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Full Length Research Paper

Do non-farm incomes really matter for poverty among small households in rural Bangladesh? A case of advanced villages

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Given the critical importance of the non-farm sector in rural Bangladesh, this paper examines the comprehensive effects of non-farm incomes on poverty reduction, namely, household production and consumption. The study was based on the original field survey with data from about 175 small households in advanced villages of Bangladesh. Standard micro-econometric techniques were used for the empirical analyses. The study found that the small households in advanced villages were in a stage that their non-farm incomes did not contribute significantly to their household production for either farm or non-farm and food consumption (calorie adequacy); and accordingly, these could be spent on non-food consumption. Finally, the study found that the overall non-farm income significantly mattered for reducing income poverty but could be still low to be realized in reducing education poverty. However, among the non-farm income components, while out-country remittance and non-farm self-employment incomes were more income poverty (incidence and gap) reducing compared to non-farm wage and in-country remittance incomes, the remittance incomes (both in-country and out-country) were reducing the severity of education poverty. Thus, the qualitative diversification of the small household workers and productive use (preferably in farm/non-farm production and demand driven education) of non-farm incomes deserved special attention.

Key words: Non-farm incomes, household economy, calorie adequacy, income poverty, education poverty, advanced villages, instrumental variable.

INTRODUCTION

Available evidences (Hossain et al., 2002; Hossain, 2004; GOB, 2005) suggest that both incomes and employments from the non-farm sector (NFS) have grown at a faster rate during the 1990s compared with the agricultural (farm) sector in rural Bangladesh. Accordingly, the Government of Bangladesh identified the NFS as a "leading sector" in the rural economy (GOB, 2005). But in practice the NFS is not getting due attention like the farm sector, despite the fact that such neglect may be socially costly (Haggblade and Hazell, 1993). The NFS expands quite rapidly in response to the farm sector development (Arif et al., 2000) and therefore merits special attention in designing poverty reduction strategies. It is envisaged that the non-farm incomes (NFIs) will have a significant impact on household production (farm and non-farm) and consumption (food and non-food). The latter consumption effects are realized in reducing food inadequacy and income poverty in the short-term. In the long-term, the NFIs can be realized in reducing human poverty. Among the three dimensions of human poverty[1], education poverty

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[1] Human poverty measures deprivations in three basic dimensions of human development: a long and healthy life (probability at birth of not surviving to

is the one where household NFIs can be best realized. However, the empirical evidence in estimating such comprehensive effects of NFIs on rural households is scant.

The poverty/non-farm empirical literatures starting mainly in the late 1980s and continuing to the present have focused on the following ways: 1) One strand of literature, mostly reviewed by Davis et al. (2008, 2009), Haggblade et al. (2007), Lanjouw and Lanjouw (2001), Reardon (1997), Reardon et al. (1998, 2001, 2007), and Winters (2007), shows that the literature has been rich in des-cription of trends and analyses of the determinants of non-farm employments (NFEs) at both the micro and meso level. 2) Another strand of research on "production and consumption linkages" has shown the meso determinants of local growth in NFEs to be conditioned by "growth motors" (Davis et al., 2009). Moreover, the NFI, generated from the meso growth-linkages, can in turn be reinvested in capitalizing agriculture (Davis et al., 2002, 2009). 3) Thus, despite the emphasis the literature has put on agriculture as a determinant of NFEs whether at micro or meso level, another strand of literature, particularly in the past decade, has examined the effects of NFIs on farm production/investment (De Janvry et al., 2005; Ruben and Den Berg, 2001; Savadogo et al., 1995; Reardon et al., 1994). Almost the same line of literature published in the special issue of Agricultural Economics: 40(2) on how participation in NFEs affects the choice of farming technology and the mix of farm activity has identified the positive and substantial impacts of NFIs on farm purchased inputs and capital investments (Preiffer et al., 2009; Hertz, 2009; Stampini and Davis, 2009; Oseni and Winters, 2009; Maertens, 2009; Takahashi and Otsuka, 2009). 4) The final strand of literature focuses on the effects of NFIs on income poverty (Lanjouw and Murgai, 2009; Nargis and Hossain, 2006; Hossain, 2005; Bezemer and Davis, 2005; De Janvry et al., 2005; Jonas-son, 2005; Araujo, 2004; Lanjouw, 2001; Arif et al., 2000). However, Ruben and Den Berg (2001) estimate the effects of NFIs on food consumption, while Zhu et al. (2009) and De Brauw and Zhu (2008) focus on the im-pact of remittance incomes on consumption patterns, and Islam and Choe (2009) estimate the impact of access to micro credit on child education.

Thus, to date, none of the studies contributed to the ability to estimate the comprehensive effects of NFIs on poverty reduction. To fill-in such knowledge gaps, this case study, therefore, dealt with the following research questions:

1) Do the NFIs affect household farm and non-farm production?
2) Do the NFIs really affect household food adequacy?
3) Do the NFIs affect income poverty only? Do the NFIs affect education poverty also?

age 40), knowledge/education (adult literacy rate) and decent standard of living (percentage of population not using an improved water source and percentage of children under weight for age) (UNDP, 2008).

Since a structural shift from farming to non-farm activities (NFAs) has already been observed in the rural economy (Nargis and Hossain, 2006), it is reasonable to conduct this study in relatively advanced rural locality like Comilla Sadar Upazila where the NFAs are relatively developed and diversified. The sample for investigations included 175 relatively small landholding households owning <2.50 acres of land (hereinafter, small households) among which poverty usually persisted.

Thus, in the context of small households of advanced villages in Bangladesh, the study aimed at estimating the effects of NFIs on household production (both farm and non-farm) and consumption (food adequacy, in-come poverty and education poverty). Our study differs from the previous studies, as summarized earlier, in several aspects. Firstly, we focused on the small house-holds in relatively advanced villages of a developing rural economy. Secondly, using the same set of data, we analyzed the comprehensive effects including both production and consumption effects of NFIs. Secondly, in addition to estimating farm production effects, we also estimated the non-farm production effects. Finally, we focused not only on income poverty but also on education poverty. Following the broader context of the NFS, this study was based on a systematic conceptual framework from individual participation in NFEs to their effects on household economy (Figure 1) and used standard econometric methods to estimate the effects of NFIs.

The paper is organized as follows. The next section briefly discusses the conceptual framework of the study. This section also deals with definitional matters, study area, data and detail empirical strategies. Results are elaborated in the third section. The final section concludes the study.

MATERIALS AND METHODS

Conceptual framework

As Pfeiffer et al. (2009) explain the household perspective (developed by Singh et al., 1986) as a useful basis for considering the impacts of NFI on rural households, separable household model with perfect markets are not relevant for the discussion of NFI effects on production and consumption, as this is the case for the consumption side only. As the emphasis of development economics has shifted toward the study of market imperfections in the context of developing rural economies (Benjamin, 1992; Skoufias, 1994; Stark, 1991; Taylor and Martin, 2001), the issue has been addressed in the household models, which are no-longer separable, in other words, non-separable household models. The similar labor and credit market imperfections, as explained in the case of rural Mexico, are also evident in rural Bangladesh. In this context, if the household is constrained by limited liquidity and/or credit, then the income earned from non-farm can affect household production (both farm and non-farm) both directly and indirectly. Similar studies to date, as summarized earlier, discusses the NFI effect on farm production, but this study attempts to extend the effects on non-farm production also. A direct effect of NFI, recognized in consumption theory and household models, is to loosen household budget constraints and stimulate expenditures on normal goods,

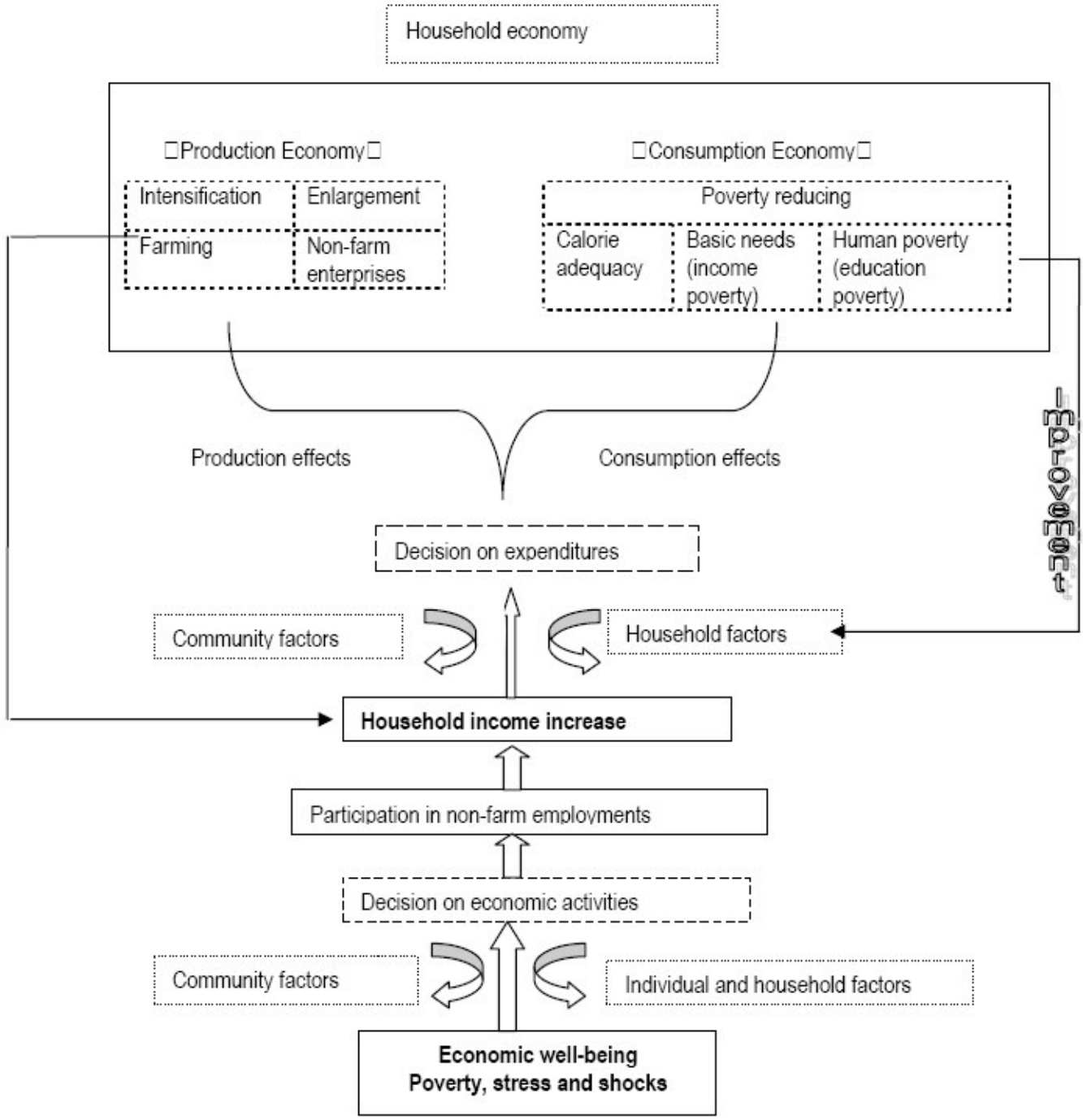

Figure 1. Household workers behavior in production and consumption in a developing rural setting.

and thus reducing income poverty. Indirect effects of NFI are more complex. They are associated with the role of NFI in providing households with income security or a decent standard of living and the liquidity to invest in new production activities or technologies, human capital and reducing human poverty.

Based on the similar idea of direct and indirect effects of NFIs on rural households, we analyzed the effects of NFIs on household production (farm and non-farm) and consumption (food and non-food). The direct consumption effects of NFIs (for example, achieving household food adequacy and reducing income poverty) in the short-term might be obvious. However, to realize the indirect effects of NFIs on human poverty, a considerable time span is required. In Bangladesh, the NFS has grown at a faster rate since early 1990s than the farm sector and now the share of household NFI is much higher than farm income (Table 1). Thus, it might be reasonable to estimate the effects of NFIs on human poverty. Among the three dimensions of human poverty, knowledge /education (adult literacy rate) poverty is the one where the NFIs could be best realized under the control of household economy management. In our knowledge, this reality could be explored by

Table 1. Summary statistics of some socio-economic characteristics at various levels.

Variables	National level		Lagging regions		Advanced regions		Comilla district	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Per capita income (BDT)	12,520.78	26,017.56	11,884.71	33,407.16	13,133.44	15,918.55	13,429.56	9,464.15
Share of NFI (%)	76.71	33.14	73.04	35.71	80.24	30.05	80.08	28.34
Household head age (years)	46.05	13.88	45.10	13.75	46.97	13.95	48.36	13.10
Household size (persons)	4.90	2.11	4.66	1.94	5.13	2.23	5.65	2.18
Landholdings (acres)	1.68	1.06	1.78	1.12	1.60	.99	1.51	.83
Education of household head schooling years)	2.85	3.93	2.94	3.97	2.77	3.90	3.47	4.21
Electricity connection (%)	31.33	46.39	27.07	44.43	35.43	47.84	67.00	47.00
Cell phone owned (%)	6.09	23.93	3.66	18.79	8.44	27.80	16.00	36.00
Value-house (BDT)	67,201.44	121,016.5	46,983.25	93,018.55	86,675.4	140,171.9	140,360.00	220,677.90

Source: Estimated from Household Income and Expenditure Survey (2005).

estimating the effects of NFIs on education poverty, and thus, the focus would be estimating education poverty rather than complete human poverty. Our discussion follows a schematic diagram in the context of household economy (Figure 1).

Definitions

In a similar work, we used a broader definition of the NFS (Malek and Usami, 2009). The rural household workers engaged in a set of earning activities that are not own-farm based or off-farm based (except household enterprises in primary farm production of crop, livestock, poultry and fisheries) are included in the NFS (Lanjouw and Lanjouw, 2001). Especially, the local NFS is defined as any earning activity that the workers are participating in within the village, other neighboring villages, growth centers or rural town (excluding municipality at district headquarters and Pouroshova at Upazia headquarters), while retaining the households in the village. In our definition, we included farm wage employments in the local NFS rather than the farm sector, because the relatively disadvantaged household (landless/land poor) workers could not work as self-employed in the farm sector; they worked mainly either as farm or non-farm day laborers. In addition, a good number of absentee household workers are engaged in remittance employments in another place like non-local areas of the country for domestic migration (hereinafter in-country) and abroad for international migration (hereinafter out-country); and these remittance employments are considered as separate components under non-local NFS. Excluding such remittance employments in the NFS is not supported by a number of similar studies (Haggleblade et al., 2009; Naude and Taylor, 2001). Naude and Taylor (2001) argue that using sub samples that take part in a given local NFS excluding remittance incomes and other transfers would produce biased results. Thus, in our paper, we included farm wage employments, non-farm self-employments, non-farm wage employments under local NFS and in-country remittance employments and out-country remittance employments under non-local NFS. Hereinafter, sometimes the NFIs, NFAs and NFEs are interchangeably used.

The concept of income is comprehensive, including income received in kind and in cash. Household income was defined as the sum of net incomes resulting from the engagements of household workers in local and non-local NFS and other incomes. Farm income was defined as all net incomes from primary production of household farm enterprises (HFEs). Non-farm self-employment income was defined as all net incomes from the household non-farm enterprises (HNFEs), mostly informal in nature, where the workers participated in the local secondary and tertiary industries. Farm wage income and non-farm wage income were gross incomes derived from wage employments within the locality. Remittance incomes (in-country and out-country) were net receipts from the household workers employed in-country and out-country. Other incomes included transfers (rental income), pensions, interests, gifts, disadvantaged allowance, etc. Other related concepts and definitions are elaborated in the empirical strategies section.

Study area and the data

Though Comilla Sadar Upazila was purposely selected for the study, it represented well the relatively advanced rural locality of Bangladesh (Tables 1 - 2). Comilla Sadar is an Upazila (sub-district) of Comilla District in one of the advanced regions, Bangladesh, located 100 km southwest of the capital city Dhaka and adjacent to Tripura of Eastern India. It is connected with Dhaka and the second most important industrial city Chittagong by the national highway and railway. Based on the focus group discussion with the key informants, two groups of villages (first group: where the farm sector is relatively more developed in terms of crop yield, technological adoption, cropping intensity, diversity in cultivation, etc.; second group: farm sector relatively less developed, but NFS relatively more developed), excluding the urban location Pouroshova at Upazila headquarters, were made. Then, four villages (two from each group) of Comilla Sadar Upazila were selected randomly so that the case study villages could be well represented. The villages are within the 15 km reach by usual modes of transport (for example, bus, auto rickshaw, rickshaw, etc.) from Comilla district headquarters. We found that their literacy rate (case study villages' average) was 75% while the national average was 53%.

Farming was relatively mechanized in the case study villages. Farmers produced plenty of rice and many types of vegetables. Household workers were engaged in local NFAs and remittance employments. Major formal employment sources were "export processing zone (EPZ)" at Comilla, government organizations (GOs), micro-finance institutions - non-government organizations (MFI-NGOs), commercial banks and private companies in the locality and non-local areas of the country mainly in Dhaka. A good

Table 2. Basic characteristics of Comilla Sadar Upazila, 2005.

Item	Characteristics
1) Location	Comilla district in the Division of Chittagong, a developed rural region. About 100 km southwest of the capital city Dhaka.
2) Literacy level	75%
3) Level of dependency on farming	Full-time farm households (10%), part-time farm households (70%), full-time non-farm households (20%).
4) Modes of transport	Connected by national highway and national railway with Dhaka and Chittagong.
5) Rural markets/growth centers	About 30 rural markets and 7 growth centers.
6) Major trade and commerce	Farm input business, farm products trade and agro-processing, transport and construction business, restaurants, handicrafts and cottage industries, grocery, etc.
7) Others	Being assigned "export processing zone (EPZ)" at Comilla.

Source: Focus group discussion with key informants (2006).

Table 3. Household participation, time allocation and income share for all landholding household workers in economic activities in Comilla Sadar Upazila 2005 – 2006.

Activities	Participation (%)	Time allocation (%)	Income share (%)
Farm enterprises	34.4	6.5	12.8
NFAs as a whole	65.7	93.4	87.4
Farm wage employments	8.6	12.8	5.1
Non-farm self-employments	20.8	18.8	27.7
Non-farm wage employments	20.2	18.1	20.3
In-country remittance employments	4.2	20.0	5.7
Out-country remittance employments	11.9	23.7	20.1
Others (rental income, pensions, interest, gifts, etc).	..	..	8.5
Total	100.0	100.0	100.0

Source: Field survey (2006).

number of households had at least one out-country remittance earner. Many household workers were engaged in HNFEs. Thus, we found relatively developed farming and moderate NFS (both local and non-local) in the case study villages. Therefore, we felt that we could justify the examination of the comprehensive effects of NFIs in such an advanced rural locality.

Since we were investigating the effects of NFIs, we took the sample of non-farm households (part time farm and full-time non-farm households) excluding full time farm households for this study. As the extent of full-time farm households was not very high (about 9%), our sample selection, to our thinking, could be justified. Accordingly, we randomly selected a sample of 214 non-farm households (about 19% of the population) proportionate to all stratums according to landholding (large, medium, small and marginal, and landless). Then, a survey was conducted among the sample households during August and September, 2006 to collect detailed data on participation, time allocation and income earned by all their workers participating in economic activities for the year 2005 - 2006. As per the view of household members/neighbours, we selected the best informed household member and interviewed for all relevant data based on a structured questionnaire.

The field survey of 2006 showed that compared to participation (66%), more labor time (about 93%) was allocated to NFAs and more income shares (87%) were gained as well (Table 3). That means, the relative returns from NFAs are higher compared to their HFEs. We also found that income poverty existed (upper poverty line per capita income: BDT[2] 10,692.00 for 2005 - 06) only in relatively small households owning <2.50 acres of land (188 households) among all landholding households. This result is consistent with other findings (Rahman and Islam, 2003; Sundaram

[2] As of 2005-06, US$ 1.00 = BDT (Bangladeshi Taka/currency) 67.08 (GOB, 2008).

Table 4. Household participation and incomes for all small household workers in economic activities in Comilla Sadar Upazila, 2005 and 2007.

Sectors	2005				2007			
	Participation (%)	Incomes		Income share/ participation ratio	Participation (%)	Incomes		Income share/ participation ratio
		Levels (BDT)	Shares (%)			Levels (BDT)	Shares (%)	
Farm enterprises	33.67	5815.53	13.17	0.39	32.92	7695.33	12.22	0.37
NFAs as a whole	66.33	38353.26	86.83	1.31	67.08	55281.57	87.78	1.31
Farm wage employments	10.36	3014.23	6.82	0.66	5.39	1566.31	2.49	0.46
Non-farm self-employments	20.32	13581.39	30.75	1.51	18.01	18387.27	29.20	1.62
Non-farm wage employments	22.11	10805.85	24.46	1.11	23.4	11323.61	17.98	0.77
In-country remittance employments	4.18	3035.03	6.87	1.64	4.14	2710.88	4.30	1.04
Out-country remittance employments	9.36	7916.76	17.92	1.91	16.15	21293.50	33.81	2.09
Total	100.00	44168.79	100.00	1	100.00	62976.90	100.00	1

Source: Field survey (2006, 2008).

and Tendulkar, 2002). That is the reason we were motivated to analyze the effects of NFIs on poverty among the small households.

Accordingly, we conducted another detailed survey among 188 small non-farm households in April – May, 2008 for the year 2007 to gather detailed data on household workers' participation and in-come gained from all economic activities, production inputs/return in HFEs and capital/ sales in HNFEs, household consumption, house-hold members' education, etc. After the survey was concluded, we found that about 13 households were not acceptable for the analyses due to insufficient data and some other reasons, and thus, the initial analyses were done based on 175 small households. Of the household income components in 2005, the non-farm self-employments showed the highest share, followed by non-farm wage employments and in-country remittance employments, whereas in 2007 the out-country remittance employments showed the highest share and return, followed by non-farm self-employments (Table 4). During the 2005 to 2007 period, a good number of household workers, especially farm wage laborers that usually did not have any certain skills/education, were replaced for out-country remittance employments - these must be for unskilled international migration. Except these differences, the level and pattern of NFIs in the years 2005 and 2007 seemed to be nearly alike. We did not have any survey for the year 2006. Therefore, we intended to estimate the empirical effects of NFIs on household production and consumption using the 2007 survey data for the 175 small households. Finally, following the method of Hadi (1992, 1994), we excluded some outliers from the sample observations for the final multivariate empirical analyses.

Empirical strategies

Estimating the effects of NFIs on household production

Due to participation in NFEs, it was felt that the households would show an increase in NFI. Then, the NFI could be invested to buy farm external inputs that would increase yields (such as fertilizer, pesticides, HYV seeds, etc.) or replace/reduce labor in household farm production (such as mechanical plowing/herbicides). The reason is that as NFI is a major source of liquidity, it is potentially important as a determinant of farm investments in the typical context where farm households face idiosyncratic credit market failure (Reardon et al., 1994). Similarly, the NFI could be invested in household non-farm production, especially in financing HNFEs. Thus, household farming is intensified and NFAs are enlarged.

Based on this idea, we first focused on the effects of NFIs on household farm production. To estimate the farm production effects, we focused on the ex-penses for farm external inputs including hired labor for the sample households. The dependent variable is a continuous variable that includes cash value for the use of all external inputs including hired labor at HFEs. First we included the main explanatory variables-total NFI or a vector of NFI components; namely, incomes from non-farm self-employments, non-farm wage employments, in-country remittance employments, out-country remittance employments and other incomes. Since farm wage employment income share in total household income was very low (2.49%), we excluded it from the NFI components in the vector. Other explanatory variables were related to farm production structures (landholdings under cultivation, share of principle crops/rice in cultivated area, and working persons involved in HFEs). We also controlled for the gender of household head, education of household head,

access to formal credit (mainly MFI-NGOs), growth center within 1 km distance, and three village specific dummies. The squared variable of landholdings under cultivation was considered to address the non-linear relationships. Two models are presented here to analyze farm production effects, one for estimating the overall NFI effect and the other one for NFI components. First, we used ordinary least square (OLS) method for the estimation. The specifications are shown below:

$$\text{Farminputs} = \partial_0 + \partial_1 NFinc\_t + \partial_3 W + u_1 .....(1-1)$$

$$\text{Farminputs} = \alpha_0 + \alpha_1 NFinc\_s + \alpha_3 W + u_2 ....(1-2)$$

Where, Farminputs is external inputs at HFEs; NFinc_t is NFI total; NFinc_s is a vector of NFI components; W is a vector of control variables; u_1 and u_2 are the error terms.

The coefficients ∂_1 and α_1 were particularly important. These coefficients measured the impacts of the total NFI and NFI components, respectively, on household farm production. If negative, it would suggest that the participation in overall or specific NFAs draws labor away from farm production thereby reducing external inputs at HFEs. If positive, it would indicate a positive role of NFIs either overall or through NFI components in overcoming credit constraints and facilitating spending in HFEs.

The problem with the above specification is that it is possible that households that gain income from NFAs have unobservable characteristics not controlled, for that could influence the use of external inputs at HFEs. This could create an omitted variable bias that makes the error term correlate with the regressor; thereby producing inconsistent estimates when OLS is used. One way to address this potential source of bias is to use an instrumental variable (IV) approach. This IV approach could be used to avoid or reduce the bias with valid instruments. However, since the NFI components are different, it is difficult to argue with any confidence about the nature of the omitted variable(s), and the dependent and explanatory variables of interest. Thus, reasonably, the direction of the bias could go either way. One way to reduce the bias is to include as many theoretically relevant control variables as possible. These might reduce the bias if the control variables are correlated with the unobservable variables. Nonetheless, the IV predicts variations in the level of NFI variable that are uncorrelated with the error term. Assuming that the instrument is not weak and fulfills the requirements for a valid instrument, this provides a consistent estimation of the regression coefficients. Since a negative bias is most likely, then it is expected that the IV estimates are higher (Oseni and Winters, 2009). Thus, we used IV approach for capturing the overall NFI effect (specification 1-1) but not for NFI components (specification 1-2).

For first specification (1-1), the instrument used was the education of household head (schooling years). Theoretically, education of household head is important for gaining NFI. We also know that households with a more educated household head have higher in-comes from non-farm work and thus may have more to spend on external inputs at HFEs. After controlling the education of house-hold head and NFI, it can be argued that education of household head is a valid instrument since it is important for gaining NFI and is very unlikely to affect the use of external inputs at HFEs. Stat-istically, this instrument is relevant because it is correlated with the NFI. It is exogenous because it does not affect how much is spent on farm external inputs, except via its effect on NFI, after including the control variables.

An additional consideration in estimating the NFI effects on farm production is that many of the external inputs at HFEs evaluated here are censored at zero since not all households, in particular, the full-time non-farm households, spend on external inputs at HFEs. Given this as the case, a censored Tobit regression was appropriate. Along with OLS and IV two-stage least square (2SLS) estimates, results for an IV Tobit are also presented where results are the coefficients giving censoring. As shall be seen, these results were similar to those found for the standard IV.

Similarly, to estimate the non-farm production effects, we focused on the working capital at HNFEs for the sample households, that is, the dependent variable for the analysis. In the first two equations (2-1a, 1b) we included a vector of NFI total excluding non-farm self-employment income and the NFI total including all components, respectively, as the main explanatory variables. In the following specification (2-2), we included a vector of NFI components, like our previous empirical model, as the main explanatory variables. Next we controlled a set of variables, namely, working persons involved in the HNFEs, education of household non-farm entrepreneurs, access to formal credit, growth center within 1 km distance and three village specific dummies. Squared variable of education of household non-farm entrepreneurs was included to address the non-linear relationship. In this case, we followed a similar estimation procedure that we followed for capturing farm production effects. For the OLS, the relationship is expressed mathematically below:

$$\text{NFE\_workcap} = \beta_0 + \beta_1 NFinc\_HNFEs\_t + \beta_3 X + v_1 ....(2-1a)$$

$$\text{NFE\_workcap} = \delta_0 + \delta_1 NFinc\_t + \chi_2 X + v_2 .....(2-1b)$$

$$\text{NFE\_workcap} = \varepsilon_0 + \varepsilon_1 NFinc\_s + \varepsilon_2 X + v_4 .....(2-2)$$

Where, NFE_workcap is working capital for HNFEs; NFinc_t and NFinc_s are defined as before; NFinc_ HNFEs_t is total NFI excluding non-farm self-employment income; X is a vector of control variables; $v_1 \ldots v_3$ are the error terms.

The coefficients $\beta_1, \delta_1, \varepsilon_1$ measured the impacts of NFIs on household non-farm production. If negative, it would suggest that the participation in respective NFAs (either overall or specific components as defined) draws labor away from household non-farm production thereby reducing working capital at HNFEs. If positive, it would indicate a positive role of NFIs in overcoming credit con-straints and facilitating spending in household non-farm production.

In this case, we used the IV approach to address the potential source of bias as considered for overall NFI effect on farm-production effects. Household landholding under ownership is found to be a valid instrument for the analyses. The estimation procedures are the same as before.

Estimating the effects of NFIs on household consumption

Since the hypothesis was that the NFI contributed to achieve consumption both in food and non-food requirements and reducing education poverty, in this study, we focused on three aspects of poverty-food adequacy, income poverty, and education poverty.

First, we analyzed how NFIs affected household food adequacy. For this, we focused on the caloric adequacy of a household, as calorie adequacy is said to be a major determinant of health and it varies over households (Ruben and Berg, 2001). The dependent variable was the log of calorie adequacy ratio[3] for the sample households for a day. The main explanatory variable included the log of total NFI or log of a vector of NFI components, as considered for farm production effects. Then, we controlled a set of explanatory variables, namely, household caloric needs for a day, household

[3]We calculated the calorie adequacy ratio by dividing household calorie intake by household requirements for a day. The result is an index of food adequacy that should be higher than one to guarantee food consumption.

size, number of female adults, access to formal credit, growth center within 1 km distance, and three village specific dummies. For continuous control variables, log is used. Two models are presented here to capture the effects of NFI as a whole first, and then specific components on household caloric adequacy:

$$\text{Log cal\_adr} = \phi_0 + \phi_1 \log NFincs\_t + \phi_2 l\,\text{og}\,Y + \phi_3 D + w_1 .....(3-1)$$

$$\text{Log cal\_adr} = \varphi_0 + \varphi_1 \log NFincs\_s + \varphi_2 \log Y + \phi_3 D + w_2 ...(3-2)$$

Where cal_adr is calorie adequacy (calorie level/calorie needs) ratio for a household/day; NFincs_t and NFincs_s are defined as before; Y is a vector of continuous control variables; D is vector of control variables; w_1 and w_2 are the error terms.

As before, our particular interests were on the coefficients ϕ_1, φ_1 , which estimated the effects of NFI on household calorie adequacy in terms of overall NFI and NFI components, respectively.

For estimating overall NFI effect on food adequacy effects, we found household landholdings under cultivation as the valid instrument. Accordingly, with OLS, the IV 2SLS regression was estimated.

Secondly, we focused on the effects of NFIs on income poverty. The deficiency in income to satisfy basic needs is by far the most widely used definition of income poverty status.

Income poverty is determined by a comparison of household income to an absolute poverty line set at the expenditure level for a balanced minimum diet of 2,112 calories with a 30% (of income poverty level income) allowance for non-food basic items per member per day (Nargis and Hossain, 2006). In our study, we did not estimate the income poverty line. Rather, we used two regional (Chittagong Division Rural - the relevant advanced rural region) income poverty lines updated for 2007 for the case study villages (BBS, 2007) - the lower and upper per capita income poverty lines. The relevant poverty line per capita incomes were BDT[4] 9,688.40 and BDT 11,463.96, respectively for lower and upper income poverty lines. We used the Foster-Greer-Thorbeck (FGT) poverty index (hereinafter income poverty index) to estimate incidence, depth and severity of income poverty among the sample households (Foster et al., 1984):

$$IP_\alpha = 1/n \sum_{i=1}^{m} [z - y_i / z]^\alpha \quad , i = 1, 2, ..., m$$

Where y_i is per capita income of the household; n is total households; m is the number of income poor households; z is the income poverty line; and α is the degree of aversion to income inequality among the poor.

We considered three versions of the income poverty index to shed light on different aspects of income poverty: (i) When α = 0, $IP_0 = m/n$ is income poor, the head-count ratio shows the percentage of households that fail to meet basic food and non-food requirements of the household members. It measures the incidence of income poverty. (ii) When α = 1, $IP_1 = 1/n \sum_{i=1}^{m} [z - y_i / z]$ is the income poverty gap ratio, shown by averaging the distance of per capita income of the poor from the income poverty line, as a percentage of the income poverty line income over all households. It measures the depth of income poverty. (iii) When α = 2, $IP_2 = 1/n \sum_{i=1}^{m} [z - y_i / z]^2$ that is, the squared income poverty gap ratio, which gives greater weight to the income shortfall, when there is greater distance of income from the income poverty line. It measures the severity of income poverty.

Thus, we estimated the effects of NFIs on the incidence and extent of income poverty at the household level. For incidence of income poverty effects, the dependent variable was the poverty status of a household as a dummy variable (1 if the household is below the income poverty line), while for extent of income poverty effects, the dependent variables were household income poverty gap and squared household income poverty gap, respectively. In the first specification (4-1), the main explanatory variable was NFI per capita, whereas in the second specification it was the vector of NFI components. We controlled for household head gender, household size, dependents workers ratio, landholdings under ownership, access to formal credit, growth center within 1 km dis-tance and village specific dummies. For estimating the income poverty effects, we followed the next specifications:

$$\begin{Bmatrix} IPov\_stat \\ IPov\_gap \\ IPov\_sev \end{Bmatrix} = \delta_0 + \delta_1 NFinc\_pc + \delta_2 Z + x_1 ....(4-1)$$

$$\begin{Bmatrix} IPov\_stat \\ IPov\_gap \\ IPov\_sev \end{Bmatrix} = \phi_0 + \phi_1 SNFinc\_PC + \phi_2 Z + x_2 ....(4-2)$$

Where, IPov_stat is household income poverty status (1 if the household is below the income poverty line); IPov_gap is household income poverty gap index; IPov_sev is squared household income poverty gap ratio (severity of poverty); NFinc_pc is NFI per capita; SNFinc_pc is a vector of NFI components (per capita); Z is a vector for control variables; x_1 and x_2 are the error terms.

Our particular interests were on coefficients δ_1, δ_2 . For interpretting these coefficients, we had to be cautious. A negative coefficient of any explanatory variable for IPov_stat and IPov_gap means the variable is contributing to reduce the incidence of income poverty and the income poverty gap, whereas it is breaking down the income poverty severity (IPov_sev).

For this analysis, we did not have any valid IV. Therefore, we depended on Probit regression for income poverty status, while on the OLS method for income poverty gap and severity.

Finally, we focused on the effects of NFIs on education poverty. As argued earlier, in the long-term the NFIs could be best realized in reducing education poverty. Therefore, we measured education poverty (education poverty status/incidence, gap and severity) at household level based on the FGT income poverty measurements[5]. In our study, education poverty was first determined by a comparison of per capita education (for 6 years and above) to an

[4] As of 2006-07, US$ 1.00 = BDT (Bangladeshi Taka) 69.03 (GOB, 2008).

[5] $EP_\beta = 1/n \sum_{i=1}^{o} [p - q_i / p]^\beta , i = 1,2,....o$ Where q_i is per capita education of the household i, n is the total sample households, O is the number of education poor households, p is the household education poverty line, and β is the degree of aversion to education inequality among the poor. Similarly, When β = 0, $EP_0 = O/n$ is the education-poor head-count ratio; When β = 1, $EP_1 = 1/n \sum_{i=1}^{n} [p - q_i / p]$ is the education poverty gap ratio; and When β = 2, $EP_2 = 1/n \sum_{i=1}^{n} [p - q_i / p]^2$ is the squared education poverty gap ratio or severity of education poverty.

education poverty line set at the universal primary level of education (five years schooling). Due to the fact that the NFS has been important since the early 1990s in rural Bangladesh, it was argued that the NFIs could be better realized in reducing household young (6 - 20 years) members` education poverty. For this reason, we focused on estimating education poverty for 6 - 20 years household members. Here are the specifications:

$$\begin{Bmatrix} EPov\_stat \\ EPov\_gap \\ EPov\_sev \end{Bmatrix} = \varepsilon_0 + \varepsilon_1 NFinc\_pc + \varepsilon_2 A + y_1 ....(5-1)$$

$$\begin{Bmatrix} EPov\_stat \\ EPov\_gap \\ EPov\_sev \end{Bmatrix} = \eta_0 + \eta_1 SNFinc\_pc + \eta_2 A + y_2 ....(5-2)$$

Where EPov_stat is education poverty status; EPov_gap is education poverty gap index; EPov_sev is severity of education poverty. The definitions of explanatory variables are the same as the specifications (4-1 or 4-2) with one exception. That is, we controlled for a primary school within 1 km distance (in the vector A) instead of a growth center within 1 km distance along with other variables as depicted in the vector Z. y_1 and y_2 are the error terms. Like the income poverty estimation, the education poverty status was estimated by Probit, whereas the education poverty gap and severity were estimated by OLS method. For interpreting the coefficients ($\varepsilon_1, \varepsilon_2, \eta_1, \eta_2$), just as with the income poverty coefficients, we had to be cautious.

RESULTS AND DISCUSSION

Characteristics of households and its production: Descriptive statistics

Since the case study villages represented relatively advanced rural areas of Bangladesh, the results found that the household income was much higher than the national average (Tables 1 and 5). On average, though the sample households in the case study villages invested relatively less financial and human capital in HNFEs as compared to HFEs, the income gained from HNFEs was much higher than the farm counterpart. Among the NFI components, the out-country remittance employments showed the highest share followed by non-farm self-em-ployments and non-farm wage employments. Since our sample included only small households (owning <2.50 acres of land), the average landholdings both under cultivation and ownership were much less than the Comilla district average (Mean = 1.51 and S.D. = 0.83). Rice was the principal crop in the case study villages which used about 48% of the household cultivated land area. Other main crops were various seasonal vegetables. About 95% households were male-headed. While the average education of household heads was 4.16 years (with S.D. 4.14), the corresponding average for household non-farm entrepreneurs was only 1.78 years (with S.D. 3.33 years).

It might indicate that the HNFEs that were run by the sample households were mostly low-productive and in-formal in-nature where formal education was not much required. About 36% of the sample households had access to the formal credit. About 78% households had at least one growth center/rural market within 1 km distance. Given the differences in village characteristics, the highest percentage (34%) of households belonged to village 4 (*Moddoy Bijiypur*), followed by village 1 (*Joshpur*), village 3 (*Raicho*) and village 2 (*Donpur*).

Effects of NFIs on farm production

Results for the analysis of the effects of NFIs on farm production are presented in Table 6. For capturing the overall NFI effect (specification 1-1) on external inputs at HFEs, we reported results for OLS, IV 2SLS, Tobit and IV Tobit regressions, while for capturing the NFI components (specification 1-2) we reported OLS and Tobit regression results. Given the consistency of the results and the appropriateness of the model, for inter-preting the overall NFI effect results we generally focused on the results of the IV Tobit[6], while for NFI components we focused on the Tobit results. The coefficient of NFI total was higher when the instrument was used, which showed that when the potential factors that could make NFI endogenous were removed, the effect of NFI in the amount of external inputs was even greater. Based on the IV Tobit results, the main explanatory variable (NFI total*)* had a negative and significant effect on external inputs at HFEs. The standardized coefficient for NFI total was -1.9690. That means, increasing the NFI by one SD (BDT 78,517.58) while holding all other explanatory variables constant would decrease our dependent variable (external inputs at HFEs) by 1.9690 SD. However, we did not have any significant effect of NFI components on the external inputs at HFEs. Thus, overall, the results are not consistent with the hypothesis that the sample households in advanced villages of Bangladesh use income from NFAs for external inputs at HFEs. This result is inconsistent with similar studies (Preiffer et al., 2009; Hertz, 2009; Stampini and Davis, 2009; Oseni and Winters, 2009; Maertens, 2009; Takahashi and Otsuka, 2009; De Janvry et al., 2005; Ruben and Den Berg, 2001; Savadogo et al., 1995; Reardon et al., 1994) that finds positive and substantial impacts of NFIs on farm purchased inputs and capital investments in different developing country contexts. But this result may be reasonable due to the fact that the NFIs might be spent mainly in household non-farm production or consumption, which would be evident later.

From the statistically significant coefficients of the control variables, we can summarize several important obser-vations. Though the sample considered the small house-holds, results showed that external inputs at HFEs were related to landholdings, and economies of scale were realized for relatively large landholding households.

Table 5. Descriptive statistics for household production of small households in Comilla Sadar Upazilla in 2007 (N = 170).

Variable names	Mean	S.D.
Farm external inputs for HFEs (BDT)	15,007.5	19,663.71
Working capital for HNFEs (BDT)	14,231.18	33,971.46
Household income total (BDT)	129,185	87,471.16
Farm income (BDT)	17,180.88	24,016.02
NFI total (BDT)	112,004.1	78,517.58
NFI total excluding non-farm self-employment income(BDT)	80,792.35	76,964.41
Farm wage income (BDT)	3,433.14	9,137.987
Non-farm self-employment income (BDT)	31,430.23	53,410.43
Non-farm wage employment income (BDT)	25,203.49	36,927.03
In-country remittance income (BDT)	5,337.209	22,168.74
Out-country remittance income (BDT)	42,319.77	76,879.93
Other incomes (BDT)	5,756.977	16,471.33
Landholdings under cultivation (acres)	0.42	0.49
Landholdings under ownership (acres)	0.48	0.63
Share of principal crop (rice) to cultivated area (%)	47.70	44.43
Working persons involved in HFEs(no.)	0.91	0.64
Working persons involved in HNFEs(no.)	0.51	0.68
Gender of household head (1 if male) (%)	94.77	22.33
Education of household head (schooling years)	4.16	4.14
Education of household non-farm entrepreneur (schooling years)	1.78	3.33
Access to formal credit (%)	36.05	48.15
Growth center within 1 km distance	78.24	41.39
Village dummies		
Village 1 (%)	28. 82	45. 43
Village 2 (%)	14.12	34.92
Village 3 (%)	22.94	42.17
Village 4 (%)	34.12	47.55

Source: Field survey (2008).

Male-headed households spent more on external inputs at HFEs compared to non-male (female) headed households. This is not unexpected as males are more likely to engage in farm activities on a larger scale compared to their female counterparts and thus spend more on external inputs at HFEs. Access to formal credit had a significant positive effect on external inputs at HFEs. However, we did not find any significant effects of other control variables on the dependent variable.

Effects of NFIs on non-farm production

Results for the analysis of the effects of NFIs on non-farm production are presented in Table 7. For capturing the overall NFI (excluding household non-farm self-employment income) effect on working capital at HNFEs (Specification 2-1a) we reported the results for OLS, IV 2SLS, Tobit and IV Tobit regression while for capturing the NFI components (specification: 2-2) we reported the OLS and Tobit regression results. However, we did not report results for capturing the overall NFI (including all NFI components) effect (Specification: 2-1b)[6]. As it were, in interpreting the overall NFI effect results, we focused on the results of the IV Tobit, while for NFI components we focused on Tobit results. In case of the IV Tobit regression, our instrument (household landholding under ownership) was not strong as the Wald test of exogeneity was not statistically significant at the standard level.

Moreover, IV Tobit regression results did not establish any significant effect on working capital at HNFEs; however, OLS results suggested negative and significant effect on working capital at HNFEs. Results for NFI components suggested that the non-farm self-employment income alone was positively contributing to working capital at HNFEs. The implication is that the household non-farm self-employment income is reinvested in running HNFEs. However, on the contrary, other incomes had a negative effect on working capital at HNFEs. Unfortunately, all wage incomes (farm as well as

[6] This result was not important as household non-farm self-employment income effect on working capital at HNFEs was captured by NFI components though specification (2-2).

Table 6. Effects of NFI on farm production among small households in Comilla Sadar Upzila in 2007.

Dependent variable: External inputs at HFEs	Specification (1-1)				Specification (1-2)	
	OLS	IV 2SLS	Tobit	IV Tobit	OLS	Tobit
NFI total	-.07708(.0741)	-1.1097(.4990)**	-.1434(.1463)	-1.9690(.9669)**	-	-
Non-farm self-employment income	-	-	-	-	-.0184(.0751)	-.0107(.1550)
Non-farm wage income	-	-	-	-	-.0680(.0392)*	-.0862(.0802)
In-country remittance	-	-	-	-	-.0345(.0337)	-.1292(.0827)
Out-country remittance	-	-	-	-	-.0597(.0448)	-.1056(.0787)
Other incomes	-	-	-	-	.0428(.0701)	.0691(.1375)
Landholdings under cultivation	1.3960(.1653)***	1.8184(.3116) ***	2.2434(.3543)***	3.0227(.6370)***	1.4058(.1658)***	2.2602(.3534)***
(Landholdings under cultivation)^2	-.9058(.16482)***	-1.1743(.2703)***	-1.5259(.3214)***	-2.0377(.5314)***	-.9100(.1653)***	-1.5263(.3190)***
Share of principal crop to cultivated area	-.0306(.0511)	-.1383(.0898)	-.0142(.1112)	-.2169(.1785)	-.0446(.0523)	-.0206(.1148)
Working persons involved in HFEs	.0040(.0391)	-.0392(.0602)	.0055(.0812)	-.0870(.1183)	.0037(.0404)	-.0056(.0822)
Gender of household head (1 if male)	.0939(.0321)***	.1209(.0482)***	.2047(.0919)**	.2396(.1116)**	.0939(.0327)***	.2005(.0900)**
Access to formal credit	.04222(.0338)	.0006(.0527)	.1337(.0768)*	.0619(.1065)	.0422(.0343)	.1243(.0763)*
Availability of growth center in the locality	.0032(.0353)	.0449(.0549)	.0018(.0762)	.0749(.1086)	.0044(.0360)	-.0055(.0784)
Constant	-.1056(.0329)***	-.1097(.4990) **	-.5434(.1391)***	-.7239(.1880)***	-.0995(.0334)***	-.5330(.1422)***
†	37.82	202.66	149.39	62.54	27.87	153.05
Prob > chi^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
‡	0.7106	0.3888	0.5109	-	0.7096	0.5234
Sample size	166	166	166	166	166	166
Left-censored observations	-	-	109	-	-	109
Wald test oΦ exogeneity (p-value)	-	-	-	0.0055	-	-

Source: Field survey (2008).; Notes: Numbers in parenthesis are standard errors followed by coefficients. Village level fixed effects included but not reported. Asterisks (*, **, ** *) significant at 10, 5 and 1%, respectively. † F (for OLS), Wald chi2 (for IV 2SLS and IV Tobit) and LR chi^2 (for Tobit) are reported. ‡Adj R^2(for OLS), R^2 (for IV 2SLS), Pseudo R^2 (for Tobit). Variables are standardized.

non-farm) and remittance incomes either in-country or out-country were not significantly related with working capital at HNFEs as similar to external inputs at HFEs. These results did not support our hypothesis that the NFI as a whole had a positive role in overcoming credit constraints and facilitating spending in household non-farm production, though household non-farm self-employment income had a positive role in expanding its non-farm production. Such findings could be reasonable in supporting the idea that all non-farm wage incomes, remittance incomes and other incomes could still be limited to financing household food or non-food consumption which would be evident later. Such findings are in line with recent studies mainly conducted in China supporting the fact that there is no link between remittance incomes (influential components of NFIs) and productive investment (Zhu et al., 2009; De Brauw and Zhu, 2008). Among the control variables, as working persons involved at HNFEs increased, working capital increased rather decreased. It may be due to the labor intensive nature of HNFEs. Education of household non-farm entrepreneurs tended to show more spending for HNFEs (though its non-linear relationship was not statistically significant). That means, education motivates household non-farm entrepreneurs to do HNFEs at a relatively larger scale. Access to formal credit decreased rather

Table 7. Effects of NFI on non-farm production among small households in Comilla Sadar Upzila in 2007.

Dependent variable: Working capital at HNFEs	Specification (2-1a)				Specification (2-2)	
	OLS	IV 2SLS	Tobit	IV Tobit	OLS	Tobit
NFI total excluding non-farm self-employment income	-.0410(.0194)**	-.0051(.0472)	-.1417(.0932)	.2482(.3676)	-	-
Non-farm self-employment income	-	-	-	-	.2985(.0394)***	.8157(.1648)***
Non-farm wage income	-	-	-	-	-.0035(.0153)	-.1430(.1233)
In-country remittance	-	-	-	-	-.0015(.0131)	-.0613(.1920)
Out-country remittance	-	-	-	-	.0105(.0161)	.0650(.0622)
Other incomes	-	-	-	-	-.0200(.0277)	-2.4592(.7323)***
Working persons involved in HNFEs	.0337(.0170)**	.0350(.0168)**	.1723(.0714)**	.1866(.0791)**	.0170(.0149)	.0977(.0592)*
Education of household non-farm entrepreneur	.0695(.0454)	.0895(.0507)*	.2948(.1628)*	.5243(.2830)*	-.0285(.0414)	-.0236(.1377)
(Education of household non-farm entrepreneur)^2	.0264(.0442)	.0091(.0481)	-.0628(.1526)	-.2591(.2499)	.0299(.0385)	.0426(.1423)
Access to formal credit	-.0366(.0159)**	-.0323(.0164)	-.1837(.0796)	-.1441(.0905)	-.0267(.0139)*	-.1522(.0645)**
Availability of growth center in the locality	-.0037(.0164)	-.0014(.0163)	-.0184(.0805)	.0187(.0918)	-.0048(.0142)	-.0473(.0653)
Constant	-.0851(.0145)***	-.0823(.0146)***	-.6770(.1439)***	-.6561(.1444)***	-.0606(.0130)***	-1.0680(.2323)
†	7.35	64.17	40.06	21.37	11.45	80.82
Prob > chi^2	0.0000	0.0000	0.0000	0.0111	0.0000	0.000
‡	0.2527	0.2774	0.2906	-	0.4456	0.5863
Sample size	170	170	170	170	170	170
Left-censored observations	-	-	145	-	-	145
Wald test oΦ exogeneity (p-value)	-	-	-	0.2438	-	-

Source: Field survey (2008). Notes: Numbers in parenthesis are standard errors followed by coefficients. Village level fixed effects included but not reported. Asterisks (*, **, ** *) significant at 10%, 5%, and 1%, respectively. † F (for OLS), Wald chi2 (for IV 2SLS and IV Tobit) and LR chi^2 (for Tobit) are reported. ‡Adj R^2(for OLS), R^2 (for IV 2SLS), Pseudo R^2 (for Tobit). Variables are standardized. Results for the specification (2-1b) are not reported.

than increased working capital at HNFEs. The implication may be that HNFEs generally depend on formal credit sources for its fixed capital rather than for working capital.

Household consumption: Calorie adequacy, income poverty and education poverty

We can summarize the characteristics of the sample households based on three poverty measures - household calorie adequacy, income poverty and education poverty. On average, the sample households in the case study villages nearly achieved calorie adequacy (household calorie adequacy ratio is 0.98 with S.D. 0.32). Though we did not have the disaggregate pictures of rice and non-rice based calorie adequacy ratio of sample households, based on our experiences, we could argue that the achievement of caloric adequacy for the sample households was possible mainly due to a higher intake of rice in their diets.

According to the lower income poverty line, as mentioned earlier, only about 13.10% of the people among the sample households were poor (Table 8). Since our focus was not to understand how big the income poverty was among the sample households, but rather to understand the effects of NFIs on income poverty, we analyzed

Table 8. Poverty levels of small households in Comilla Sadar Upazila, 2007.

Poverty measures	Income poverty		Education poverty	
	By lower poverty line	By upper poverty line	For all household members	For 6 - 20 years household members
Poverty incidence (%)	13.10	20.24	42.3	44.0
Poverty gap (%)	3.22	5.40	19.0	29.3
Poverty severity (%)	1.17	2.06	10.8	24.3

Source: Field survey (2008).

income poverty effects based on the upper income poverty line. It was noted that the upper income poverty incidence (20.24%) was well below the national rural income poverty incidence (about 44%). As the study area represented a relatively advanced rural locality, the income poverty incidence was not comparable with the national poverty level. However, compared to the upper income poverty incidence (20.24%), the poverty gap (5.40%) and poverty severity (2.06%) were not as acute among the sample households.

As for the income-poor/non-poor classifications depicted in Table 9, we observed higher income in the non-poor sample households both in total and in all specific components; and the differences among the total, farm income, total NFI, and two NFI components' level (namely, non-farm self employment and out-country remittance incomes) were statistically significant. Among the non-income related characteristics, we observed statistically significant differences in the dependents-workers ratio, per capita education, landholdings, and growth center/primary school within 1 km distance between the income-poor and non-poor small households.

Based on the education poverty line as mentioned earlier, about 42% of the sample households (for all household members) were education poor; the rate was slightly higher for 6 - 20 years household members. The education poverty gap and severity were much higher for the 6 - 20 years household members compared to all house-hold members. The education-poverty gap and severity were also worse than income poverty levels. Such a picture of education poverty strikes us as alarming.

According to the education-poor/non-poor classifications, we observed statistically significant higher income in non-poor sample households in total, total NFI, and out-country remittance income. While we did not observe higher income for any specific income components for income-poor households, higher income for education-poor households in the case of three specific income components (namely, farm income, farm wage income and in-country remittance income) was evident. However, these differences were not statistically significant. Among the non-income related characteristics, we observed statistically significant differences in landholdings and primary school within 1 km distance between the education-poor and non-poor small households.

Effects of NFIs on calorie adequacy

As the relationships were shown in specifications 3-1 and 3-2, we estimated the effects of NFIs (overall and NFI components, respectively) on household calorie adequacy (Table 10). For the first specification, we reported results for OLS and IV 2SLS regression, while only OLS results for the second specification. Given the consistency of the results and the appropriateness of the model for interpreting the overall NFI effect results, we focused on the results of the IV 2SLS regression. Our results suggested that the effect of overall NFI on calorie adequacy was not significantly positive. Results for NFI components suggested that all NFI components (except in-country remittance income) were not significantly related to household calorie adequacy. Thus, our findings are inconsistent with the hypothesis that the NFI has a significant positive effect on household caloric adequacy. The reason underlying such an inconsistent result might lie in our crude measurement of household calorie intake, which is attributed mainly to rice. Additional investigation could explore this answer[7]. Moreover, since the sample represented households of a relatively advanced rural locality of Bangladesh, these households must spend more of their NFIs on non-rice based calorie food and other non-food lumpy consumption (for example, building houses, purchasing furniture, buying new clothes, etc.). An in-depth investigation of the effect of NFI on disaggregated calorie adequacy (rice based and non-rice based) and non-food consumption expenditure could explore this in greater detail. Among control variables, household size and growth center within 1 km distance positively contributed on calorie adequacy.

Effects of NFIs on income poverty

The previous section found that the NFI had no significant positive effect on household calorie adequacy. Based on this finding, one can argue that the NFI should have a positive effect on income poverty as the income poverty line is estimated based on the food and non-food basic consumption expenditures.

[7] However, we found that household farm (with a higher share of rice farming) income had a significant and positive effect on calorie adequacy.

Table 9. Descriptive statistics of small households by poverty incidence in Comilla Sadar Upazila, 2007.

Characteristics	Total sample		Income poverty incidence					Education poverty incidence				
	Mean	S.D.	Non-poor (N=97)		Non-poor (N=97)		Stat. sig. test	Non-poor (N=97) Mean		Poor (N=71)		Stat. sig. test
			Mean	S.D.	Mean	S.D.		Mean	S.D.	Mean	S.D.	
Income per capita (BDT)	25,673.00	25,139.68	30,054.08	26,400.34	8,406.40	2,044.58	***	30,786.56	29,967.64	18,686.88	13,799.21	***
Farm income per capita (BDT)	3195.51	4,689.90	3,741.16	5,005.13	1,045.03	2,090.65	***	2,876.16	3,491.47	3,631.81	5,951.61	-
NFI per capita (BDT)	21,172.59	15,857.32	23,972.23	16,260.2	10,138.73	7,047.09	***	23,347.01	16,996.14	18,201.91	13,719.79	**
Farm wage income per capita (BDT)	687.85	1,912.30	575.61	1,846.14	1,130.22	2,125.37	-	496.74	1,724.52	948.96	2,127.43	-
Non-farm self-employment income per capita (BDT)	6,119.65	11,440.98	6,992.54	12,518.68	2,679.41	3,937.99	**	6,362.59	12,350.65	5,787.74	10,143.55	-
Non-farm wage income per capita (BDT)	4,664.74	6,695.80	4,667.61	6,949.10	4,653.43	5,680.04	-	4,895.24	7,381.09	4,349.83	5,663.06	-
In-country remittance per capita (BDT)	1,244.37	5,899.05	1,528.12	6,569.61	126.05	734.99	-	1,112.11	5,448.38	1,425.05	6,500.15	-
Out-country remittance per capita (BDT)	7,252.39	13,690.64	9,017.93	14,802.07	2,94.12	1,714.99	***	9,688.49	15,223.07	3,924.21	10,482.70	***
Other incomes per capita (BDT)	1,147.02	3,629.19	1,223.222	3,418.616	846.67	4,408.51	-	1,252.177	3,195.66	1,003.35	4,169.01	-
Gender of household head (1 if male) (%)	94.65	22.58	94.78	22.33	94.12	23.88	-	94.85	22.23	94.37	23.22	-
Household size (no.)	5.68	1.95	5.64	2.06	5.85	1.44	-	5.91	2.11	5.38	1.68	*
Dependent workers ratio	2.16	1.55	1.97	1.48	2.88	1.61	***	2.09	1.50	2.25	1.61	-
Per capita education (schooling years)	5.12	2.78	5.5	2.78	3.62	2.26	***	7.04	2.22	2.75	1.19	***
Landholdings under ownership (acres)	.51	.64	.60	.69	.15	16.79	***	.68	.73	.27	.41	***
Access to formal credit (%)	36.31	48.23	34.33	47.66	44.12	50.40	-	34.02	4.83	39.44	49.22	-
Availability of growth center in the locality (%)	77.98	41.56	83.58	37.18	55.88	50.40	***	80.41	39.89	74.65	43.81	-
Availability of primary school in the locality (%)	82.14	38.41	87.31	33.41	61.76	49.33	***	88.66	31.87	73.24	44.59	***

Source: Field survey (2008).
Notes: Asterisks (*, **, ** *) significant at 10, 5, and 1%, respectively.
'-' stands for 'statistically not significant' at the standard level of significance.

Table 10. Effects of NFI on calorie adequacy among small households in Comilla Sadar Upzila in 2007.

Dependent variable: Log of calorie adequacy ratio at household level	Specification (3-1)		Specification (3-2)
	OLS	IV 2SLS	OLS
NFI total	.0258(.0537)	.0966(.1437)	-
Non-farm self-employment income	-	-	.0043(.0064)
Non-farm wage income	-	-	-.0017(.0065)
In-country remittance	-	-	-.0470(.0110)***
Out-country remittance	-	-	-.0066(.0069)
Other incomes	-	-	-.0026(.0075)
Calorie needs	-1.1715(.3157)***	-1.2609(.3423)***	-1.0190(.3020)***
Per capita education	-.0060(.0607)	-.0427(.0769)	.0531(.0593)
Household size	1.1691(.3320)***	1.2373(.3395)***	1.0416(.3157)***
Female adults	-.1153(.0774)	-.1116(.0749)	-.1130(.0734)
Access to formal credit	.0412(.0648)	.0348(.0637)	-.0041(.0653)
Availability of growth center in the locality	.1326(.0783)	.1342(.0763)*	.1048(.0768)
Constant	8.3699(2.2925)***	8.3136(2.2198)***	7.5341(2.2422)***
†	2.09	23.03	3.26
Prob > chi^2	0.0282	0.0106	0.0001
‡	0.0606	0.0984	0.1579
Sample size	170	168	170

Source: Field survey (2008). Notes: Numbers in parenthesis are standard errors followed by coefficients. Village level fixed effects included but not reported. Asterisks (*, **, ** *) significant at 10%, 5%, and 1%, respectively. † F (for OLS), Wald chi2 (for IV 2SLS). ‡Adj R^2(for OLS), R^2 for IV 2SLS.

As shown in specifications 4-1 and 4-2, regression results for income poverty incidence and gap were, as a whole, statistically significant, while the result for severity of income poverty, as a whole, was not statistically significant (Table 11). Accordingly, this study could not make a conclusion about the impact of NFI on income poverty severity, and thus, the conclusion was limited to, within the impact on the income poverty incidence and the in-come poverty gap level. As noted earlier that while we did not have any valid instrument for estimating the impact of NFI, however, our conclusion might not be free of omitted variable bias. Given these limitations, the statistically significant variable coefficients of our main variables of interest showed that the NFI as a whole was contributing to reduce income poverty incidence and income poverty gap, whereas among the NFI components out-country remittance and non-farm self employment incomes were more income poverty reducing compared to non-farm wage and in-country remittance incomes. Among the control variables, only a growth center within 1 km distance had a statistically significant income poverty-reducing role in the case study villages.

Effects of NFIs on education poverty

Diagnostics statistics, as depicted in Table 12, showed that overall regression results for three education poverty indices (for 6 - 20 years household members) were not strongly fitted. The implication of such results may be that the overall NFI could be still low to realize an effect in reducing education poverty. However, we could make several important observations from the statistically significant coefficients. The overall NFI had no statistically significant effect on reducing education poverty incidence; however, it was significantly increasing education poverty gap and reducing its' severity. Among the NFI components, in-country remittance income was breaking down the education poverty incidence and gap, while both remittance incomes (in-country and out-country) were reducing the severity of education poverty. These findings are in line with recent studies in China (Zhu et al., 2009) which finds no significant impact of remittances on health and education; and in Bangladesh (Islam and Choe, 2009) which finds a negative impact of access to micro-credit on children's education. Among the control variables, only one point was important: per capita education was significantly reducing education poverty incidence and gap.

Conclusion

Focusing on the small households in relatively advanced villages with a developing rural economy, this study estimated the comprehensive effects of NFIs on poverty reduction, namely, household production and consumption. Results suggested that the NFAs were no longer marginal among the small households and their workers. Referring to the effects of NFIs on household production,

Table 11. Effects of NFIs on income poverty among small households in Comilla Sadar Upazila in 2007 (N = 175).

	Income poverty					
	Poverty incidence		Poverty gap: OLS		Poverty severity: OLS	
	Probit (4-1)	Probit (4-2)	OLS (4-1)	OLS (4-2)	OLS (4-1)	OLS (4-2)
NFI per capita	-.9755(.3107)***	-	-.0064(.0010) ***	-	.0594(.0208)***	-
Non-farm self-employment income per capita	-	-.7900(.3501)**	-	-.0039(.0010)***	-	.0273(.0190)
Non-farm wage income per capita	-	-.4798(.2061)**	-	-.0008(.0010)	-	.0062(.0190)
In-country remittance per capita	-	-1.0419(1.0253)	-	-.0027(.0009)***	-	.0217(.0184)
Out-country remittance per capita	-	-1.8822(.8462)**	-	-.0045(.0011)***	-	.0567(.0213)***
Other incomes per capita	-	.1003(.1500)	-	-.0009(.0010)	-	.0005(.0189)
Gender of household head (1 if male)	-.0757(.1338)	-.1034(.15451)	-.0000(.0008)	-.0001(.0009)	.0086(.0167)	.0127(.0173)
Household size	-.0347(.1659)	.1882(.2010)	.0007(.0009)	.0011(.0009)	.0086(.0180)	.0011(.0187)
Dependents workers ratio	.1746(.1388)	.1316(.1559)	.0002(.0009)	.0006(.0009)	-.0004(.0176)	.0014(.0186)
Per capita education	-.1213(.1757)	-.0831(.1872)	.0010(.0010)	.0007(.0011)	-.0186(.0201)	-.0141(.0210)
Landholdings under ownership	-.3251(.2331)	-.1955(.2611)	-.0013(.0010)	-.0013(.0012)	-.0016(.0214)	-.0049(.0227)
Access to formal credit	-.0160(.1389)	.0657(.1634)	.0001(.0009)	.0001(.0009)	-.0063(.0170)	-.0037(.0178)
Availability of primary school in the locality	-.2503(.1419)*	-.2987(.1551)**	-.0005(.0009)	-.0005(.00010)	.0057(.0185)	.0085(.0189)
Constant	-1.4312(.21989)	-1.9826(.4873)***	-.0071(.0008)	-.0071(.0008)***	.0355(.0164)**	.0352(.0166)**
†	54.18	61.42	6.87	4.67	1.13	0.85
Prob > chi^2	0.0000	0.0000	0.0000	0.0000	0.3427	0.6205
‡	0.3201	0.3629	0.2787	0.2478	0.0084	-0.0136
Sample size	168	168	168	168	168	168

Source: Field survey (2008). Notes: Numbers in parenthesis are standard errors followed by coefficients. Village level fixed effects included but not reported. Asterisks (*, **, ** *) significant at 10, 5, and 1%, respectively. † LR Chi2 (for Probit), F (for OLS) are reported. ‡Pseudo-R2 (for Probit), Adj R^2 (for OLS) are reported. Variables are standardized.

we found that the effect of overall NFI was not significantly positive either on farm or non-farm. Among the NFI components, the household non-farm self employment income alone had a significant positive role in expanding its non-farm production. In case of household consumption effects, the NFI had no significant positive effect on household calorie adequacy, as if, it was mainly attributed to rice. Thus, it was argued that these households could spend more of their NFIs on non-rice food items and other non-food lumpy consumption. Later, based on an estimate of food and non-food consumption expenditure we found that the overall NFI was contributing to reduce income poverty incidence and gap, as well. The overall NFI could be still low to realize an effect in reducing household education poverty incidence; although it was significantly increasing the education poverty gap and reducing its severity.

However, among the NFI components, while the out-country remittance and non-farm self-employment incomes were more income poverty (incidence as well as gap) reducing compared to non-farm wage and in-country remittance incomes, the remittance in-comes (in-country and out-country) were reducing the severity of education poverty. Thus, we could conclude that the NFI significantly mattered for reducing income poverty could be still low to realize an effect for reducing but education poverty among the small households in the advanced villages of Bangladesh. From the policy perspective, qualitative diversification of the small household

Table 12. Effects of NFIs on education poverty among small households in Comilla Sadar Upazila in 2007 (N = 175).

	Income poverty					
	Poverty incidence		Poverty gap: OLS		Poverty severity: OLS	
	Probit (4-1)	Probit (4-2)	OLS (4-1)	OLS (4-2)	OLS (4-1)	OLS (4-2)
NFI per capita	.1052(.1279)	-	.0008(.0003)**	-	.0007(.0003)***	-
Non-farm self-employment income per capita	-	.0604(.1123)	-	.0004(.0003)	-	.0003(.0002)
Non-farm wage income per capita	-	.0357(.1178)	-	.0001(.0003)	-	-.0002(.0002)
In-country remittance per capita	-	.3602(.1664)**	-	.0011(.0003)***	-	.0005(.0002)**
Out-country remittance per capita	-	.0200(.1317)	-	.0004(.0004)	-	.0005(.0003)**
Other incomes per capita	-	.0330(.1228)	-	-.0001(.0003)	-	.0001(.0002)
Gender of household head (1 if male)	-.0690(.1042)	-.0968(.1076)	-.0003(.0003)	-.0004(.0003)	.0001(.0002)	.0001(.0002)
Household size	-.3334(.1240)***	-.3352(.1283)***	-.0005(.0003)*	-.0006(.0003)**	-.0003(.0002)	-.0003(.0002)
Dependents workers ratio	.1532(.1096)	.1343(.1151)	.0006(.0003)*	.0005(.0003)	.0001(.0002)	.0001(.0002)
Per capita education	-.2105(.1259)*	-.2664(.1332)**	-.0008(.0003)*	-.0008(.0003)**	.0004(.0002)	.0004(.0003)
Landholdings under ownership	-.0079(.1308)	-.0269(.1389)	-.0004(.0004)	-.0004(.0004)	.0001(.0003)	-.0000(.0003)
Access to formal credit	-.0145(.1057)	-.0078(.1086)	-.0001(.0003)	-.0001(.0003)	.0002(.0002)	.0002(.0002)
Availability of primary school in the locality	-.0776(.1320)	-.0991(.1363)	-.0004(.0004)	-.0006(.0004)	.0003(.0003)	.0003(.0003)
Constant	-.1928(.1018)*	-.1878(.1040)*	.0003(.0002)	.0003(.0003)	.0024(.0002)***	.0024(.0002)***
†	17.83	24.93	2.43	2.34	2.28	2.04
Prob > chi^2	0.0857	0.0509	0.0080	0.0048	0.0132	0.0159
‡	0.0773	0.1082	0.0861	0.1077	0.0776	0.0855
Sample size	168	168	168	168	168	168

Source: Field survey (2008). Notes: Numbers in parenthesis are standard errors followed by coefficients. Village level fixed effects included but not reported. Asterisks (*, **, ** *) significant at 10, 5, and 1%, respectively. † LR Chi2 (for Probit), F (for OLS) are reported. ‡Pseudo-R2 (for Probit), Adj R^2 (for OLS) are reported. Variables are standardized.

workers and productive use (preferably in farm/non-farm production and demand driven education) of NFIs deserved special attention.

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