average treatment effects on the treated by taking the mean difference in mean outcomes between treatment and control household observations. In the estimation of ATT, we impose common support as well as caliper. Imposition of common support excluded the treatment observations with propensity scores outside the boundary of the highest and lowest propensity scores of the control group. Imposition of caliper ensures the matching of treatment observations with the control observations only within a limited range of probability and we arbitrarily determine the level of caliper in our case is 0.00005. Applying common support as well as caliper enhances the match quality as well as precise estimation of ATT. Use of common support and caliper reduces significant number of observations. The number of treated observations that has been off-supported due to application of common support and caliper has been presented in Figure 1 and Table IV.

Figure 1: **Off-Supported Treated Observations**



The changes in the socio-economic status also take place through changes in attitude and behaviour as a result of programme's non-credit services. For example, the effects can take place through empowerment of women. This can lead to a higher social status, better education and more independence of women. It also helps them to be able to cope with economic shocks (e.g. loss of an important family member, natural catastrophes, etc.) by means of savings, credit and micro insurance products. The changes also take place through different

other non-credit facility such as access to primary/tertiary health care facility, children's education and different other training programmes. A range of indicators can be used for assessing the impact of household's socio-economic status. Here we consider some of the important ones that go in line with the aims and objectives of BRDB programmes. The estimates of ATT are shown in Table IV for the BRDB's intervention using three matching techniques, namely NNM, Radius and Kernel.

An attempt has been made here to estimate per-capita annual income for both the programme and the control households. Result shows that per-capita annual household income is significantly higher for the programme households than that of the control households. Without matching, the mean difference of per-capita annual income is BDT[7] 4,448, which is statistically significant at 1 per cent level (Table IV). Even though this difference narrowed down after the matching performed, it remains statistically significant at 5 per cent level in all three types of matching techniques. After matching, the ATTs of per-capita annual income between programme households and control households range from BDT 2,556 to BDT 2,637.

Similarly, per-capita annual expenditure is also found significantly higher for the programme households than that of the control households. Without matching, the mean difference is about BDT 3,448. With nearest neighbourhood matching, the mean difference of per-capita annual expenditures between programme households and control households is about BDT 3,496 and statistically significant at 1 per cent level. The mean differences are BDT 3,098 and BDT 2,685 in cases of Radius and Kernel matching respectively, and both are significant at 1 per cent level.

We also estimate ATT for per-capita annual expenditures on food, education and health. We found programme households, on average, spend more on food compared to control households. However, we do not found statistically significant ATT for per-capita annual spending on health and education. This result confirms the findings of Rahman *et al.* (2007) that found no significant difference in terms of expenditure on health and education between programme and control households.

The above results indicate that the programme households, on an average, are in a better-off situation than their control counterparts in terms of both earnings and expenditure. However, intervention fails to induce households to spend more on health and education.

[7] BDT stands for Bangladeshi Taka.

TABLE IV
PSM ESTIMATES OF ATT FOR OUTCOME VARIABLES FROM DIFFERENT MATCHING TECHNIQUE

Outcome Variables	Without Matching		NNM		Radius		Kernel	
	ATT	t-stat	ATT	t-stat	ATT	t-stat	ATT	t-stat
Per-Capita Annual Income (Taka)	4447.93	4.35***	2616.59	2.14**	2637.99	2.46**	2555.75	2.86***
Per-Capita Annual Expenditure (Taka)	3447.96	6.71***	3495.99	4.98***	3098.23	4.76***	2684.65	4.94***
Present Cultivable Land (Decimal)	25.19	3.75***	18.28	2.52**	20.57	3.12***	16.22	2.88***
Household's Annual Spending on Food (Taka)	8293.35	5.35***	4423.73	2.89***	4854.66	3.41***	5205.49	4.08***
Household's Annual Spending on Education (Taka)	1897.20	0.80	585.69	0.58	1302.66	1.25	1991.08	1.37
Household's Annual Spending on Health (Taka)	1123.06	1.65*	480.60	0.59	154.05	0.21	658.06	1.03
Average Years of Schooling of Household Members	0.62	5.97***	0.18	1.37	0.084	0.68	0.186	1.75*
Human Development Index (0-100) Constructed for Sample Households	2.18	2.10**	3.04	2.06**	2.33	1.73*	1.68	1.64*
Livelihood Index (0-100) Constructed for Sample Households	20.33	19.9***	15.74	11.3***	15.67	12.07***	16.37	14.92***
Asset Score Index (0-100) Constructed for Sample Households	8.46	8.53***	3.76	2.83***	3.89	3.21***	4.01	3.91***
Women Empowerment Index (0-100) Constructed for Sample Households	5.64	3.16***	5.51	2.25**	4.09	1.75*	4.35	2.34**
Caliper used for Each Estimation			0.00005		0.00005		0.00005	
No. of Off-Supported Treated Sample due to imposition of common support			250		250		156	
Total Sample	2,315		2,065		2,065		2,159	
Treated: Control	1565:750		1315:750		1315:750		1409:750	

Note:*, **, and*** denote statistical significance at the 10, 5 and 1per cent levels respectively.

Education is an important human development outcome that helps households to accumulate better human capital which in turn contributes to ensure better livelihoods for them. Though there is a significant mean difference of schooling years of household members between programme households and control households without matching, this difference nearly disappears when matching techniques were performed. This result is consistent with our findings that programme households do not spend more on education compared to their counterparts.

In addition to assess the impact of BRDB on its beneficiaries through individual outcome indicators presented above, attempts have been made here to see the impacts in a composite outcome framework. At this stage, several composite indicators have been constructed in the first place. Then a comparison is made between the programme and the control households in terms of the outcomes achieved as reflected by these composite indicators. Finally, contribution of BRDB programme participation has also been judged using PSM. The composite indicators that have been constructed here include non-land asset index, human capital index, livelihoods index and women's social development index. The ATTs for all these composite indices are also presented in Table IV.

For non-land asset index, a total of nine individual assets including livestock, poultry and selected household and productive assets have been considered. Result shows statistically significant differences between the programme and the control households in respect of asset ownership. While ATT for asset score index is 8.5 percentage points before matching, ATT remains around 4 percentage points after matching techniques are performed and remains statistically significant at 1 per cent level.

For constructing human capital index, three outcome indicators in the areas of health, education and employment have been taken into account. Like the non-land asset index, significant differences have also been observed here between the programme and the control households in terms of human development outcome although the level of significance is weak in this respect. After matching techniques were applied, the ATTs range between 1.6 percentage points and 3 percentage points. Earlier, we have seen that programme households are not spending more on human capital compared to that of control households.

For constructing the livelihoods index, a total of six indicators have been taken into consideration from the areas of physical and financial assets, housing and sanitation, and income. Result shows significant differences between the programme and the control households in terms of livelihoods outcome (Table

IV). After the PSM applied, the result shows that the ATTs on livelihood index are around 16 percentage points between programme and control households.

Women's involvement in income earning and social activities has drawn much attention in recent times. As women constitute half of the entire population of the country, it is inevitable that each and every development and social activities must effectively involve women. BRDB has also given due importance in involving women in its programmes and projects. In particular, BRDB has one dedicated programme for women's development in addition to involving women in the other programmes/projects. In this context, attempt has been made here to construct an index - women's social development index - to capture the status in women development among the programme households in comparison with the control households. A total of 8 indicators have been taken into consideration in this respect in the areas of women's social participation, mobility, income earning activity and family decision making. The ATTs for all three types of matching techniques in the case of women empowerment index are statistically significant and range between 4 and 5.5 percentage points. This result implies BRDB's intervention has played role in empowering women, though the magnitude is small.

Impact on Poverty Reduction

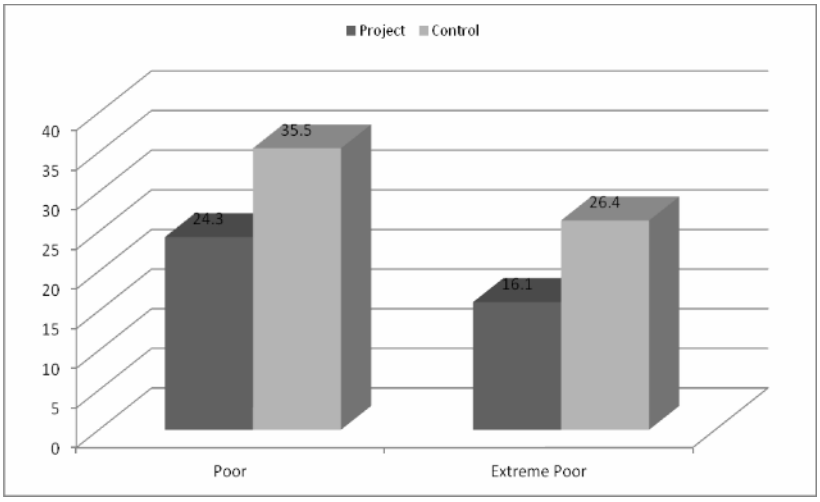
BRDB was initially mandated to organise the small and marginal farmers into cooperative societies for increasing agricultural production through improved means. With the tremendous success of this approach, BRDB shifted its focus and priorities to the development of the landless and asset less rural poor. By shifting its strategy and expanding its activities, the BRDB aims to alleviate rural poverty by reaching the rural poor and by making provision of financial and technological inputs and skills development for them to improve their standards of living. BRDB runs specifically three country-wide poverty alleviation programs; these are: (1) integrated poverty alleviation program (IPAP), (2) rural poverty alleviation program (RPAP), and (3) rural livelihood project (RLP). These programmes provide skill training and micro-credit for income generating activities, raise awareness and rebuild the confidence and human development of the participating poor households. These supports from BRDB help the landless and asset less rural poor to achieve ascent in their living standards and human resource.

The Household Income and Expenditure Survey (HIES) shows a modest improvement in poverty head count since the early 1980s. The head-count ratio for 2005 using the CBN method shows that the incidence of poverty at the

national level has declined to 40 per cent using the upper poverty line (2122 Kcal/person/day). The corresponding figure for rural is 43.8 per cent. And, the incidence of extreme poverty at the national level was 25.1 per cent in 2005 using the lower poverty line. The corresponding figure for rural was 28.6 per cent.

To examine the poverty implications of BRDB programmes, we have attempted to measure the poverty status of the respondent households. The incidence of poverty is measured by the head-count ratio, which simply measures the proportion of people below the poverty line. Rather than measuring the new poverty line income based on the new data, we have updated existing BBS's poverty line income that was estimated in 2005 on the basis of the cost-of-basic-needs (CBN) method (BBS 2007).

Figure 2: **Head Count Poverty Status of Respondent Households**



Source: Authors' Own Calculation.

As BRDB is working in the rural area with a view to develop the socio-economic condition of the rural poor, here we consider the poverty line incomes for rural area to estimate the poverty head-count. However, as poverty lines income is available for 2005 and the cost of living index has changed remarkably since then, it requires the updating of poverty line for 2005 to 2009. Updating of poverty line has been done based on the consumer price index (CPI) for rural areas.

After updating both the upper and the lower poverty lines, poverty status of the respondent households has been measured. The estimated poverty rates for both the programme and the control households are presented in Figure 2. In the case of moderate poverty line, around 24 per cent of respondents from programme households remain below the poverty line, while the corresponding figure is 35.5 per cent for the control households. In the case of lower poverty line, while around 16 per cent of respondent households of BRDB remain in extreme poverty, it is 26 per cent for the control households.

VI. CONCLUDING REMARKS

Despite several problems that BRDB is facing both at the management and field levels, the outcomes that BRDB has so far been able to achieve are remarkable. It has been able to assist its beneficiaries in almost all areas that BRDB aimed at the beginning at varying degrees though. It helped significantly in achieving poverty reduction goal of the government. BRDB has been quite successful in helping its beneficiaries to move up in the poverty ladder and to overcome poverty as well. Poverty rate among the BRDB programme beneficiaries is 11 percentage points lower than that of the control households as well as national average. This indicates that the poverty reduction rate is much faster among the programme beneficiaries than that of the control households and the country as a whole. BRDB also helped its beneficiaries significantly in accumulating assets (both land and non-land), achieving better livelihoods and securing women's empowerment. However, BRDB has not been able to contribute significantly in the areas of human capital development for its beneficiaries.

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