Working Paper No. 24

Agricultural Practice and its Relation to Poverty and Food Security in Selected River Basins in Bangladesh: A Situation Analysis

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August 2011

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Published by:

BRAC
75 Mohakhali
Dhaka 1212
Bangladesh

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Fax: (88-02) 8823542
Website: www.brac.net/research

Printing and Publication
Altamas Pasha

Cover design
Md. Abdur Razzaque

Design and layout
Md. Akram Hossain

BRAC/RED publishes research reports, scientific papers, monographs, working papers, research compendium in Bangla *(Nirjash)*, proceedings, manuals, and other publications on subjects relating to poverty, social development and human rights, health and nutrition, education, gender, environment, and governance.

Printed by BRAC Printers at Tongi, Gazipur, Bangladesh.

Acknowledgements

We would like to thank Dr. Mahabub Hossain, Executive Director, BRAC for advising us with his valuable comments and guidance. As for the data, we thank IRRI for collecting data for the year 2000 and RED for the year 2008. We would also like to acknowledge the invaluable feedback and suggestions received from Dr. Shahe Alam, Consultant, RED and Mr. Narayan C Das, Research Fellow of BRAC RED. And last but not the least, we would like to thank the International Union for the Conservation of Nature (IUCN) for funding the project and Ms. Bushra Nishat of IUCN for providing us with feedback and support for the paper. Finally, we would like to thank Mr. Hasan Shareef Ahmed, Chief, Editing and Publication, RED for diligently editing the manuscript and Mr. Akram Hossain for formatting and designing the outlook of the paper.

RED is supported by BRAC's core fund and funds from donor agencies, organizations and governments worldwide. Current donors of BRAC and RED include Aga Khan Foundation Canada, AusAID, Australian High Commission, Bill and Melinda Gates Foundation, NIKE Foundation, Campaign for Popular Education, Canadian International Development Agency, Charities Aid Foundation-America, Columbia University (USA), Department for International Development (DFID) of UK, European Commission, Fidelis France, The Global Fund, GTZ (GTZ is now GIZ) (Germany), Government of Bangladesh, The Hospital for Sick Children, ICDDR,B Centre for Health and Population Research, Institute of Development Studies (Sussex, UK), Inter-cooperation Bangladesh, International Committee of the Red Cross, International Research and Exchange Board, Manusher Jonno Foundation, Micro-Nutrient Initiative NOVIB, OXFAM America, Plan Bangladesh Embassy of the Kingdom of the Netherlands, Royal Norwegian Embassy, SIDA, Stanford University, Swiss Development Cooperation, UNICEF, University of Leeds, World Bank, World Food Programme, Winrock International USA, Save the Children USA, Save the Children UK, Safer World, The Rotary Foundation, Rockefeller Foundation, BRAC UK, BRAC USA, Oxford University, Karolinska University, International Union for Conservation of Nature and Natural Resources (IUCN), Emory University, Agricultural Innovation in Dryland Africa Project (AIDA), AED ARTS, United Nations Development Program, United Nations Democracy Fund, Family Health International, The Global Alliance for Improved Nutrition (GAIN), The Islamic Development Bank, Sight Saver (UK), Engender Health (USA) and International Food Policy Research Institute (IFPRI).

Abstract

Poverty and food security in the context of Bangladesh has become a major concern over time. While efforts have been intensified to increase crop yield through increased land use, using inorganic fertilizers, pesticides, irrigation equipments, and so forth, these activities are frequently threatened by natural and biological hazards such as floods, cyclones, tornadoes, drought, and insects/pests. Moreover, it is assumed that the climate change induced changes of precipitation pattern would have an impact on the flooding characteristics across the basins of the Ganges, Meghna and the Brahmaputra (GMB) rivers, which might influence the agricultural land use and livelihood of people living near the river basin. This study attempts to present a situation analysis in the context of agricultural practices in the GMB basins and its relation to poverty and food security. The study finds that the riverbank areas are encumbered with a greater burden of poverty compared to the comparison areas. In terms of food security, despite the fact that one third of the households reported being chronically poor, more than 95% households in 2008 reported to be food secured. Hence, the households in comparison areas were found in a relatively better situation compared to the riverbank areas.

Executive summary

Background

Poverty and food security in Bangladesh in the context of sustainable agricultural practices have been a major concern in the recent times. Intensifying land use, using inorganic fertilizers, pesticides, irrigation equipments, and adoption of other technologies are being practiced widely among the farmers to increase crop yield from scarce arable land. Nevertheless, the agricultural activities hence are frequently threatened by natural and biological hazards such as floods, cyclones, tornadoes, drought, and insects/pests. Moreover, it is assumed that the climate change induced changes of precipitation pattern would have an impact on the flooding characteristics across the basins of the Ganges, Meghna and the Brahmaputra (GMB) rivers, which might influence the agricultural land use and livelihood of people living near the river basin. This study attempts to present a situation analysis in the context of agricultural practices in the GMB basins and its relation to poverty and food security.

Methods

The study has been based on secondary data initially collected for a number of different projects carried out by International Food Policy Research Institute (IFPRI), International Rice Research Institute (IRRI), and the Research and Evaluation Division (RED) of BRAC. From the robust dataset, a cohort of 21 villages has been selected based on their geographic locations. Nine of those 21 villages were termed as riverbank areas (situated within 0.25 km from the GMB riverbanks), while the remaining 12 were termed as comparison villages (situated substantially far away from the riverbanks). It is hypothesized for the sake of the paper that the agricultural practices would vary between the riverbank and comparison areas, which would influence the level of poverty and food security in the given areas. Thirty households selected primarily from each village during 2000 were re-visited in 2008 for data collection. Thus, panel data of the 235 households from the riverbank areas and 312 households from comparison areas have been used to analyze the poverty and food security situation.

Findings

Both in the riverbank and comparison areas, people have predominantly been involved in agricultural activities during 2000-2008, though the average farm size has reduced over time in both areas. Since the average family size did not show an increase, the reasons for reduction of cultivable farm size needs further studies, because the reduction of farm size might have significant impact on the agricultural practice and profitability.

The riverbank areas were found to be encumbered with a greater burden of poverty compared to the comparison areas between the two study periods. This is evidenced by the poverty prevalence and movement of households into and out of poverty. The overall poverty situation in the study areas was found to be significantly influenced by the amount of land cultivated by the households and on their pertinent agricultural income. In addition, the self perceived household economic status over the longer period (20 years from 2008) though has showed improvement in both areas, the level of improvement was higher for the households in the comparison areas. Apart from enhanced family income generating capacity through earnings from businesses and remittance, the households identified adoption of modern agricultural technology and diversification of agricultural practices as the main reason for improvement of overall socioeconomic status. Contrary to that, agricultural loss has also been identified as a significant reason for deterioration of household economic status together with increased family expenditure and reduced earning capacity of the households.

Thus, agricultural intensification appears to be inevitable for poverty alleviation and ensuring food security. This has been observed during 2000-2008 both in the riverbank and comparison areas with the increase of cropping intensity and change of cropping pattern. The cropping intensity, however, has been found to increase more in the comparison areas together with wider irrigation availability from 2000 to 2008. Nevertheless, though around one-third of the households in the study areas experienced chronic poverty, more than 95% households in 2008 reported to be food secured. Hence, the households in comparison areas were found in a relatively better situation compared to the riverbank areas.

Conclusion

This study gives an overall perspective of poverty and food security status of households in the GMB basins. Nevertheless, further research is necessary in the context of trans-boundary river flow to depict a relative picture of poverty and food security both upstream and downstream of river flows. Within the existing synergy of agricultural practices and trans-boundary rive flows a number of research issues have been identified as

1. Vulnerability assessment of households lying in the river basin,
2. Reduction of the risks of food insecurity through cropping intensification and change of cropping pattern,
3. Agricultural input changes with the proximity to rivers in the GMB basin,
4. Profitability in crop production practices in the GMB agro-ecological zone,
5. Impact of disaster on agriculture and poverty of households in the GMB basin,
6. Poverty in the GMB basins is influenced by the proximity of households to rivers, and
7. Adaptation in agricultural practices to poverty alleviate.

Introduction

Background

The agro-ecological zones of Bangladesh constitute major part (80%) of the total alluvial floodplain (144,000 km^2) formed by the Ganges-Padma, Meghna and Jamuna-Brahmaputra rivers and their tributaries (FAO/UNDP 1988) in the forms of active river floodplains, meander floodplains, piedmont plains, estuarine floodplains and tidal floodplains. The 80,500 km^2 river floodplains (Brammer 1997) are essential for the livelihoods of many among 147 million people due to existing wide scale smallholder intensive subsistence agriculture (UNPRB 2006). The rural socio-economic development has close association with the agricultural growth involving intensive land cultivation (Turner and Doolittle 1978), i.e., output from per unit of land with various necessary agricultural inputs. According to FAO (1997), food security at the farm household level is a matter of individual household's access to enough food. Thus, it is closely linked with the issues of poverty, access, sufficiency, vulnerability and sustainability. At the household level, food security is measured by actual dietary intake of all household members using household income and expenditure surveys. Inability of people to manage food due to poverty was used as a proxy indicator for measuring food insecurity used by Smith *et al.* (2000).

Concern over sustainability of agriculture and food security in Bangladesh is mounting due to the deteriorating land quality, declining yield, and increasing population. To increase crop yield from the scarce arable land, farmers are intensifying land use, increasing the use of inorganic fertilizers, pesticides, irrigation equipments, and other technologies (Hossain 1988). However, the agricultural activities in Bangladesh are frequently affected by natural calamities such as floods, cyclones, tornadoes, drought, pests etc. Almost 50% of the total land is flooded every year because of the concentrated rainfall during the monsoon, which has the evidence of massive crop damage (Framjii 1977, Shahabuddin 1999). One-fifth of the country is typically flooded every year, and in extreme years, nearly two-thirds of the country can be inundated. Moreover, due to the climate change situations induced changes of precipitation pattern in terms of delayed or advanced onset and withdrawal of monsoon as well as increased monsoon precipitation would have impact on the flooding characteristics across the basins of the Ganges, Brahmaputra and the Meghna river. Thus, there might be changes in the timing of peaking in the major rivers resulting in increase in the magnitude, frequency, depth, extent and duration of floods. Change of flooding pattern would bring dramatic change in the land use pattern of Bangladesh (Mirza 2002).

However, crop diversification may help farmers minimize the risk from natural hazards, because this has often caused major changes in cropping patterns, use of agricultural inputs, and management of soil fertility, and so forth. Traditional cropping practices, such as mixed cropping, crop rotation, and intercropping disappeared gradually (Hossain and Kashem 1997). This has led to the increased practices of monocropping and a higher dependency on external inputs such as irrigation, inorganic fertilizers, and pesticides. Monocropping along with the imbalanced application of inorganic fertilizers, pesticides, and intensification of land use without application of organic fertilizers has led to deteriorated soil quality and fertility (Hossain and Kashem 1997, Rahman and Thapa 1999, and Task Force Report 1991). In Bangladesh, more than 65% of the total agricultural land is suffering from declining soil fertility, and about 85% of net cultivable area has organic matter below the minimum requirement (Hossain 1990, Task Force Report 1991). As a result, crop yields are decreasing steadily, despite increased use of agricultural inputs (Ahmad and Hasanuzzaman 1998, Ali 1995, Hossain and Kashem 1997, Pagiola 1995, Rahman and Thapa 1999). The increased use of inorganic fertilizers, insecticides and pesticides has led to contamination of water bodies and the spread of diseases, which have adversely affected aquatic life, livestock and people (Hossain and Kashem 1997, Rahman and Thapa 1999). Likewise, the excessive use of ground water is primarily thought to be the main cause of presence of high level of arsenic in ground water in the northern and northwestern parts of Bangladesh (Ullah 1998). Ensuring food security for the huge population through sustained agricultural production within the existing synergy of declining soil fertility, decreasing yields, increased and imbalanced use of inorganic fertilizers and pesticides has become a serious challenge for Bangladesh.

Sustained agricultural growth induces rural system change that includes changes in bio-physical environment (land use/land cover), economic infrastructure (cropping intensity, land, labour, and technological productivity, farm income), and social conditions (literacy, housing, transport) in rural areas. For balanced agricultural and rural development planning, in which agricultural growth and small land holder's socioeconomic well-being would continue simultaneously (as per the national standard), the level of agricultural growth and rural socioeconomic change should be understood in the context of demographic, market, environmental, institutional, and technological factors that configure them. Existing studies on Bangladesh agriculture and rural development have examined the conditions of micro-level agricultural intensification and change (Ali 1987, and 1995, Turner and Ali 1996); the public policy and political economic issues of rural development, micro-credit, and energy systems; and the role of women in agriculture and socioeconomic development (Ahmed *et al.* 2001, Amin *et al.* 1994, Bayes 2001, Biswas *et al.* 2001, Blair 1985, Hye 1989, Matin and Hulme 2003, Rahman 1996, Rahman 1999, Sharif 1992). These studies did not explore the nature and causes of rural system changes in the context of their proximity to the active river flows. An understanding of these changes may have important policy implications. This study aimed to find the status of food security and poverty of the households living near the three major rivers in Bangladesh.

Conceptual framework

The study is based on the hypothesis that the change of agricultural practices, e.g., cropping intensity, cropping pattern, income from agriculture, etc. precipitates change in the rural livelihood (e.g., occupation, land ownership, poverty, food security etc). Additionally, nearness of the villages to major rivers Ganga, Brahmaputra and Jamuna would influence the agricultural practices and thereby the livelihood e.g., poverty and food security. It is generally assumed that with the increase in household size, the demand for food also increases. In subsistence agriculture system cropping intensification increases total food production and ensures household food security. It is, therefore, assumed that the population increase would lead towards increased cropping intensity, change of cropping schedule, agricultural inputs for secured crop production, and thus reducing risk.

Methods

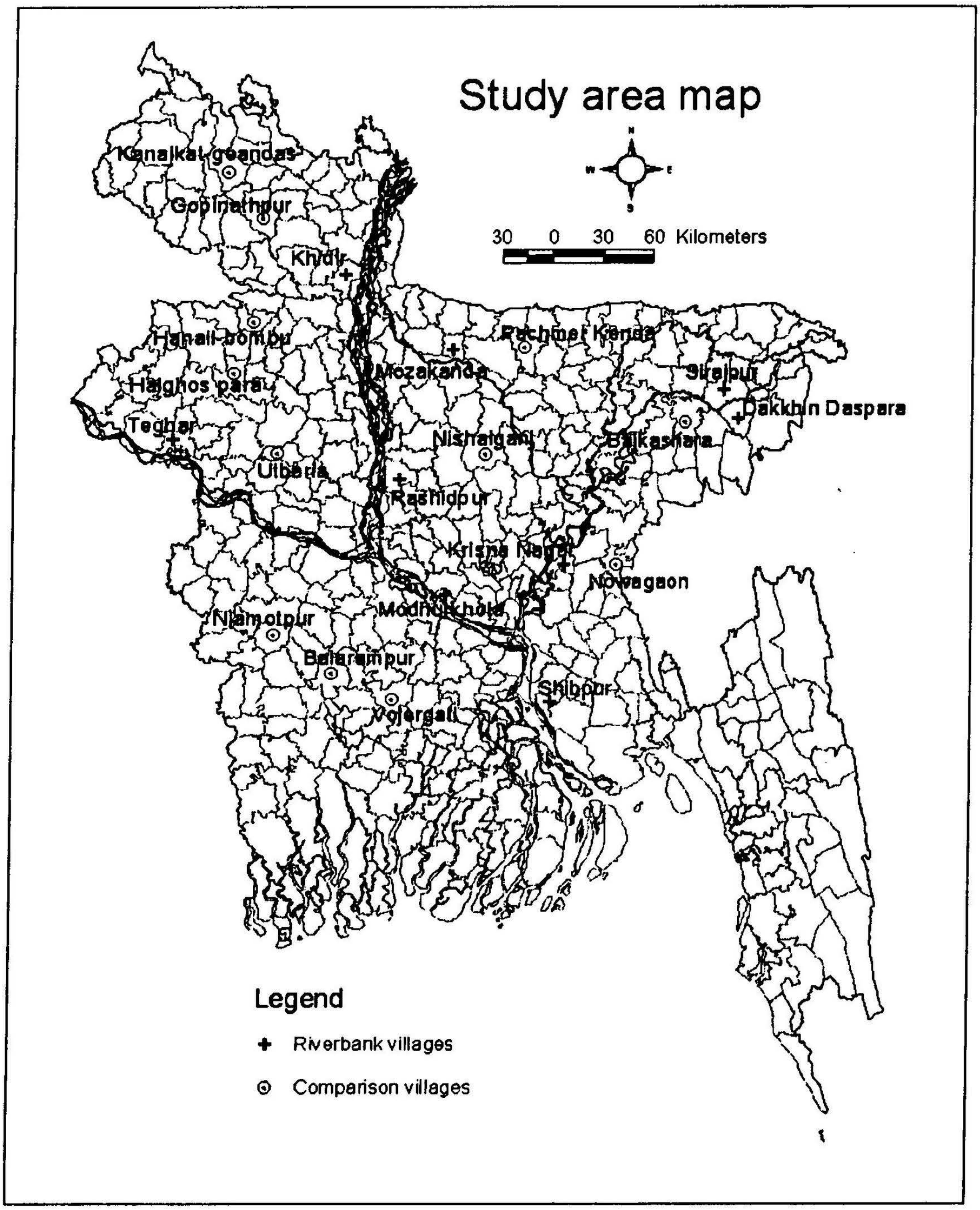
The study is based on secondary data, initially collected for a number of different projects from a multitude of organizations such as IFPRI, IRRI and BRAC RED. The original dataset extends over 20 years (1988-2008). However, for this study, data from the year 2000 and 2008 were used to form a panel data set. The initial data set used a multi stage random sampling and a deviation of that data set is used for this study. The initial data set includes samples from 62 villages. However, 21 villages were selected purposively nearby active rivers to conduct a poverty and food security situation analysis in this study. Nine of these villages, termed as riverbank areas, were within 0.25 km from the GMB riverbanks, while the remaining 12 villages were significantly far away from the nearby active river and termed as comparison villages (Fig. 1). The rest 41 villages were dropped out due to their ambiguous locations within the framework of this study.

It was assumed that the agricultural system of the study areas would influence the poverty and food security of the villages lying near the river more than those were further away. The survey collected information on the basis of similarities between them on a number of fronts. A census of all the villages was carried out on socioeconomic features such as ownership of land, major sources of income, education of the household wage earners, cropping intensity, cropping pattern, etc. However, for the sample survey, 30 households were selected from each village during 2000 and those were re-visited in 2008. Thus, panel data of 270 households from the riverbank areas and 360 households from comparison areas were used to analyze the poverty and food security situation with respect to the location of villages from the nearby river flow.

The household poverty has been defined in terms of total household income and expenditure for consumption of 2100 kcal food per person per day. The term cropping intensity has been defined as:

$$\text{Cropping Intensity} = \left(\frac{\text{Total cropped area}}{\text{Net sown area}}\right) * 100$$

Figure 1. Map of Bangladesh showing the villages selected for the study



Results and discussion

Socio-demographic conditions of the households

The socio-demographic profile of the households in the study areas shows that there was no significant difference in average family size between riverbank and comparison areas both in 2000 and 2008. However, the family size slightly increased in the riverbank areas, while it reduced slightly in comparison areas. The national level average household size was reported to be 4.8 (BBS 2004). The average years of education of household wage earners increased over time and the education status of wage earners in comparison areas was better than the riverbank areas. There was significant increase in the number of households having access to electricity both in the riverbank and comparison areas from 2000 to 2008. Though there was no significant difference in the number of households having electricity access between riverbank and comparison areas in 2000, the number of households with electricity access was significantly higher in the comparison areas in 2008 (Table 1).

Table 1. Socio-demographic condition of households in the study areas

Socio-demographic conditions	Riverbank		Comparison	
	Year 2000	Year 2008	Year 2000	Year 2008
Average family size	5.3	5.4	5.2	5.1
Average year of education of household wage earner	3.6	3.7	4.1	4.3
HHs having electricity (%)	32.1	53.2	34.7	62.0
n	235		312	

Occupation of household heads

Household heads involved directly in agricultural activities increased significantly ($p<0.01$) from 2000 to 2008 in the riverbank areas. However, there was decrease in the level of household heads involved in business and selling labour (agricultural or non-agricultural) during 2000-2008. Contrary to the riverbank areas, household heads involved in agriculture and agricultural labour reduced from 2000 to 2008 in the comparison areas. Though there was reduced number of household heads involved in non-agricultural labour, involvement in business and service increased over time in the comparison areas (Fig. 2). Nevertheless, it is clearly understood that the agriculture and agricultural labour remained the predominant occupation of household heads in both areas.

Figure 2. Scenario of occupation of household heads of the sample households

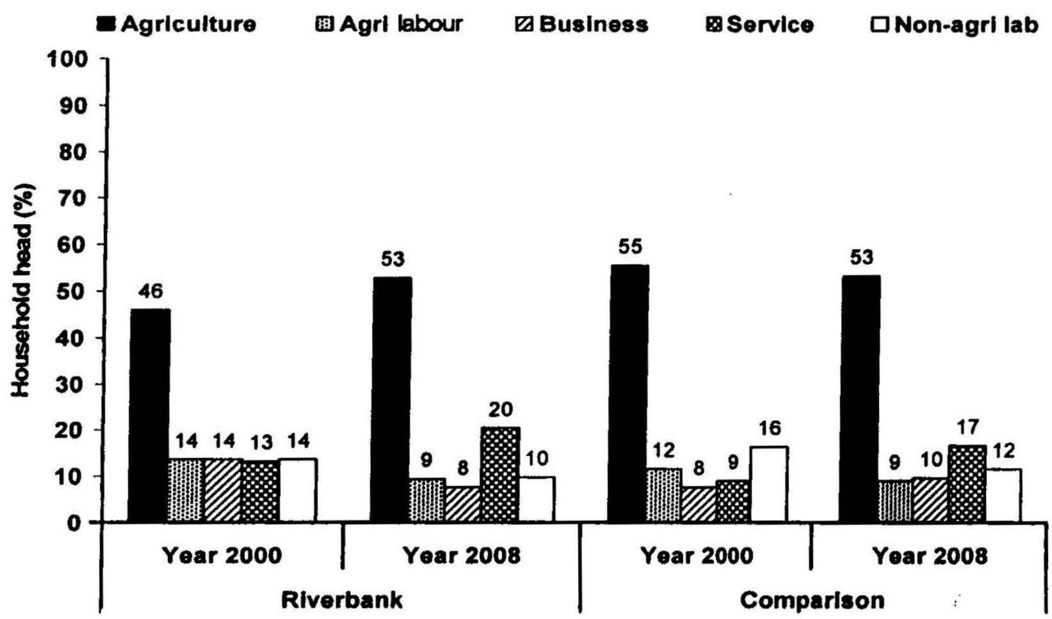


Table 2 shows the proportion of household heads involved in different occupation during 2000 both in riverbank and comparison areas. The table also shows how the household heads involved in a specific occupation in 2000 have shifted to other occupations in 2008 as percent of their earlier occupation. For example, 46% of the total household heads (N = 235) in the riverbank areas were involved in agriculture e.g., 108 household heads. The transition matrix (Table 2) shows how this 108 household heads have changed their occupation over time in 2008. Thus, 86 (79.6%) of 108 household heads were involved in agriculture in 2008 and the remaining 22 household heads shifted to other occupations like agricultural labour (3.7%), business (3.7%), service (12%) and other labour (0.9%). Similar explanation goes for all other occupations both for riverbank and comparison areas. The occupational transition of household heads during 2000-2008 shows that both in the riverbank areas and comparison areas majority of the people (36.6% and 42.4%, respectively) stayed steady with agriculture. In addition to that quite considerable proportion of people involved in other occupations viz., agricultural labour, business, service and non-agricultural labour, both in the riverbank and comparison areas shifted to agriculture from 2000 to 2008 (Table 2). Hence, agriculture seems to be the major occupation in the study areas influencing the overall socioeconomic condition.

Table 2. Transition of occupation from 2000 to 2008

Occupation of HH head (2000) in percentage	Occupation of HH head (2008) in percentage				
	Agriculture	Agricultural labour	Business	Service	Other labour
Riverbank					
Agriculture	79.6	3.7	3.7	12.0	0.9
Agricultural labour	28.1	25.0	12.5	6.3	28.1
Business	31.3	6.3	31.3	21.9	9.4
Service	29.0	3.2	0.0	67.7	0.0
Non-agricultural labour	31.3	21.9	0.0	15.6	31.3
Comparison					
Agriculture	76.9	3.5	5.2	11.0	3.5
Agricultural labour	30.6	36.1	2.8	8.3	22.2
Business	29.2	0.0	58.3	8.3	4.2
Service	14.3	0.0	7.1	75.0	3.6
Non-agricultural labour	21.6	17.6	7.8	13.7	39.2

Land ownership

Extreme population pressure in Bangladesh renders very low household-level endowment of land. There is only 8.0 million ha arable land in the country to support 147 million people. The latest Agricultural Census enumerated 17.8 million rural household in 1996, of which 29% did not own any cultivable land, and 53% owned less than 0.2 ha (called "functionally landless"), an amount that cannot generate sufficient income. At the other extreme, only 0.1% of households owned lands of over 10 ha and 2.1% owned more than 3.0 ha (Hossain 2009).

However, table 3 shows a similar pattern of land ownership. Households owning up to 0.2 ha of land were the majority both in 2000 and 2008. However, the share of such small holders of the total land was minimum both in the riverbank (7.5 - 8%) and comparison areas (2.8 – 5.3%) during 2000-2008. On the other hand, the proportion of households owning more than 2 ha of land reduced both in the riverbank and comparison areas during 2000-2008. Thus, the overall trend of increasing the number of small and medium farm size categories exist, while the number of large size land holders decreases. The average farm size used for cultivation reduced significantly in both areas over time (Table 3).

Table 3. Changes in the distribution of land ownership

	Riverbank				Comparison			
	Year 2000		Year 2008		Year 2000		Year 2008	
	% HH	Share (%)	% HH	Share (%)	% HH	Share (%)	% HH	Share (%)
Up to 0.20 ha	53.6	7.5	51.9	8.0	44.6	2.8	47.4	5.3
0.20 - 0.40	11.5	8.4	16.6	12.9	15.1	6.3	12.5	8.1
0.40 - 1.0	22.6	35.0	21.7	34.6	20.5	20.4	19.2	24.5
1.20 - 2.00	8.9	29.6	6.8	25.5	10.9	23.2	13.5	28.8
Over 2.00 ha	3.4	19.5	3.0	19.0	9.0	47.2	7.4	33.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Average cultivated farm size (ha.)	0.53		0.49		0.87		0.68	

Annual cropping pattern

Table 4 shows the cropping pattern and cropping intensity in the riverbank and comparison areas, in 2000 more intensive cropping practices in the riverbank areas (168.0%) compared to that of the comparison areas (139.1%). The proportion of fallow land in the riverbank areas was less than that in the comparison areas. However, in the comparison areas higher proportion of land was used for single cropping than the riverbank areas, though the proportion of land used for two and three crops in a year was comparatively less.

Table 4. Annual cropping pattern and cropping intensity in 2000

	Riverbank			Comparison		
	n	Land ha	Land (%)	n	Land ha	Land (%)
Fallow	9	0.9	1.3	19	2.9	1.7
Rice + fallow	128	17.2	24.3	354	70.1	41.6
Other crop + fallow	57	7.9	11.1	52	4.5	2.6
One crop	185	25.13	35.4	406	74.59	44.2
Rice + Rice	207	25.4	35.8	374	63.7	37.8
Rice + Other crop	88	10.4	14.7	122	20.2	12.0
Other crop + Other crop	36	4.5	6.3	26	2.3	1.4
Two crop	331	40.28	56.8	522	86.21	51.1
Other crop + Rice + Rice	2	0.4	0.6	43	4.4	2.6
Other + Rice + Other	34	4.0	5.6	5	0.5	0.3
Other crop + Other crop + Other crop	1	0.2	0.3	-	-	-
Three crop	37	4.60	6.5	48	4.83	2.9
Total	562	70.9	100.0	995	168.6	100.0
Total crop area ha		119			262	
Cropping intensity (%)		168.0			139.1	

The cropping pattern in comparison areas of 2008 contradicts with that of 2000 when compared with the riverbank areas in terms of less fallow land, less single cropping but more double cropping. The practice of cultivating three crops in a year was identically higher in the riverbank areas in 2008. Nevertheless, the overall cropping intensity in the riverbank areas presumably toppled over time and in 2008 the cropping intensity in comparison areas raised as high as 166.4% (Table 5). This gives the indication of higher adoption of modern agricultural technology in the comparison areas as well as possibly more profitability from agricultural practices/crop production. Both in the riverbank and comparison areas rice has been found to be the major crop, since the alternative crops like pulses, vegetables, potato, sugarcane, jute, etc. are grown other than rice.

Table 5. Existing cropping pattern and cropping intensity in 2008

Year 2008	Riverbank areas			Comparison areas		
	n	Land ha	Land (%)	n	Land ha	Land (%)
Fallow	2	0.19	0.3	5	0.99	0.8
Rice + fallow	141	20.07	32.3	188	40.89	31.8
Other crop + fallow	71	11.58	18.7	44	7.57	5.9
One crop	212	31.66	51.0	232	48.46	37.6
Rice + Rice	145	19.08	30.7	352	59.53	46.3
Rice + Other crop	34	4.89	7.9	72	8.83	6.9
Other crop + Other crop	13	1.74	2.8	32	3.31	2.6
Two crop	192	25.72	41.4	456	71.68	55.7
Other crop + Rice + Rice	3	0.20	0.3	1	0.10	0.1
Other + Rice + Other	35	4.32	7.0	36	7.21	5.6
Other crop + Other crop + Other crop			0.0	1	0.27	0.2
Three crop	38	4.52	7.3	38	7.58	5.9
Total	444	62.09	100.0	731	128.71	100.0
Total crop area ha		97			215	
Cropping intensity (%)		155.7			166.4	

It is assumed that cropping diversification may help farmers to minimize risk arising from natural hazards. However, this has caused major changes in cropping patterns, use of agricultural inputs, and management of soil fertility. Furthermore, the area under irrigation and area devoted to high yield variety (HYV) rice cultivation have helped increase the cropping intensity considerably. Use of inorganic fertilizers increased six times during 1970–90, and the use of pesticides increased about threefold in just one decade, during 1982–92 (Rahman and Thapa 1999). On the other hand, the area under pulses, oilseeds, fodder and natural inland fisheries declined (FFYP 1998). Traditional cropping practices, such as mixed cropping, crop rotation, and intercropping also disappeared gradually (Hossain and Kashem 1997). Monocropping along with imbalanced use of inorganic fertilizers, pesticides, and intensive land use without application of organic fertilizers have led to deterioration of soil quality and fertility (Hossain and Kashem 1997, Rahman and Thapa 1999, Task Force Report 1991).

Irrigation practice for agriculture

Table 6 provides data on the availability of the irrigation in the study areas. It is evident that the proportion of land cultivated without irrigation reduced significantly from 2000 to 2008 both in the riverbank and comparison areas with the subsequent increase of land under irrigation coverage. Thus, the irrigated area in the riverbank areas increased from 61% to 71%, whereas in the comparison areas 96% land were cultivated with irrigation (Table 6). However, it is remarkable that the use of ground water irrigation in the riverbank areas reduced from 2000 to 2008, while a reverse scenario was observed in the comparison areas. This gives the indication that the availability of surface water in the comparison areas might have reduced over time leading to the increased adoption of agricultural technologies e.g., shallow and deep tubewells.

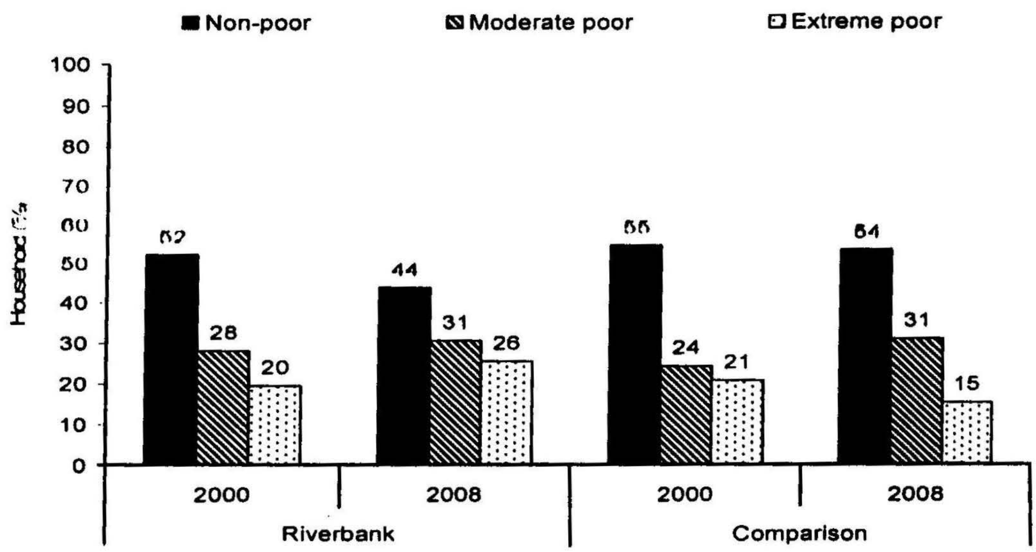
Table 6. Available irrigation practices in study areas: 2000-2008

Irrigation status	2000				2008			
	Riverbank		Comparison		Riverbank		Comparison	
	Land (ha)	%	Land (ha)	%	Land (ha)	%	Land (ha)	%
Cultivated land	71.1	100.0	188.0	100.0	62.1	100.0	129.0	100.0
Without irrigation	27.7	38.9	77.0	41.0	18.0	29.0	5.0	3.8
With irrigation	43.4	61.1	111.0	59.0	44.1	71.0	124.0	96.2
Ground water irrigation	41.3	95.0	98.7	88.9	39.0	88.4	110.8	89.3
Surface water irrigation	2.2	5.0	12.3	11.1	5.1	11.6	13.2	10.7

Poverty

The incidence of poverty at the household level in the study areas has been determined considering household income and expenditure for consumption of a standard food basket consisting of approximately 2122 kcal per day. The prevalence of poverty in the riverbank areas increased significantly from 2000 to 2008, while in the comparison areas, the proportion of now poor households increased by only 1%. Thus, higher poverty prevalence is observed in the riverbank areas compared to the comparison areas both in 2000 and 2008 (Fig. 3).

Figure 3. Scenario of poverty incident in the riverbank and comparison areas



The transition of household poverty shows that in the riverbank areas 34.5% households could never come out of poverty during 2000-2008, whereas in the comparison areas this rate was 29.5%. This indicates higher incidence of chronic poverty in the riverbank areas. In addition, the proportion of households always remaining above the poverty level in the comparison areas was higher than that of riverbank areas (Table 7). Apart from the problem of persistent poverty in both areas, there were also a considerable proportion of households (13.2% in riverbank, 15.7% in comparison areas) who could get exit from poverty. However, this improvement was tarnished due to higher proportion of households moving into poverty (21.7% in riverbank, 17.0% in comparison) compared to those getting rid of poverty. Considering the households moving into and moving out of poverty, the poverty burden in the riverbank areas increased during 2000-2008 compared to that of comparison areas. Nevertheless, if we include the transitory poor with the chronically poor, almost two-thirds of the households experience poverty at some time or other. Hossain and Nargis (2009) reported that it is important to maintain stability in the price of staple food for economic stability of low-income households in the context of sharp impact of the food crisis on poverty.

Table 7. Transition of household poverty during 2000-2008

Poverty Status	Riverbank HH (%)	Comparison HH (%)
Always non-poor	30.6	37.8
Non-poor to poor	21.7	17.0
Poor to non-poor	13.2	15.7
Always poor	34.5	29.5
All households	100.0	100.0

Self perceived economic status of the households

While asked about the change of self perceived economic status of the households in last 20 years from 2008, it was found that higher proportion of households in the comparison areas mentioned improvement compared to the riverbank areas. Thus, in the riverbank areas higher percentage of households also mentioned deterioration of economic status over time. Since, higher proportion of households could improve the economic status in comparison areas, relatively fewer households mentioned about unchanged economic situation (Table 8).

Table 8. Change of self perceived economic status of the households in last 20 years from 2008

	Riverbank		Comparison	
Status	n	Household (%)	n	Household (%)
Improved	113	48.1	183	58.7
Unchanged	68	28.9	72	23.1
Deteriorated	54	23.0	57	18.3
Total	235	100.0	312	100.0

In this perspective, the most significant reasons identified for the improvement of household economic status both in the riverbank and comparison areas were: (i) changes in agricultural practices – technology adoption and diversification in terms of fish farming, rearing livestock, (ii) involvement in business, (iii) enhanced family capacity – increased number of earning members, earning from service, (iv) remittance, and (v) other opportunities such as transport system improved. It is worthy to mention that in the comparison areas more number of households has identified involvement in business as the prime reason for improvement in economic status than the riverbank areas. Nevertheless, in the riverbank areas enhancement of family capacity was by more proportion of the households as the mentioned reason for improvement than the comparison areas (Table 9).

Table 9. Reasons of improving household economic status

Reasons for improvement	Riverbank HH (%)	Comparison HH (%)
Adoption of agricultural technology	21.7	23.0
Enhanced family capacity	24.3	6.6
Business	24.3	41.0
Remittance	8.7	7.1
Engaged in other agriculture (fish/livestock etc.)	5.2	2.2
Other opportunities	15.7	20.2

The households both in the riverbank and comparison areas mentioned increase of family expenditure and reduced family capacity due to losing earning member as the major reasons for deterioration of household economic status during the last 20 years. Apart from that loss of agricultural practices in terms of crop loss, low yield, low market price, flood and drought, land loss were also identified as the reason behind deterioration of household status (Table 10).

Table 10. Reasons for deterioration of household economic status in last 20 years from 2008

Reasons for deterioration	River bank HH (%)	Comparison HH (%)
Agricultural loss	16.7	17.5
Increased family expenditure	42.6	47.4
Reduced family capacity	37.0	33.3
Other	3.7	1.8

Food security

Data on food security status of the households in riverbank and comparison areas in terms of households having 3 meals a day in the previous week reported. It was observed that there was substantial improvement from 2000 to 2008. Compared to the food security status of 2000, in the riverbank areas 8.9% more households reported food secured in 2008, while the same in the comparison areas was 12.5%. Thus, in both areas households with deficit food reduced remarkably during 2000-2008. However, the overall improvement of food security status in the comparison areas was better than the riverbank areas. Hence, Table 11 shows the percentage of households reporting to have 3 meals a day in the previous week of reporting, which is considered as an indicator of food security, both in the riverbank and comparison areas during the year 2000 and 2008.

Table 11. Food security status of households (% of households)

Food availability level	Riverbank		Comparison	
	2000	2008	2000	2008
Taken 3 meal a day	86.0	94.9	84.6	97.1
n	235		312	

The logit regression analysis of poor households shows that in the study areas there was significant relationship with the cultivation of land (ha) and poverty of households both in 2000 and 2008. With the increase in cultivating land the probability of households being poor reduces both in 2000 and 2008. Again, household depending on income from agriculture has significantly higher probability of being poor. However, the probability of households being poor had no significant relation with their location in the riverbank areas in 2000, while in 2008 the situation changed with their significantly higher probability of being poor (Table 12).

Table 12. Logit regression of household poverty

	2000			2008		
Variable	Marginal fixed effect	Standard error	p value	Marginal fixed effect	Standard error	p value
Cultivating land	-0.489	0.057	0.000	-0.468	0.064	0.000
Income from agriculture	0.221	0.044	0.000	0.324	0.045	0.000
Riverbank	0.03	0.046	0.750	0.079	0.048	0.100

Hence, it has been found that both in the riverbank and comparison areas people were involved in agriculture predominantly during 2000-2008, though the average farm size has reduced over time in both areas. Since, the average family size did not show major increase the reasons for reduction of cultivable farm size needs further studies, since the reduction of farm size might have significant impact on the agricultural practice and its profitability. The riverbank areas have been found to be burdened with poverty over time compared to the comparison areas. This is evidenced by the calculated poverty prevalence and movement of households into and out of poverty. However, the self perceived household economic status over the longer period (20 years from 2008) though has improved in both areas, the relative improvement in the comparison areas has been found better. Apart from enhanced family capacity, earning from businesses and remittance, the households identified adoption of agricultural technology and diversification of agricultural practices as the main reason for improvement of overall socioeconomic status. Contrary to that, agricultural loss has also been identified as a significant reason for deterioration of household economic status together with increased family expenditure and reduced earning capacity of the households. Thus, agricultural intensification is inevitable for poverty alleviation and ensuring food security in the study areas. This has been observed as well during 2000-2008 both in the riverbank and comparison areas with increased cropping intensity and change of cropping pattern. The cropping intensity, however, has been found to increase more in the comparison areas together with wider irrigation practices from 2000-2008. Nevertheless, though around one-third of the households in the study areas experienced chronic poverty, more than 95% households in 2008 reported to be food secured. Hence, the comparison areas have been found in a relatively better situation compared to the riverbank areas. Dependence of households on agriculture increases the chance of being poor; however, the size of land cultivated also has significant bearing in this regard. Thus, there is some indication that the households in the riverbank areas might be more vulnerable to poverty and food security. Environmental constraints such as flood, drought, soil salinity and poor land quality limit frequent cultivation of high demanding crops and lower their yield, thereby hinder agricultural growth and rural development. Under uniform demand levels, the high constraining environments give rise to the high technical labour and input intensive farming systems in which both cropping intensity, land and labour productivities are lower than in low and medium constrained environments (Ali 1987). Further research is necessary to reveal the impact of river flow on the agricultural practices, poverty and food security from a trans-boundary aspect.

Conclusion and recommendations

This study gives an overall perspective of poverty and food security status of households in the GMB basin areas. The findings show that agriculture was the main occupation of the household heads in both riverbank and comparison areas both in the 2000 and 2008. However, in both areas agricultural practice was dominated (approximately 60%) by cultivation of small land size (0.2-0.4 ha) and the average size of cultivated land reduced over time. The cropping intensity in the comparison areas increased over time from 2000 to 2008 compared to that of the riverbank areas. This might have been influenced by the adoption of modern agricultural practices. The findings show that the riverbank areas are more poverty burdened though the situation of food security has improved over time. The areas far from the active rivers however shows better situation with improvements of cropping pattern, cropping intensity and poverty reduction. Nevertheless, using the data set of this study it was not possible to determine the vulnerability of the households as well as the impact of water availability from rivers on the agricultural practices as crop yield, crop loss, profitability of farming, etc. Thus, further research is necessary in the context of trans-boundary river flow to depict a relative picture of poverty and food security both upstream and downstream of river flows, e.g.

1. Households in the GMB basin are vulnerable to a number of factors, e.g., natural disaster, economic, and livelihood. Thus, it is necessary to conduct an overall vulnerability assessment of households with respect to the trans-boundary river flows.

2. It is assumed that due to population increase and reducing farm size people would intensify cropping and change the cropping pattern to increase yield and reduce the risk of food insecurity. Thus, it is necessary to assess how these factors differ in areas nearby the main rivers and in the areas far from the river flows in the GMB basin. Thus, it requires studying how the crop yield varies due to crop intensification and change in cropping pattern over time.

3. Agricultural input in terms of seeds, irrigation, inorganic fertilizer, pesticides etc. would differ between areas near to the river flow and the areas far from the river flow. For example, there would be more use of shallow tubewell irrigation system in areas near the rivers, while it would need more deep tubewells to use ground water in areas far from the river flow.

4. The difference in agricultural input would influence the profitability of agricultural practices in the GMB agro-ecological zone. Thus, it is necessary to study the profitability of agricultural practices and reveal its impact on poverty alleviation.

5. Disasters like flood might be influenced by the flow of water in the rivers, precipitation, etc., which would cause the crop loss and thereby would affect the agricultural practices rendering impoverishment of people living nearby the rivers. Hence, research is needed to measure the vulnerability of agricultural practices induced by disaster.

6. Bangladesh is a country with wide scale small holder intensive subsistence agriculture. Since the agricultural productivity is assumed to be influenced by the trans-boundary river flows, it is necessary to study its impact on poverty.

7. People living in the GMB basin have adapted themselves with the existing natural, social and economic situation. Agricultural practices have also changed to cope with the changed situation. Thus, it is necessary to identify the existing adaptation measures adopted already and what other potential measures could be adopted for poverty alleviation and ensuring food security.

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