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Community-based Disaster Management and Its Salient Features: A Policy Approach to People-centred Risk Reduction in Bangladesh

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Abstract

The discourse of disaster management has undergone significant change in recent years, shifting from relief and response to disaster risk reduction (DRR) and community-based management. Organisations and vulnerable countries engaged in DRR have moved from a reactive, top-down mode to proactive, community-focused disaster management. In this article, we focus on how national disaster management policy initiatives in Bangladesh are implementing community-based approaches at the local level and developing cross-scale partnerships to reduce disaster risk and vulnerability, thus enhancing community resilience to disasters. We relied chiefly on secondary data, employing content analysis for reviewing documents, which were supplemented by primary data from two coastal communities in Kalapara Upazila in Patuakhali District. Our findings revealed that to address the country's vulnerabilities to natural disasters, the Government of Bangladesh has developed and implemented numerous national measures and policies over the years with the aim of strengthening community-focused risk reduction, decentralising disaster management, developing cross-scale partnerships and enhancing community resilience. Communities are working together to achieve an all-hazard management goal, accepting ownership to reduce vulnerability and actively participating in risk-reduction strategies at

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multiple levels. Community-based disaster preparedness activities are playing a critical role in developing their adaptive capacity and resilience to disasters. Further policy and research are required for a closer examination of the dynamics of community-based disaster management, the role of local-level institutions and community organisations in partnerships and resilience building for successful disaster management.

Keywords

Community-based approach, community participation, partnership, disaster management, inclusive risk reduction

Introduction

Over the last two decades, the discourse of disaster management has undergone significant change, notably shifting from relief and response to disaster risk reduction (DRR), community-based disaster management (CBDM) and enhancing community resilience to natural disasters. The results of these changes have been evident in terms of the reduction in death and property loss, particularly in the developing world (Haque & Uddin, 2013; Victoria, 2003). Organisations engaged in disaster management called it a paradigm shift as they moved from a reactive, top-down mode handling disasters to proactive, community-focused disaster management based on local resources and capacities to reduce risk and vulnerability (UNISDR, 2004; Victoria, 2003). The CBDM approach focuses on building the capacity of communities to assess their vulnerability to both human-induced and natural hazards and develop strategies and resources necessary to prevent and mitigate the impact of identified hazards as well as to respond, rehabilitate and reconstruct following their onset. CBDM strategies have become increasingly important in the face of global climate change, increased populations expanding into more vulnerable regions and the heightened recognition of a need for greater linkages between top-down governmental and community-level responses. CBDM empowers communities to be proactive in disaster management and creates a space for them to develop strategies on their own terms rather than waiting for already overstretched governments and NGOs (Haque & Uddin, 2013; Jahangiri, Izadkhah, & Tabibi, 2011; Khan & Rahman, 2007). In this article, we intend to concentrate on the evolution of disaster management policy initiatives in Bangladesh, particularly community-based and partnership-oriented approaches.

It is critical to examine CBDM in the most vulnerable areas of the world, and Bangladesh is quite appropriate for this purpose. This is because Bangladesh ranked number six in the Global Climate Risk Index (Eckstein, Künzel & Schäfer, 2018). Approximately 70–80 tropical cyclonic storms are generated globally, of which 7 per cent originate in the Bay of Bengal and make landfall along the Bangladesh coast, which covers 47,211 sq. km (Mallick, Rahaman, & Vogt, 2011; Raj, Ullah, & Akhter, 2010; Smith, 2004). The human vulnerability along the Bangladesh coast is reflected in the 60 million people living in the region, and the prevailing

precarious socio-economic conditions, with GDP per capita less than USD1,516 (World Bank, 2019).

Since 2000, Bangladesh's coast has been struck by two severe cyclones of comparable magnitude and intensity to the 1970 and 1991 cyclones; noticeably, not only were the human toll and property damage much less than previous disasters but the recovery and rehabilitation processes also seemed more robust (Raj et at., 2010). Raj et al. (2010) and Chowdhury (2003) assert that the cyclone of 19 May 1997 was similar to that of 1991 but only 155 people died mainly because nearly 600,000 people moved or were successfully evacuated to shelters. It can be presumed that the accumulated learning by the local communities helped to deal with cyclone early warnings, and thus saved their lives and properties. Transformed community-based approaches and resilience to cyclone disasters were further reflected during the onset and post-event recovery from cyclone Aila, which severely affected the eastern coast of India and south-western coast of Bangladesh on 25 May 2009—death tolls were limited to 200 lives in Bangladesh (Azad & Khan, 2015; Panda et al., 2011). The trend in cyclone disaster impact along Bangladesh's coastal regions clearly exhibits significant improvement in disaster preparedness, DRR and robust community resilience—labelled by some as an indicator of a paradigm shift (Haque & Uddin, 2013).

As Bangladesh has experienced frequent and extreme climatic events, such as cyclones, droughts, heatwaves, cold waves and floods (IPCC, 2012), over the years, successive governments, civil society organisations and development partners have come up with approaches to help the affected people adapt to climate change-induced natural disasters where preparedness is a concomitant process requiring the engagement of all sectors (O'Brien, 2006; Planning Commission, 2012). Preparedness must address how to minimise losses that arise when natural processes interact with human settlement in ways that create loss and disruption (Paton & Johnston, 2006). Community members who recognise their lives or livelihoods to be especially vulnerable to hazards are more likely to cooperate in relevant disaster preparedness initiatives than those who do not (Paton, Johnston, Smith, & Millar, 2001). Awareness raising at all levels has been found to be particularly important when addressing the complexities of climate change, including the likely impacts on local people and the causes of vulnerability (Red Cross/Red Crescent Climate Centre, 2004).

In this article, we focus on CBDM, which is synonymously referred to in the disaster literature as community-based disaster risk reduction (CBDRR), community-based disaster risk management (CBDRM) and community-based disaster preparedness (CBDP), and in this article, we consider these terms interchangeably (Luna, 2014). CBDM emphasises the most vulnerable groups, families and people in the community impacted by repeated disasters. However, socio-economic and especially political aspects of vulnerability need to be addressed to create disaster-resilient communities focusing on community-based approaches (Blaikie, Cannon, Davis, & Wisner, 1994; Heijmans, 2004). Here, we provide an overview of the CBDM aspects of Bangladesh, synthesising government policy frameworks and field observation. Our specific objectives of this study are twofolds, to explore: (a) the scope of the CBDM framework under

government policy regimes and (b) the drivers and application of the CBDM approach to reduce disaster risk and enhance community resilience to disasters.

Methods of the Study

Our research aimed at analysing whether the institutional mechanisms of disaster management in Bangladesh reflect the community-based approach and partnership of stakeholders at the implementation level. For policy analysis, we relied chiefly on secondary data, which were supplemented by primary data from two coastal communities in Kalapara Upazila under the Patuakhali District. As Bangladesh has experienced numerous devastating cyclones and long-lasting floods that have caused immense suffering to people and damage to properties in recent decades, we relied on secondary data on the relevant disaster response and management policies. Official documents from the government and donors, study reports from NGOs and other organisations, journal articles, newspaper clippings, TV reports and documentaries, and internet resources from reliable and responsible sources were used for our analysis. To ensure openness in discussing sensitive issues, we used informal discussions with stakeholders at different levels. Through personal contacts and over the internet, we collected reports and documents from government agencies, NGOs and donors in Bangladesh, such as the Bangladesh Disaster Preparedness Centre (BDPC), the Disaster Forum, the Department of Disaster Management (DDM), the Ministry of Disaster Management and Relief (MoDMR), and the United Nations Development Programme (UNDP).

A content analysis was employed for reviewing documents with various combinations and permutations of the following 10 sets of keywords: ‘disaster management’, ‘community-based’, ‘public involvement’, ‘decision-making’, ‘relief and rehabilitation’, ‘disaster resilience’, ‘disaster management projects’, ‘disaster policy implementation and impacts’, ‘community participation’ and ‘community resilience to disasters’. The document review process aimed to identify the key triggers, such as strengths, capability and community initiatives, that make them more resilient to disasters. A DRR lens was also used in reviewing the pieces of literature to scrutinise the community empowerment process of disaster-affected communities.

The Community-based Disaster Management Approach

The CBDM approach is a fundamental form of community empowerment and a compelling mechanism for enforcing the transmission of ideas and claims from the bottom up. CBDM aims to reduce disaster impacts and risks through community participation that places people at the centre of development (Luna, 2014; Urry, 2011). Historically, top-down, interventionist approaches have dominated the disaster management field. However, O’Brien and O’Keefe (2014)

stated that both top-down and bottom-up approaches are needed in adaptation structures as deductive and inductive methods of disaster management planning and community empowerment. In 2005, the United Nations International Strategy for Disaster Reduction (UNISDR) developed the Hyogo Framework for Action (HFA), 2005–2015, for building the resilience of nations and communities to disasters. It prioritised DRR at the community level that offers a way of engaging with communities and making them self-sufficient (UNISDR, 2007). As the community is the key resource and frontline actor in community-based approaches, community participation in the development and implementation of disaster plans ensures ownership that can enable communities to prevent, reduce and effectively respond to stress, shocks and potentially disastrous events (O'Brien & O'Keefe, 2014). Increasing emphasis has been placed on community-based approaches that focus on the root causes of vulnerability rather than isolated disaster events (Blaikie et al., 1994).

In recognising the need for vulnerability reduction for effective disaster management, the failures of a top-down management approach have become evident. This approach has been unsuccessful in addressing the needs of vulnerable communities. A better understanding of disasters and losses also brings to light the fact that the increased occurrence of disasters and disaster-related loss has been due to the exponential increase in the occurrence of small- and medium-scale disasters. As a result, numerous scholars (e.g., Choudhury, Uddin & Haque, 2019; Haque & Uddin, 2013; Shaw, Mallick, & Islam, 2013) feel that it is important to adopt a new strategy, which directly involves vulnerable people themselves in the planning and implementation of mitigation, preparedness, response and recovery measures. This bottom-up approach has received wide acceptance because it considers communities as the best judges of their own vulnerability and capable of making the best decisions regarding their well-being. The search for a newer approach led to the formulation of the CBDM strategy.

The aim of CBDM is to reduce vulnerabilities and to strengthen people's capacity to deal with hazards and cope with disasters. A thorough assessment of a community's exposure to hazards and an analysis of their specific vulnerabilities and capacities is the basis for activities, projects and programmes that can reduce disaster risks. Because a community is involved in the whole process, their real and felt needs as well as their inherent resources, are considered. Therefore, there is a greater likelihood that problems will be addressed with appropriate interventions. People's participation is focused not only on CBDM processes but also on its contents. It is anticipated that the local community should be able to gain directly from improved disaster risk management. This, in turn, will contribute to a progression towards safer conditions and the improved security of livelihoods and sustainable development. This underlines the point that the local community is not only the primary actor but also the beneficiary of the risk reduction and development process (Yodmani, 2001).

The implementation of CBDM requires the consideration of many essential features. Following Yodmani (2001) and Haque and Uddin (2013), the primary ones are identified as follows:

1. The local community has a central role in long- and short-term disaster management and therefore the focus of attention in disaster management must be on the local community.
2. Disaster risk or vulnerability reduction is the foundation of CBDM; the primary content of disaster management activities revolves around reducing vulnerable conditions and the root causes of vulnerability. The primary strategy for vulnerability reduction is increasing a community's capacities and their resources, and improving and strengthening their coping strategies.
3. Disaster management must establish linkages to community development processes as disasters are viewed as unmanaged development risks and unresolved problems of the development process. CBDM should lead to a general improvement of the quality of life of the vast majority of the poor and of the natural environment.
4. CBDM contributes to people's empowerment—to be physically safe; to have more access to, and control of, resources; to participate in decision-making that affects their lives; and to enjoy the benefits of a healthy environment.
5. As the community is a key resource in DRR, their role and interests must be recognised. The community is the key actor as well as the primary beneficiary of DRR. Within the community, priority attention is given to the condition of the most vulnerable as well as to their mobilisation in DRR. The community must directly participate in the whole process of disaster risk management—from situational analysis to planning and implementation.
6. A multi-sectoral and multi- and trans-disciplinary approach must be applied. CBDM brings together a multitude of community stakeholders for DRR and to expand their resource base. Local community-level institutions link up with the intermediate and national levels, even up to the international level, to address the complexity of vulnerability issues. As a result, a wide range of approaches to DRR is employed.
7. The CBDM approach is an evolving and dynamic framework and therefore its implementation must be monitored, evaluated and adapted to incorporate newer elements. Lessons learned from practice continue to be built into the theory of CBDM and the sharing of experiences, methodologies and tools by communities and CBDM practitioners continues to enrich practice.

It is recognised that community participation and empowerment is the fundamental principle in CBDM. However, while such activity is practiced, there is a lack of knowledge of the long-term outcomes (Marsh, 2001; Midgley, 1986). It is realised that community-based initiatives help to identify local hazards and develop locally appropriate strategies and development activities to reduce disaster losses (O'Brien & O'Keefe, 2014). CBDM engages the community from planning and decision-making to implementation, which provides less scope for failure. If failure does happen, the effects could be minimised immediately with the consultation of the community people. It is intended to strengthen coping and

adaptive capacities at the local level where the primary impacts of hazard events and environmental stresses are experienced (Masing, 1999; Skertchly & Skertchly, 2001). Community-based approaches claim to build on existing local knowledge and experience as well as the resources and coping and adaptive strategies of local people (Benson, Twigg, & Myers, 2001; Masing, 1999; Tobin & Whiteford, 2002). Empowering local people by supporting them to become increasingly self-reliant is the aim of CBDM approaches (Uphoff, 1991) that mobilise people collectively and enable hope to survive (Luna, 2014).

The negative side of community-based approaches lays in the relative lack of resources, decision-making, and legislative and regulatory powers available to local-level actors and institutions at the centre of initiatives (Lavell, 1994). However, in some cases, community participation in disaster management was not possible at desired levels due to the traditional thinking of the community, the bureaucratic attitude of government officials, the scarcity of resources and prevalent socio-cultural norms and values (Ahmed, 1994; Rahman, 2008). Sometimes, misuse of power and conflict of interest among stakeholders weakens the whole process.

Community-based Disaster Management: The Global Case

CBDM actively engages the community to address their root causes of vulnerabilities and propose a way of transforming risk and techniques for developing their capacity. The community people can understand their major constraints and opportunities that exist in the community. In this process, community people are able to support the community enhancement project according to their social, economic and human capacities (Kafle & Murshed, 2006). Scholars such as Hudson and Huges (2007) and Kenney, Phibbs, Paton, Reid, and Johnston (2015) have argued that community values, perceptions and practices had been overlooked in disaster studies. A recent study conducted by Kenny et al. (2015) revealed that community-based risk reduction has a clear role in community risk reduction and found that since 2010, a series of earthquakes hit New Zealand that took 185 lives and injured more than 800 residents (Canterbury Earthquake Royal Commission, 2012). The 2010 earthquake severely affected the urban Māori community (total people affected 25,725) due to their geospatial concentration, and widely impacted financial resources, sanitation, power and transport and health facilities. The Maori community has a long experience with tsunamis and episodic flooding, and Kenney et al. (2015) found that the Maori community actively engaged and contributed in disaster recovery after the earthquake in 2010. The active involvement of the community in building resilience was a notable factor in reducing the associated disaster risks. They also found that the use of traditional ecological and cultural knowledge and technologies were useful during adverse situations. The Maori community's knowledge and understanding, values and cultural practices were closely linked with their behaviour and actions to minimise the risks induced by disasters. The Maori community also ensured community well-being at individual and family levels

based on their previous experiential knowledge. For instance, the Maori people protected land and settlements by preventing land slippage from devastating flooding and built bedrock. The community also ensured food security by applying traditional resource management processes, that is, using sustainable hunting and fishing. In addition, trees and vegetables were planted to meet their needs following a traditional process (*Mahinga Kai*). Development activists and planners designed and implemented projects following traditional values and cultures, which made it successful in risk reduction (Kenney et al., 2015). An inter- and extra-tribal relationship was established to enhance community resilience by following the priority of actions of the HFA.

Like other communities, the government of Australia has also placed more importance on community-based risk-reduction approaches since the late 1980s. The community emergency management approach can be traced following a three-day workshop in 1996 emphasising that effective risk management at the community level is fundamentally about *managing the vulnerability of communities to risks*, recognising that 'vulnerability' is a function of community susceptibility and resilience to hazards (Jones, 2013). However, the approach aims to prepare communities, to respond to unexpected events through their active involvement in local government and voluntary supports. The concept has been regarded as an integrated approach to emergency management and it works through coordination between the community and the government. For example, in the 1990s, Emergency Management Australia (EMA) applied the risk management process in Queensland. The Australian National Strategy for Disaster Resilience (NSDR) acknowledges that 'a national, coordinated and cooperative effort is required to enhance Australia's capacity to withstand and recover from emergencies and disasters' (COAG, 2011, p. iv). Thus, a comprehensive approach is followed in emergency management processes to enhance the capacity of communities as this approach incorporates factors of communities, such as human, physical, social and economic resources, to mitigate the risks of communities, and the people living in communities are able to develop resilient resources and become more resilient to protect against future disasters (Berkes & Ross, 2012; Zhou, Wang, & Jia, 2010). In Australia, this approach is generally considered as one of the key parts of emergency management.

The 1997 Red River Valley flood was the worst flood of the 20th century in Canada. The International Joint Commission (IJC) was established in 1909 through the Boundary Waters Treaty between Canada and the United States of America (USA) to assist the national governments in preventing and resolving disputes between the two countries in relation to trans-boundary water and trans-boundary environmental issues. The federal governments of both countries were eager to mitigate future floods of the same magnitude as 1997. Both governments depend on the IJC to play an advisory role. On 12 June 1997, the USA and Canadian governments jointly commissioned the IJC to investigate the causes and effects of the Red River flood. To assist this process, the IJC established the International Red River Basin Task Force in September 1997. From the beginning of their work, both the IJC and the Task Force involved the public to investigate the nature of the flood problems along with mitigation. To incorporate public

experiences, perceptions and expertise into final recommendations, the Red River Basin Task Force conducted public hearings in the communities of Moorehead, Grand Forks, Winnipeg, St. Agatha and Pembina. The hearings allowed the public to voice their concerns and opinions about the recommendations contained in the Task Force and IJC interim reports and on the Plan of Study for the remaining work. The above processes showed that the public involvement through public hearings influenced the final recommendations of the IJC. The IJC treated public input as especially valid and important, and they were successful in incorporating many of the public's major concerns into the final report (Haque, Kolba, Morton, & Quinn, 2002).

Integration of the Community-based Disaster Management Approach in National Policies and Guidelines of Bangladesh

Bangladesh made noticeable progress in disaster management by shifting the paradigm from disaster response to DRR. Longitudinal studies note that this shifting of the paradigm has become a tool for risk reduction. For example, in 2007, the catastrophic cyclone Sidr struck in the southwest coastal zone of Bangladesh, which took 4,234 lives, with 1,001 missing and over 55,000 people suffering from different physical injuries, diseases, malnutrition and livelihood losses (GoB, 2008). In 2009, cyclone Aila and the associated storm surge struck southwest Bangladesh, occurring across 11 coastal districts, killing 190 people, leaving approximately 1 million men, women and children homeless, and destroying the livelihoods of the affected people (Ministry of Food and Disaster Management [MoFDM], 2009). In considering the views of the new paradigm, the government of Bangladesh is working with the community people to mitigate the risks of vulnerable communities. As a result, the death toll was reduced to 12 in the 2013 cyclone Mahasen and to 7 in the 2015 cyclone Komen, down significantly from 4,234 in 2007's cyclone Sidr and 190 in cyclone Aila in 2009 (BBC, 2013; GoB, 2008; Ministry of Disaster Management and Relief [MoDMR], 2015b; MoFDM, 2009;). The changes in these figures highlight not only a reduction in death causalities but also the transformation has been evident in policies and plans for reducing community vulnerabilities. A major shift was made in the domain of disaster management in Bangladesh in 2010 in the light of global policies such as HFA and United Nations Framework Convention on Climate Change (UNFCCC), and the government of Bangladesh enacted the Disaster Management Act, 2012, which addresses the various issues of DRR. In this Act, the community-based approach has been incorporated into necessary lawful actions to create DRR structures with coordinated efforts of the community people as well as several stakeholders working to enhance the resilience capacity of vulnerable peoples. The Act also provides the legal basis for committees at the local level, including the: City Corporation Disaster Management Committee, District Disaster Management Committee, Upazila Disaster Management Committee, Pourashava Disaster Management Committee and Union Disaster Management Committee (UDMC; MoFDM, 2012).[1]

The government of Bangladesh has also developed a National Plan for Disaster Management (2010–2015, 2016–2020; MoDMR, 2016), which has placed emphasis on community participation from planning to implementation of disaster management activities at the local level. For example, community-based approaches like the Cyclone Preparedness Programme (CPP) have created a holistic DRR culture within the community by forming a unit-based operation in the coastal zone of Bangladesh. Like the CPP, community risk assessment (CRA) and the Risk Reduction Action Plan (RRAP) are followed by community members with the supports of local government institutions, development partners and other stakeholders in developing community-based RRAPs (MoFDM, 2010). Following community-based risk-reduction perspectives, the Disaster Management Policy, 2015, has been formulated for the engagement of local community people along with different stakeholders. This toolkit has created a culture among the community members in ensuring their roles and responsibilities as assigned by the local-level disaster management committees (MoDMR, 2015a). The Disaster Management Policy, 2015, was formulated under the Section 19 of the Disaster Management Act, 2012. The aim of this policy is to bring good governance in the culture of disaster management by ensuring the accountability of all stakeholders, including community members, development organisations, local-level disaster management committees and so on. In the meantime, the government has taken initiatives to ensure peoples' participation and to form community-based organisations at the grass-roots level for strengthening the capacity of vulnerable people in assessing and examining their risks and in preparing themselves for responding to anticipated hazards efficiently (MoDMR, 2015a). The literature on successful disaster management and CBDRR reveal that the community-based approach has made a significant difference in the disaster response and risk-reduction culture and in enhancing community resilience to disasters. Table 1 captures the key significances of CBDM and its major limitations based on an extensive critical review and field data.

Drivers of Community Engagement

Communities identify risks related to disasters, decide on risk reduction and solve disaster risk problems through planning and actions. Communities are entities characterised by a degree of shared norms, values and patterns of reciprocity and are capable of cooperative behaviour (Winchester, 2014). Community members clearly experience different degrees of access to community institutions and resources, depending on social status and particularly the social capital provided by networks (Desai, 2002). The communities use local knowledge to deal with hazards as well as manage resources for their lives and livelihoods. Despite displaying high degrees of functional consistency and mobilising capacity, local communities are heterogeneous. Prominent community members also develop potentially beneficial links where possible with local government and NGO actors (Eade, 1997). However, the existing coping mechanisms and capacities of the community are important to DRR plans and strategies. It is observed that

community-level decision-making is a negotiated process that is coloured by local power struggles and politics as much as by more altruistic values (Tobin, 1999). However, people have learned from adverse experiences and developed ways of responding to disruptive events throughout the history for their survival (O'Brien & O'Keefe, 2014). Ideally, the community manages the implementation of DRR measures in a coordinated way.

Local-level Partnerships and Collaboration

The importance of partnerships and collaboration processes is widely acknowledged and highlighted in the domain of disaster management, as disasters are 'wicked problems' and require multi-agency collaboration and partnerships to handle them (Haque & Uddin, 2013). In Bangladesh, Khan and Rahman (2007) note that institutional collaboration and partnerships in disaster management are viewed as an effective alternative approach that involves all stakeholders—the government, local communities, NGOs, community-based organisations, media, the private sector, international organisations and donor agencies. Choudhury and Haque (2016) and Choudhury et al. (2019) documented a wide range of NGO and local institutional collaboration in disaster response and recovery during cyclones Sidr and Aila as well as partnerships in awareness and capacity-building projects in Bangladesh for managing flood and cyclone disasters.

Disaster management literature in Bangladesh indicates that there is a wide recognition that effective disaster response at the local level is not possible by government agencies alone and that the cost of management needs to be shared by all stakeholders. Still, the major lacuna in the institutional framework continues to be a lack of functioning partnerships among the stakeholders. The massive flood of July 2004 showed that there were no partnerships functioning and there was little coordination. The Local Consultative Group (LCG) concluded that massive shortcomings existed in the forecasting, preparedness and coordinated response to the crisis (LCG, 2004). As a result, NGOs conducted relief and rehabilitation efforts largely without government directives and coordination. Initially, the government appeared confident in dealing with the post-disaster recovery singlehandedly. When things were getting worse, it made a sudden appeal for international assistance on 17 August 2004 through the UNDP, Dhaka. Another report argues regarding the handling of 1998 floods that 'limited evidence of government coordination was found in the recovery phase' (Haque, Khan, Uddin, & Chowdhury, 2012). Save the Children (USA) also proclaimed that 'there was a general lack of coordination among actors' (Haque et al., 2012). In the wake of the latest cyclone, the BBC reported, 'Plenty of agencies, but not enough aid—too little, too late', and further quoted a professional working in an affected area: 'The reason why these people are not receiving enough help is because there is no coordination between the government and aid agencies' (Haque & Uddin, 2013).

A striking example of poor management and coordination is the following case. Southkhali village in Shoronkhola Upazila of Bagerhat District was one of the worst hit by Sidr. During a visit immediately after the event to the area, the Indian foreign minister pledged his country's intention to rebuild all the houses in

that and the surrounding villages. From then onwards, nominal government initiative was taken to give shelter to the affected people in this area, and a virtual ban was put into effect on others, including NGOs and aid agencies, to build houses for the affected people. The pledged Indian support did not come in due time, and even 100 days after the event, people in this area were forced to live without shelter (BBC, 2008). Perhaps this unfortunate decision arose from the lack of international/bilateral coordination, bureaucracy on both sides in Bangladesh and India, a lack of understanding of the gravity of not providing shelter to victims on time or from the unnecessary exercise of power on the administration's part, even when in distress.

To this extent, it underscores the importance of examining the collaboration and effectiveness of institutional partnerships from the perspective of a shift from a managerial approach to an approach using participatory, collective decision-making and resource sharing to manage disaster risk. Since community members are the direct and most seriously affected victims, effective and sustainable partnership requires a change from a partnership approach based on equality to a focus on the community and local institutions.

NGOs work as a catalyst and play a significant role in local-level disaster management in rural Bangladeshi society where the old institutions and organisational systems had become inadequate to provide external service delivery and govern disasters at all levels. Our field research found that NGOs are contributing efficiently and effectively in all phases of the disaster cycle in the studied unions. A total of 32 NGOs were working in Kalapara Upazila, including Nilgajn and Dulashar Unions, where 13 were directly working for disaster management with various projects. Both Nilganj and Dulashar Unions developed a comprehensive disaster management plan, DRR strategy and risk mapping with the help of local NGOs working for DRR and climate change adaptation (i.e., Concern Worldwide Bangladesh (Bangladesh), Muslim Aid (UK), Friendship (Bangladesh) and Speed Trust). It was impossible for both unions to develop a disaster management plan, risk-reduction strategy and risk mapping without the help of local NGOs, although all funding was received from national and international NGOs, including ActionAid Bangladesh, Plan International Bangladesh, Islamic Relief, Red Crescent Societies, UKAid, and USAid. Many NGOs also provided capacity-building training to UDMC members, local school and madrasah teachers, religious personalities, school students, local elites and villagers.

The UDMCs operate as per the guidelines of the Standing Orders on Disaster (SOD), partnering with NGOs to enhance their capacity. With respect to risk-reduction strategies, the SOD urges UDMCs to prepare a comprehensive disaster management plan. In Nilganj and Dhulasar Unions, the UDMC has received substantial technical assistance for disaster management and recovery through their horizontal linkages with several NGOs. As part of their technical capacity-building assistance, the NGOs organised training on evacuation protocols during disasters, preparedness interventions and options for local volunteers. NGO activities thus played a vital role in enhancing the UDMC's technical capacity as well as its planning and budgeting activities. For example, for the few years preceding our study period, as per the advice from the NGOs, both studied Union

Parishads (UPs) had been allocating contingency funds to disaster response and recovery budgets. NGOs have also facilitated the sharing of information at local meetings. For example, following cyclones Sidr and Aila, volunteers shared their experiences, identifying challenges they faced and which response strategies worked best.

NGOs working for disaster management also support monthly meetings for UDMCs in kind and with cash to regularise the meeting as UDMC members were very reluctant to attend meetings during non-disaster periods. A few NGOs form disaster management committees in parallel with UDMC, but in a smaller size and focusing on their active members and including local CPP volunteers, local elites, and UP chairmen and members (e.g., Muslim Aid UK and Concern World Bangladesh). Our study found that all NGOs, including those who did not have any projects on disaster management, worked for the early warning, response, relief and recovery phases during cyclones Sidr, Aila, and Mohasen. Many NGOs undertook immediate projects for disaster recovery, rehabilitation, and capacity enhancement after the recent disasters in line with government priorities and allocated contingency funds for dealing with emergency situations. All NGOs did relief work and early warning dissemination based on UDMC decisions and active coordination.

Capacity Building Through Community Participation

Local people are the main actors in reducing disaster risks in their communities through multi-stakeholder participation. In this regard, their involvement is important in vulnerability assessment, from planning to implementation. Community participation is a dynamic process in which all members of the group exchange or share ideas and contribute to activities toward problem-solving (Banki, 1981). The capacity building discourse to fully address the needs of vulnerable people suggests that both collaborative and government-civil society relations may be required (Jalali, 2002). In adaptation to climate change, the functional capacity to collectively identify problems, take decisions and act on them, and to allocate resources are the most important attributes of communities (Dynes, 1998). Community organisation or mobilisation is an important area in terms of preparedness that is a combination of structural and non-structural measures designed to reduce known risks and ensure effective responses to disaster (O'Brien, 2006). Particular stress has been put on local capacity building (Alexander, 1997; Rocha & Christoplos, 2001) as a means of increasing resilience to natural hazard events, preventing disasters and adapting to environmental and climatic change. Social capital building entails laying the foundations for increased or altered forms of cooperation in everyday community life as well as in extreme circumstances (Marsh, 2001; Uphoff, 1991, 1992). However, capacity building of the community is an important part of the process of empowering vulnerable people to cope with and adapt to the impact of disasters, which is needed to move to a world where communities are the first line of defence in facing disasters (Luna, 2014). This is taken into consideration because the community is the first responder after disastrous situations and is more locally focused (O'Brien & O'Keefe, 2014).

Government Initiatives for Community Participation

Bangladesh has placed a priority on community participation in disaster management, inspired by community-based approaches where people's opinions and participation play vital roles (Hossain, 2013). In 1997, the Ministry of Food and Disaster Management (renamed as the Ministry of Disaster Management and Relief in 2012) issued the SOD that describes the different roles and responsibilities of different committee members who are involved in DRR and emergency management. Additionally, Bangladesh adopted a daft national plan for disaster management in 2007 and finalised that in 2010 for the period 2010–2015 (DMB, 2010). The strategic national plan emphasises community participation in disaster management activities. The Government of Bangladesh is also determined to provide assistance and protection to all who suffer disproportionately from the consequences of natural disasters so that they can resume normal life as quickly as possible (MoFDM, 2007). However, politicians have to be involved through workshops and orientation programmes because until it is transformed from a social movement into a larger local and political movement, the civil society-led social movement for community participation will not succeed. All aspects of CBDM are now under legal coverage with the Disaster Management (Committee Formation and Activities) Rules, 2015, promulgated under the Disaster Management Act, 2012.

Practices of Community Participation in Bangladesh: A Case Study of Cyclone Preparedness Programme

After a devastating cyclone on 12 December 1970, the Bangladesh Red Crescent Society (BDRCS) initiated a programme, with the active participation of community volunteers, on the early warning system that is regarded as a significant instrument in saving human life. In 1972, the Bangladesh government took charge of the CPP, which is now run by the Ministry of Disaster Management and Relief with operational support provided by BDRCS. It was understood that disasters cannot be prevented but that by undertaking preparedness activities, disaster risks and losses of lives and wealth could be reduced. The early warning system begins with a cautionary warning from the Bangladesh Meteorological Department (BMD) to CPP volunteers, who then announce the warning of a cyclone and or associated storm surges. Volunteers disseminate the warning through various mechanisms to make people aware so that they can take preparation to withstand the upcoming disaster (Hossain, 2013). In the case of 1–3 cautionary cyclone signal, the volunteers lift up 1 red flag and disseminate the warning by telling community people to inform one other; for a Level 4–7 cautionary signal, the volunteers raise 2 red flags and disseminate the warning through microphones or megaphones; and when a Level 8–10 cautionary signal is announced, the volunteers raise 3 red flags and disseminate the warning through microphones or megaphones and sounding a siren.

The CPP working area includes 350 unions (the lowest administrative unit of local government) and 40 upazila (subdistrict) in 13 coastal districts. There are 55,260 volunteers, of which 18,420 are women, in 3,684 units at the community level. Each unit has five small groups, namely warning, rescue, first aid, shelter

and response. Each group consists of three members, of which one is female and every member of each group is from the local community. Union and upazila team leaders are also working in each union and upazila from the community, and these leaders are responsible for the coordination of the volunteers' activities in times of disasters and the post-disaster period. CPP volunteers reside and work within the community. However, while community-level early warning systems are linked to regional or national information systems, they incorporate elements of local knowledge (Howell, 2003).

Another example of CPP initiatives is the planting of trees around houses and beside roads in the coastal zone to reduce disaster risk during tidal surges by reducing water and wind speed. The Government of Bangladesh implemented a social forestry programme as a preparedness action under the Ministry of Environment and Forest. This programme is being implemented by the government in partnership with communities on a profit-sharing basis. The community is responsible for plantation of the trees and overall care for them up to 15 years. Warner (2003) found that recent plans to increase local participation in flood management in Bangladesh without providing funding for the use of local actors may be 'a case of flooding [responsibilities] rather than seriously involving the grass roots in operating and maintaining flood defences' (Warner, 2003, p. 194). It is well recognised that people's participation in disaster management activities has a healing power, as victims of disasters express themselves through voices and actions that can be used to build resilience (Luna, 2014). But doubts have been raised in other contexts concerning the capacity of civil society organisations to simultaneously undertake a partnership with government institutions and maintain a meaningful advocacy role (Lister & Nyamugasira, 2003).

Inclusive Risk Reduction Action Plan: A Partnership Approach

The inclusive risk reduction action plan (IRRAP) is an excellent example of CBDM in flash flood-prone areas of Bangladesh. After a devastating flood in 2014, the local government of Durgapur Upazila of Netrokona District, located in northeastern Bangladesh, undertook an initiative for the development of an IRRAP. This administrative unit was quite susceptible to flash floods because of being a low-lying area. In 2014, a flash flood caused a great deal of damage to infrastructure, including roads, embankments and standing crops (Nasreen, Hossain, Azad, & Hassan, 2014). To reduce the devastating effects, the European Commission's Department for Humanitarian Aid and Civil Protection (ECHO) under its Disaster Preparedness Programme (DIPECHO) VII developed an IRRAP in two unions of Durgapur Upazila through multi-stakeholder consultations. The process targeted the chairmen and members of UP, teachers, farmers, guardians of school-going children, businessmen and special groups including women, disabled persons and children (Nasreen et al., 2014).

At the beginning of the process, a meeting was held with the UDMC and Ward Disaster Management Committee (WDMC) to ensure the participation of all groups. A participatory approach was followed to include the views of all stakeholders, including ideas from vulnerable groups. From the beginning, the process provided

a short training workshop for the participants on how to analyse community hazards and risks, following CRA techniques. The training also emphasised preparedness mechanisms and first aid; during the CRA process, the local inhabitants identified their potential risks, vulnerabilities and opportunities. The community also developed a hazard map and indicated specific areas and properties, such as roads, embankments, houses and crop fields, which were prone to flash flooding. Finally, a group consultation process developed a RRAP and identified major actions based on prioritised risks (Nasreen et al., 2014). After the recommencement of a joint CRA, the UDMC and WDMC took the initiative to repair roads, tube wells and embankments and tried to revive the livelihood of vulnerable groups. Participants also developed four schools and a transition school with the help of DIPICHO VII, which were also to be used as flood shelters during emergency situations. The participants in the CRA worked effectively with the members of the UDMC and WDMC to mitigate vulnerabilities. The key challenge of this process was that conservative mindsets of local people hindered the participation of women. However, in this case, the community-based approach has lessened their risks by creating and applying their own community-developed RRAP (Nasreen et al., 2014). By examining this case, we can argue that CBDM is a platform that interlinks multi-level stakeholders to generate a harmonious framework for DRR.

Table 1. Drivers, Strengths and Weakness of Community-based Disaster Management

Issues	Drivers	Strengths	Weakness
Networking (Berkes & Ross, 2012)	Networking creates social bonds within the community.	Community people are well understood in advance regarding their capacities and capabilities that are very helpful in facing disastrous situations.	Sometimes dilemmas have occurred by hiding information that disrupts the flow of networking.
C3-approach (collaboration, coordination and cooperation) (Nasreen, et al., 2014)	Consensus has been made through collaboration and coordination of the community.	Decisions are disseminated quickly and effective due to community consensus.	In some cases, community initiatives may experience problems due to the negligence of influential leaders.
Social cohesion (Azad & Khan, 2015)	Entities of the communities share norms and values and make themselves aware to ensure consideration of others before, during and after the disaster situation.	The community has strong degrees of solidarity that encourage them to build community cohesion.	Social cohesion breaks down sometimes due to incapability to meet their basic requirements.

(Table 1 Continued)

(Table 1 Continued)

Issues	Drivers	Strengths	Weakness
Collective community initiatives (Dynes, 1998; Wenger, 2000)	Collective initiatives create a common platform for addressing and mitigating disaster risk.	The quality of work is ensured by the collective efforts in community-based disaster management processes, such as embankment repairing, social forestry programmes, and building and repairing culverts and earthen roads.	Due to a lack of funding, the community members are unable to implement the structural initiatives.
Participation in CRA and RRAP processes (Nasreen et al., 2014)	People actively participate in identifying their risks and create their risk-reduction plan according to other community members' input, following a bottom-up approach.	The community members are engaged in developing an Inclusive Risk Reduction Action Plan (IRRAP) with the help of Government Organisations and NGOs.	Influential members of the community may interrupt the whole process and ignore the importance of vulnerable populations.
Indigenous knowledge (Berkes & Ross, 2012; Howell, 2003)	Indigenous knowledge helps society to fight against disasters.	The capacity of the community helps to prepare and respond to disasters.	In some cases, the community people cannot use their indigenous knowledge in reducing the risks of emerging hazards.
Volunteerism (Nasreen et al., 2014)	Humanity lies in volunteerism.	The volunteers are very committed to saving the local people's lives and properties.	Sometimes volunteers are unable to perform their duties and responsibilities due to lack of skills and shortage of modern equipment.

(Table 1 Continued)

(Table 1 Continued)

Issues	Drivers	Strengths	Weakness
Adaptability (Masing, 1999; Skertchly & Skertchly, 2001)	The community takes adaptive measures by using their experiences and lessons from past disasters.	By using adaptive measures, the community can avoid disaster risks competently.	Religious superstitious sometimes increase community vulnerability and make them distressed in taking adaptive measures that put them into a poverty trap.
Early warning dissemination (Choudhury et al., 2019)	People have a strong belief regarding the dissemination of early warnings.	The community is more aware of early warning and also is motivated to respond to reducing risks.	Some community people do not understand the indicators of signals regarding early warning.
Social security (Azad & Khan, 2015; Yodmani, 2001)	Local disaster management committees are very proactive to ensure the safety and security of vulnerable people. Women's participation is ensured in these committees to make an inclusive decision regarding the reduction of disaster risk.	People are working actively to protect themselves from social pathologies such as trafficking, bullying, sexual harassment and theft through the formation of social groups.	All people may not receive benefits equally.

Source: Developed by authors based on conceptual understanding of CBDM.

Note: The table indicates the salient thematic areas of CBDM along with its strengths and limitations.

Discussion

While the perspectives of structural and non-structural approaches to DRR provide key insights, we explicitly agree with CBDRR as it is a more 'comprehensive and holistic approach' (Birkmann, 2006). In addressing communities' vulnerability, this approach documents the dynamic process of susceptibility in delineating multiple dimensions of hazards (Birkmann, 2006; Blaikie, Cannon, Davis, & Wisner, 2005). Although there is a shift in the nature of responses and risk reduction, the community-based perspective has been key in the reduction of losses and damages from disasters across the developing

and developed world (Allen, 2006). Since the late 20th century, local governments in countries prone to unanticipated environmental shocks, especially Bangladesh (Choudhury et al., 2019), China (Zhang, Yi, & Zhao, 2013), Iran (Jahangiri et al., 2011), Malaysia (Zahari & Ariffin, 2013), Indonesia (Van Voorst, 2016) and Taiwan (Chen, Liu, & Chan, 2006) have been using community participation as a key tool for assessing and developing alternative plans for DRR. We have examined these arguments in the context of cyclones and floods in Bangladesh. Our study showed that CBDM has been a successful approach at the local governance level, especially when it includes: (a) inclusive community participation and partnership, (b) a strong partnership approach to building networks, (c) resource mobilisation and (d) monitoring and evaluation of DRR plans.

Inclusive participation—such as the participation of disabled persons, women, children and pregnant mothers—has been mainstreamed into the risk assessment process at the community as well as the local institutional level in coastal regions of Bangladesh. For example, the UPs and the UDMC applied a CRA tool to delineate the unanticipated risks and vulnerabilities of the susceptible communities. For this, UPs, in collaboration with local NGOs, have been organising planning meetings to engage all stakeholders in the risk assessment process. Participants from several groups highlight major problems and prioritise them based on different types of natural calamities, such as storm surges, floods and cyclones. The goal of this engagement is to prioritise risk-reduction actions through a participatory decision-making process. For example, this participatory decision-making process emphasises where bridges, roads and culverts have broken due to disasters and suggests necessary steps for managing funding and repair strategies. Community members, furthermore, organise a core committee to manage funds from different local and national organisations. This practice also provides an opportunity for community members to get training on understanding early warning signals prior to a disaster and how to respond during and after disasters. This process has been recognised by existing studies (e.g., Blaikie et al., 2005; Habiba, Shaw, & Abedin, 2013; Shaw et al., 2013) as a salient feature of the CBDM approach to building resilience to natural perturbations. For example, Blaikie et al. (2005) argue that community-based approaches elicit key strengths of community members—such as risk-based ideas and adaptation strategies to strengthen community resilience to frequent environmental pressures. In a similar vein, many others (e.g., Chen et al., 2006; Jahangiri et al., 2011; Zahari & Ariffin, 2013; Zhang et al., 2013) underline participatory approach as a stepping stone in designing policy, coordinating DRR mechanisms and in implementing the planned actions following the cycle of disaster management.

To make the approach more participatory, a strong network, both formal and informal, is required at the community level. We found that an informal network is more capable of dealing with natural calamities in cooperation with formal networks, such as linkages between the UPs and other government and non-government agencies. The key strengths of this informal network are: (a) flexibility to address emerging behaviour of vulnerable groups, (b) empowering vulnerable people to work with government and non-government organisations, (c) creating

partnerships in DRR measures and (d) helping to implement the government and non-government actions in an appropriate way. In cyclone-prone areas, such informal networks have also been working to disseminate early working messages quickly and strong partnerships have been playing a crucial role in engendering a sense of belonging among community members in coastal Bangladesh (Choudhury et al., 2019; Rashid, 2013). Although weak coordination is identified by numerous authors (e.g., Choudhury et al., 2019; Pranesh, Palanichamy, Saidat, & Peter, 2017), our study suggests that this informal network can work as a bridge between community members and other officials, especially higher-level government officials. Similarly, Zahari and Ariffin (2013) found that local networks had been foundational in designing evacuation plans and temporary shelter homes in Malaysia. This clearly suggests that 'communities of practice' (Wenger, 2000, p. 229) are key factors in the process of CBDM. In this context, Wenger (2000) identifies three key aspects of 'communities of practice': (a) collective understanding that connects community members together and develops a sense of joint enterprise, (b) mutuality that becomes a key to developing harmonious engagement in partnership and (c) developing group norms for the usage of community resources. Our findings revealed that these principles have been playing a revolutionary role in designing a CBDM model at the community level in coastal regions of Bangladesh.

Resource mobilisation is also identified as a significant issue for CBDM in Bangladesh. Community members play a pioneering role in mobilising resources in the face of an emergency. In such cases, and especially during and in the aftermath of a cyclone, local stakeholders can initiate response and recovery activities because of mutual engagement and existing partnerships. Indeed, co-financing and sharing responsibility for disaster recovery activities can reduce the burden on local government agencies and support the rapid commencement of disaster management functions. The success of disaster management depends significantly upon local-level agencies rather than on government and non-government organisations (Jahangiri et al., 2011). While co-financing and sharing responsibility strengthen the continuum of disaster management, malpractices—for example corruption, political nepotism in relief distributions and overlooking the priority of vulnerable groups—diminish the strength of communities and community members. This argument is also supported by other studies (e.g., Choudhury & Haque, 2016; Choudhury et al., 2019; Mahmud & Prowse, 2012).

Our critical evaluation also suggests that a participatory approach develops a culture of monitoring and evaluation that helps community-based and local-level organisations and community members to generate a risk-based framework for action. This framework has been employed in rebuilding communities' capacity to mitigate disaster risks and vulnerabilities by utilising active participation and the risk-informed knowledge of community members. While this framework is key to implementing the planned risk-reduction actions, key pitfalls—such as the lack of funding, the scarcity of appropriate technology and the lack of integration between scientific and lay knowledge—have limited the success of CBDM systems in Bangladesh. Despite these limitations, the community-based approach can be an effective tool for DRR if the best lessons community members have

learned from experiencing environmental shocks can be documented in an appropriate way.

Conclusion

Our critical evaluation finds that the CBDM approach has been a key part of the policy transition of disaster management from a top-down process to a community-centred, need-based approach since the late 20th century (Chen et al., 2006) in many countries, including developed and developing nations such as Australia, New Zealand, Iran, China, Indonesia and Bangladesh. Due to global climate change, this approach has been used widely with a focus on building bridges between community members and key stakeholders in DRR processes, as proactiveness among community members builds a platform to generate new ideas for dealing with natural calamities (Haque & Uddin, 2013; Khan & Rahman, 2007). Findings of our study also suggest that adaptation practices can only be successful if they integrate community-based adaptation mechanisms into the process, especially into structural measures taken by the government and non-government organisations. O'Brien and O'Keefe (2014) noted that community members are frontline actors in the disaster management process; their active engagement in adaptation measures creates a sense of ownership and helps to underline the root causes of communities' vulnerability (Blaikie et al., 1994). The dynamic nature of this approach is a key strength to build a sense of ownership among community members based on experience with and learning from natural disasters.

Recognising the importance of learning at the community level, multiple stakeholders in Bangladesh have been designing their risk-reduction actions following the best practices used by community members. For example, after two consecutive catastrophic cyclonic storms in 2007 and 2009, government organisations, including community-based organisations and local NGOs, began incorporating risk-based actions in the context of global frameworks, for example, the Sendai Framework for Disaster Risk Reduction and the Paris Agreement. To encourage active participation and develop effective governance, the government has developed various committees at the lower tier of local governance using a partnership approach, in which community members are key agents in developing a RRAP. The country has also implemented CBDM under various laws and regulations, such as the SOD (2019) and the Disaster Management Act, 2012. These rules and regulations provide guidelines for local-level institutions regarding how to ensure local participation in implementing disaster management activities. Results from this study and other similar research suggest that the active involvement of community members enables local-level institutions to identify the underlying reasons behind communities' vulnerabilities. In this participatory process, people can ensure the necessary flexibility and utilise their capabilities to propose locally appropriate actions for risk reduction.

Our study also finds that a community-based, participatory approach in DRR also builds strong networks in community settings. Therefore, the formal

participation of vulnerable people in a wider network of CBDM can promote resource mobilisation. Such networks also establish an actionable risk communication process to gain knowledge and ideas from community members who have learned from disaster experiences. Sharing this knowledge and ideas help local government agencies to introduce locally appropriate, need-based actions for the reduction of unanticipated risks. Overall, our study suggests that for the long-term sustainability of DRR mechanisms, community members should be actively engaged in DRR measures from the very beginning of any initiatives.

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Article

A Baseline Survey on Postharvest Handling of Selected Vegetables at Different Locations of Bangladesh

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Abstract

Proper postharvest processing and handling are important parts of modern agricultural production. The adoption of improved postharvest practices can reduce a substantial amount of food losses, improve overall food quality and safety, enhance consumers' acceptance, and thus add to the value of the marketable products. A baseline survey was conducted on vegetable production, sorting, washing and packaging at four vegetable growing districts such as Narsingdi District, Bogra, Jashore District and Pabna to generate some baseline indicators which will help developing a mechanical device for vegetable washing. Two upazilas from each district were purposively selected based on the existence of primary and secondary vegetable markets. Primary data were collected from randomly selected 71 farmers, 30 Beparis/Paikers and 20 retailers. The study revealed that vegetable washing is generally practiced by farmers and Paikers and it varied from location to location. Sorting and grading of vegetables were done by either farmers or Beparis/Paikers. In all locations, red amaranth and root crops (carrot and radish) were washed by farmers to get a better price. Farmers and traders used bamboo basket, plastic crate, plastic bag and jute sack for packaging of selected vegetables. Washing and grading of vegetables was a profitable activity for the farmers.

Keywords

Vegetable, sorting, washing, packaging

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Introduction

Proper postharvest processing and handling are important parts of modern agricultural production. Postharvest processes include the integrated functions of harvesting, cleaning, grading, cooling, packaging, storing, transporting and marketing. The adoption of improved postharvest practices can reduce a substantial amount of food losses, improve overall food quality and safety, enhance consumers' acceptance, and thus add to the value of the marketable products. Various chemicals are widely used to reduce the incidence of postharvest pest and diseases. Although it is effective, this method is discouraged or even discarded in recent years due to economic, environment and health concerns. The longer shelf life and less postharvest infestation of vegetables are needed to export and store for marketing in the supermarket at different distant places.

A remarkable loss of horticultural crops occurs after harvest due to improper handling. Even in a developed country, like the USA, postharvest losses are significant and go up to 20 per cent (Yahia & Ait-Oubahou, 2001, p. 1). These losses not only comprise the nutrition losses but also the loss of land, energy (fuel and machinery), fertilisers, chemical, irrigation water and labour. The increase in yield and productivity is lagging significantly behind the increase in world population and the nutritional food need for the world. Therefore, reduction in postharvest losses should be considered as a strategic requirement all over the world, especially in developing countries. The increase in yield without reducing postharvest losses, will not be sufficient in securing the availability of food in the world. Reduction of postharvest loss makes food availability, enhances trade and distribution, lowers the price for the consumers and increases the farmers' income.

Postharvest losses of fruits and vegetables in Bangladesh were 25–50 per cent and 25–40 per cent (Amiruzzaman, 1990, p. 2; Miaruddin & Shahjahan, 2008, p. 3), respectively. About 10–50 per cent of these fruits are lost during handling and transportation especially due to lack of proper packaging (Bala, 2000, p. 4). Postharvest losses of important fruits and vegetables at different levels (growers, traders, wholesalers and retailers) were ranged from 23.6 per cent to 43.5 per cent (Hassan, Chowdhury, & Akhter, 2010, p. 5).

Vegetables are perishable crops. In Bangladesh, after harvesting, vegetables are generally transported in the market without sorting, grading and washing. There are many microorganisms and dust on the surface of the vegetables. The products are infected by microorganisms easily. Unhygienic products are sold in the markets. Some traders wash products with impure water of local ponds/canals. These washed products are harmful to human health that causes different diseases. Besides, a huge quantity and quality of products are lost. Sanitation is a great concern to produce handlers, not only to protect the produce against postharvest diseases but also to protect the consumers' food-borne illnesses. Escherichia coli O157:H7, salmonella, cryptosporidium, hepatitis and Cyclospora are among the disease-causing organisms that have been transferred via fresh fruits and vegetables (Burditt, 1982, p. 6; Mitcham, Zhou, & Kader, 1997, p. 7). Washing is a standard postharvest handling operation for many fruits and vegetables to remove adherences, dirt, latex and external pathogenic structures. Unfortunately,

in Bangladesh, fruits and vegetables are hardly washed before entering into the marketing channel, and this contributes to poor quality and considerable losses of the produce. A little works on sorting, washing and packaging of fresh vegetables are done in Bangladesh. To develop a mechanical vegetable washing machine, such information is lacking. For this purpose, the study was conducted to explore the current status of sorting, washing and packaging of vegetables to reduce postharvest losses and marketing hygienic products using the mechanical washing machine in a commercial scale.

Objectives of the Study

a) To describe a brief profile of vegetable farmers and Beparis/Paikers.
b) To identify the status of sorting, washing and packaging of selected vegetables.
c) To estimate the profitability of washing and grading of vegetables.

Materials and Methods

This study was conducted in the selected vegetable growing areas of Bangladesh during the year of 2015.

Site Selection

Four vegetable growing districts such as Narsingdi District, Bogra, Jashore District and one major carrot growing area as Pabna were purposively selected to collect baseline data and information on vegetable production and washing. Two upazilas from each district were selected with the consultation of vegetable scientists of Bangladesh Agricultural Research Institute (BARI). The selected areas are listed in Table 1.

A total of 121 respondents including 71 vegetable farmers, 30 Paikers and 20 retailers were randomly selected for interviewing to gather primary data and information. Primary and secondary markets were taken into consideration.

Table 1. Selected Study Areas for Primary Data Collection

District	Upazila
Jashore	Jashore Sadar and Bagharpara
Bogra	Bogra Sadar and Shibganj
Narshingdi	Raipura and Shibpur
Pabna	Ishurdi

Source: The authors.

Data Collection

Survey questionnaire was developed by incorporating indicators for fulfilling the study objectives. The draft questionnaire was modified with the help of Agricultural Economics Division, BARI, through pre-testing in the project area at Palpara bazar and Bramandi village in Shibpur upazila under Narsingdi district on 25 December 2014. Trained enumerators and scientists of the project collected primary data from selected farmers and traders using structured questionnaire through personal interview. Secondary data were also collected from journal papers, reports and internet.

Results and Discussion

A Brief Profile of the Respondents

Farmer

The average age of the respondent vegetable farmers was estimated at 43.3 years which was ranged from 21 to 60 years. Majority of the farmers were illiterate (30.19%) followed by primary (28%) and secondary (23.63%) levels of education. Average cultivated land of farmers was found to be 0.99 ha and the length of experience on vegetable farming was 21.25 years which was ranged from 4 to 40 years. Among the farmers, the highest cultivation landowners were found in Ishwardi, Pabna (1.66 ha), and the lowest in Narsingdi District. It is observed that negligible numbers of farmers got training on postharvest handling technology of vegetable washing and sorting (Table 2).

Table 2. Brief Profile of the Sample Vegetables Farmers in the Study Areas

Sl No.	Profile	Narshingdi	Ishurdi	Bogra	Jashore	All Area
1	Age (year)	42.0	43.0	47.5	40.5	43.3
2	Level of education (%)	32.5	37.5	33.75	21.0	30.19
	Illiterate	42.0	25.0	32.00	13.0	28.00
	Primary	15.5	25.0	24.00	30.0	23.63
	Secondary	5.0	–	10.25	27.0	10.56
	Higher secondary	5.0	12.5	–	9.0	6.63
	Degree and above					
3	Vegetable cultivated land (ha)	0.45	1.66	1.18	0.67	0.99
4	Experience on vegetable cultivation (year)	21.0	21.0	26.00	17.0	21.25
5	Training on washing and sorting (%)	–	1.0	–	–	0.25

Source: The authors.

Vegetable Traders

The average age of the vegetable Beparis/Paikers of the study areas was at about 40 years. Majority of the traders were illiterate (42.83%) followed by primary level education (36.58%). Average experience of vegetable traders was 18.33 years which was ranged from 14 to 23 years. It observed that none of them got training on postharvest technology of vegetable washing and sorting (Table 3).

The average age of the respondent retailers in the study areas was 42 years which was ranged from 40 to 44 years. Majority of the retailers were educated at primary level (41.75%) followed by illiterate (33.25%). Average experience on vegetable traders was 12.75 years which was ranged from 9 to 16.5 years. It observed that none of them got training on postharvest technology of vegetable washing and sorting (Table 4).

Table 3. Brief Profile of the Respondent Vegetable Beparis/Paikers in the Study Areas

Sl No.	Profile	Narshingdi	Bogra	Jashore	All Area
1	Age (year)	45.5	38.5	35.0	39.67
2	Level of education (%)	43.5	47.50	37.5	42.83
	Illiterate	46.5	25.75	37.5	36.58
	Primary	10.0	13.0	12.5	11.83
	Secondary	–	13.75	12.5	8.75
	Higher secondary				
3	Experience on vegetable business (year)	23.0	18.0	14.0	18.33
4	Training on washing and sorting (%)	–	–	–	–

Source: The authors.

Table 4. Brief Profile of the Respondent Vegetables Retailers in the Study Areas

Sl No.	Profile	Narshingdi	Bogra	All Area
1	Age (year)	44.0	40.0	42.0
2	Level of education (%)			
	Illiterate	41.5	25.0	33.25
	Primary	46.0	37.5	41.75
	Secondary	12.5	37.5	25.0
3	Experience on vegetable business (year)	16.5	9.0	12.75
4	Training on washing and sorting (%)	–	–	–

Source: The authors.

Status of Vegetables Washing in the Study Areas

A questionnaire survey was conducted in different locations to explore the current status of sorting, washing and packaging done for different vegetables at farmers and traders level in order to generate some baseline indicators and the economics behind it. The baseline indicators were later used to fabricate mechanical device for washing vegetables. However, the status of vegetable washing at farmers' and traders' level in different locations is briefly discussed below.

Narsingdi District

The respondent farmers of Shibpur upazila mentioned that they did not wash country bean with freshwater after harvesting, but wholesalers washed country beans after buying from farmers for maintaining freshness and to minimise weight loss during transportation (Figure 1). They washed radish, carrot, red amaranth and Indian spinach with pond water or supply water for cleaning dust and soil. Without washing, consumer and traders do not want to purchase the vegetables. Cauliflower farmers said that they did not wash cauliflower with water (Figure 2). Again, some wholesalers who export the beans do not wash the beans. Retailers used to spray freshwater over the vegetables for maintaining freshness and minimising weight loss (Figure 3).

The respondent traders of Raipura upazila mentioned that they did not wash brinjal with water. They also explained that brinjals were damaged when washed with freshwater (Figures 4 and 5). Farmers used to wash red amaranth, Indian spinach and stem amaranth with pond water or supply water for removing soil and dust. Farmers cannot sell them if they are not washed.

Bogra District

The farmers of Shibganj upazila sorted cucumber without washing with water and packing in a plastic crate for transportation (Figure 6). Some wholesalers were sorting and washing cucumber (*khira*) with freshwater and packed in jute bags for transportation (Figure 7). Wholesalers were sorting, grading and drying radish without washing with water and packed into the plastic bags (Figure 8).

Data were collected from vegetable farmers, wholesalers and retailer in Raja Bazar at Bogura Sadar. Farmers used to wash radish, stem amaranth, carrot and brinjal for cleaning mud from the surface of the vegetables. Retailers' used to spray water over the brinjal, red, stem amaranth and carrot for maintaining freshness.

Pabna District

Farmers said that they washed carrot with freshwater after harvesting for selling local market (Figure 9). A famous carrot grower stated that they generally packed harvested fresh carrots in jute bag and stored in commercial cold storage for 6-8 months without washing. On the other hand, carrots were washed with freshwater manually for selling in the local market (Figure 10). Farmers harvested radish by means of hand tool in the rainy season and manually washed with freshwater (Figure 11).

Jashore District

Wholesalers generally sort and wash brinjals with supply water before packing them in jute bags for transportation. They said that during unloading brinjal, no weight loss occurred and freshness was maintained (Figure 12). In Figure 13, an enumerator was taking information on vegetable washing status from the farmers.

Bagarpar

Bagarpar upazila of Jashore District is one of the vegetable growing areas. Information on vegetable processing was collected from farmers and retailers. Farmers washed stem amaranth, red amaranth and Indian spinach with supply water (Figures 14–16).

Figure 1. Washing Bean with Fresh Water in Palpara Bazaar, Shibpur, Narsingdi

Source: The authors.

Figure 2. Farmers' Cauliflower Field at Bramandi Village, Shibpur, Narshingdi

Source: The authors.

Figure 3. Collecting Information from Vegetable Retailer

Source: The authors.

Figure 4. Jashore Wholesale Market in Raipura, Narsingdi

Source: The authors.

Figure 5. Jashore Retail Market in Raipura, Narsingdi

Source: The authors.

Figure 6. Sorting of Cucumber in Mohasthan Bazar, Shibganj, Bogra
Source: The authors.

Figure 7. Sorting and Washing of Cucumber (Khira) in Mohasthan Bazaar, Shibganj, Bogra
Source: The authors.

Figure 8. Sorting, Grading and Drying of Radish at Mohasthan Bazaar, Shibganj, Bogra
Source: The authors.

Figure 9. Collecting Information from Progressive Farmer in Shahapur, Ishardi
Source: The authors.

Figure 10. Carrot Washing Manually in Silimpur, Ishardi
Source: The authors.

Figure 11. Radish Washing Manually in Silimpur, Ishardi
Source: The authors.

Figure 12. Sorting and Washing of Brinjal and Packed in Jute Bag by Traders in Jashore Sadar
Source: The authors.

Figure 13. Collecting Information from Farmers in Churamankhati, Jashoresadar
Source: The authors.

Figure 14. Farmer Washing Stem Amaranth with Supply Water Bagharpara, Jashore
Source: The authors.

Figure 15. Taking Information from Farmer About Vegetable Sorting, Washing and Packing in Bagarpara, Jashore

Source: The authors.

Figure 16. Collecting Information from Farmer in Bagarpara, Jashore

Source: The authors.

Sorting, Washing and Packaging of Vegetable by Farmers

Jashore District

The sampled farmers of Jashore District did not cultivate carrots but cultivated other vegetables such as red amaranth, brinjal, bitter gourd and stem amaranth. They harvested red amaranth and brinjal by hand. It is observed that harvesting losses of red amaranth and brinjal were 0 per cent and 5 per cent, respectively. Farmers washed red amaranth with canal and tap water but did not wash brinjal. The washing loss of red amaranth was nil and washing vegetable fetched higher price ranged from Tk 1.0 to Tk 2.0 per kg. They sorted red amaranth and brinjal by hand and packed in bamboo basket and jute bag. Sorting losses ranged from Tk.5.0 to Tk. 8.0 and packing costs ranged from Tk 0.20 to Tk 0.26 per kg of studied vegetables.

Bogra District

The sampled farmers of Bogra cultivated carrots, red amaranth and brinjal. They harvested red amaranth and brinjal by hand and carrot was harvested by hand tool. It is observed that harvesting losses of carrot, red amaranth and brinjal were 6 per cent, 0 per cent and 26 per cent, respectively. Farmers washed carrot, red amaranth and brinjal with canal, river and tube well water. Washing losses of carrot, red amaranth and brinjal were 8 per cent, 13 per cent and 10 per cent and washing vegetable fetched higher price ranged from Tk 1 to Tk 2 per kg. They sorted carrot, red amaranth and brinjal by hand and packed in plastic bag, bamboo basket and jute bag. Sorting loss of them were 9 per cent, 9 per cent and 12 per cent, and their packaging costs were Tk 0.40, Tk 0.30 and Tk 0.13–0.26 per kg, respectively (Table 6).

Table 5. Sorting, Washing and Packaging of Vegetables by Farmers in Jashore District

		Name of Vegetables	
Sl No.	**Particulars**	**Red Amaranth**	**Brinjal**
1.	Vegetable cultivated land (ha)	0.32	1.5
2.	Production (t/ha)	11.55	24.7
3.	Market price (Tk/t)	21,000–10,000	600–2,000
4.	Harvesting technique		
	Manually	Hand	Hand
	Mechanically	–	–
5.	Harvesting loss (%)	0	5
6.	Sources of washing water		No wash
	Drain/canal water	√	–
	Tap water	√	–
7.	Washing loss (%)	–	–
8.	Washing time (min/40 kg)	30	–
9.	Excess price due to washing (Tk/kg)	1–2	–
10.	Sorting method		
	Manually	Hand	hand
	Mechanically	–	–
11.	Sorting loss (%)	5	8
12.	Sorting time (min/40kg)	20–25	30–40
13.	Package type	Bamboo basket	Bamboo basket, Jute sack
14.	Packaging cost (Tk/kg)	0.20	0.13–0.26

Source: The authors.

Table 6. Sorting, Washing and Packaging Activities of Vegetable in Shibganj, Bogra

		Vegetable Type		
Sl No.	**Washing and Sorting Parameters**	**Carrot**	**Red Amaranth**	**Brinjal**
1	Vegetable cultivated land (ha)	0.1	0.04	0.1
2	Production (t/ha)	38	38.53	37
3	Market price (Tk/t)	32,000–10,000	25,000–12,000	13,000–8,000
4	Harvesting technique			
	Manually		Hand	Hand
	Mechanically	Hand tool		
5	Harvesting loss (%)	6	0	26
6	Sources of washing water			
	Drain/canal water	√	√	√
	River water	–	–	√
	Tube well water	–	–	√
7	Washing loss (%)	8	13	10
8	Washing time (min/40 kg)	45	30–40	30–45
9	Excess price due to washing (Tk/kg)	2–3	1–2	1–2
10	Sorting method			
	Manually	Hand	Hand	Hand
	Mechanically	–	–	–
11	Sorting loss (%)	9	9	12
12	Sorting time (min/40kg)	30	20–30	20–30
13	Package type	Plastic bag, bamboo basket	Bamboo basket	Bamboo basket, plastic bag
14	Packaging cost (Tk/kg)	0.40	0.30	0.13–0.26

Source: The authors.

Pabna District

The sampled farmers of Pabna cultivated carrots. They harvested carrot by hand tool. It is observed that harvesting losses of carrot was 4.48 per cent. Farmers washed carrot by using legs of labour with supply water reserved in polyethylene-lined ditch. Washing losses of carrot was 4.48 per cent and washing vegetable fetched higher price ranged from Tk 1 to Tk 2 per kg. They sorted carrot by hand and packed in plastic bag and jute bag. Sorting loss of it was 8 per cent and packaging cost was Tk 0.82 per kg (Table 7).

Table 7. Sorting, Washing and Packaging Activities of Vegetable in Ishurdi, Pabna Farmers

Sl No.	Washing and Sorting Parameters	Vegetable Type	
		Carrot	Radish
1	Vegetable cultivated land (ha)	0.6	0.57
2	Production (t/ha)	46.45	50
3	Market price (Tk/t)	32,000–16,000	15,000–20,000
4	Harvesting technique		
	Manually	–	Hand
	Mechanically	Hand tool	
5	Harvesting loss (%)	7.73	0.00
6	Sources of washing water,	Supply water by leg	Supply water
	Tap water	√	√
	River water	√	√
	Tube well water	√	√
7	Washing loss (%)	4.48	5
8	Washing time (min/40 kg)	30–45	30–40
9	Excess price due to washing (Tk/kg)	1–2	1–1.5
10	Sorting method		
	Manually	√	√
	Mechanically	–	–
11	Sorting loss (%)	0	0
12	Sorting time (min/40 kg)	5–10	5–10
13	Package type	Plastic bag, jute Sack	Plastic bag,
14	Packaging cost (Tk/kg)	1	1

Source: The authors.

Sorting, Washing and Packaging of Vegetable by Traders

Jashore District

Carrots were washed by 20 per cent traders and they did not wash red amaranth. Brinjals were washed manually by supply water by 40 per cent traders. Washing losses of carrot and brinjal were 0 per cent and 2 per cent, respectively. Washing vegetable fetches higher price ranged from Tk 1 to Tk 2 per kg. About 20 per cent of traders sorted carrot and brinjal by hand and packed in plastic bag, and jute bag. Sorting loss of them 2 per cent and 5 per cent, respectively, and packaging costs of carrot, red amaranth and brinjal were Tk 0.80, Tk 66 and Tk 0.06–0.80 per kg, respectively (Table 8).

Table 8. Sorting, Washing and Packaging of Vegetable by Paiker in Jashore District

Sl No.	Washing and Sorting Parameters	Vegetable Type		
		Carrot	Red Amaranth	Brinjal
	Washing done by paiker (%)			
	Yes	20	0	40
	No	80	100	60
1	Sources of washing water			
	Drain/canal water	√		
	Tube well water	√	–	√
2	Washing loss (%)	0	–	2
3	Washing time (min/40 kg)	30–45	–	20–30
4	Excess price due to washing (Tk/kg)	1–2	–	1–1.5
	Sorting done (%)			
	Yes	20	0	20
	No	80	100	80
5	Sorting method			
	Manually	Hand	–	Hand
	Mechanically			
6	Sorting loss (%)	2	–	5
7	Sorting time (min/40kg)	20–30	–	10–15
8	Package type	Jute sack	Bamboo basket	Plastic bag, jute sack
9	Packaging cost (Tk/kg)	0.80	0.66	0.06–0.8

Source: The authors.

Bogra District

50 per cent traders washed carrot, 57 per cent traders washed red amaranth and 43 per cent traders washed brinjal manually by supply water. Washing losses of carrot, red amaranth and brinjal were 5 per cent, 5.33 per cent and 2 per cent, respectively. Washing vegetable fetches higher price ranged from Tk 1 to Tk 2 per kg. About 50 per cent of traders sorted carrot and 1 per cent traders sorted red amaranth and 43 per cent traders sorted brinjal by hand and packed in plastic bag, and jute bag. Sorting losses of them 8, 5.33 and 5 per cent respectively and packaging costs of carrot, red amaranth and brinjal were Tk 0.75, Tk 66 and Tk 0.06–0.80 per kg, respectively (Table 9).

Table 9. Sorting, Washing and Packaging of Vegetable by Paiker in Shibganj, Bogra

Sl No.	Washing and Sorting Parameters	Vegetable Type		
		Carrot	Red Amaranth	Brinjal
	Washing Done by Paiker (%)			
	Yes	50	57	43
	No	50	43	57
1	Sources of washing water			
	Drain/canal water	√		√
	River water	√	√	
	Tube well water	√	√	√
2	Washing loss (%)	5	5.33	2
3	Washing time (min/40 kg)	30–45	15–20	10–15
4	Excess price due to washing (Tk/kg)	2–3	1–1.5	1–1.5
	Sorting done (%)			
	Yes	50	1	43
	No	50	86	57
5	Sorting method			
	Manually	Hand	Hand	Hand
	Mechanically			
6	Sorting loss (%)	8	5.33	5
7	Sorting time (min/40kg)	20–30	10–15	10–15
8	Package type	Plastic bag, plastic crate, jute sack	Bamboo basket	Plastic bag, plastic crate, jute sack
9	Packaging cost (Tk/kg)	0.75	0.66	0.06

Source: The authors.

Narsingdi District

Farmers and traders of Narsingdi District did not sort, wash and packaging of carrots. Farmers did not sort red amaranth but 22 per cent farmers washed it by hand and packed into bamboo basket. Twenty-two farmers sorted and washed brinjal and packed into jut bag, and bamboo basket. A total of 33 per cent traders sorted and washed red amaranth and packed into plastic bag, and jute bag. A total of 66 per cent traders sorted brinjal by hand and 28.5 per cent traders washed it by hand and packed them into plastic bag, and jute bag (Table 10).

Table 10. Sorting, Washing and Packaging Status of Vegetables in Narshingdi, Bogra, Jashore and Pabna Districts

Parameters	Narshingdi		Bogra		Jashore		Pabna	
	Farmers	Traders	Farmers	Traders	Farmers	Traders	Farmers	Traders
Sorting Manually								
Carrot (%)	–	–	100	50	0	20	50	–
Red amaranth (%)	0	33	100	1	66	0	–	–
Brinjal (%)	22	66	100	43	100	20	–	–
Washing Manually								
Carrot (%)	–	–	87.5	50	0	20	87	–
Red amaranth (%)	22	33	87.5	57	100	0	–	–
Brinjal (%)	22	28.5	87.5	43	0	40	–	–
Packaging							–	–
Carrot	–	–	Plastic bag, bamboo basket	Plastic bag, plastic crate, jute sack	No produce	Jute sack	Plastic bag, jute sack	–
Red amaranth	Bamboo basket	Bamboo basket	Bamboo basket	Bamboo basket	Bamboo basket	Bamboo basket		
Brinjal	Jute bag, bamboo basket	Plastic bag, jute bag,	Bamboo basket, plastic bag	Plastic bag, plastic crate, jute sack	Bamboo basket	Plastic bag, jute sack	–	–

Source: The authors.

Bogra District

A total of 100 per cent farmers sorted carrots, red amaranth and brinjal by hand and 87.5 per cent farmers washed them and packed into bamboo basket and plastic bag. A total of 50 per cent traders sorted and washed carrots by hand and packed them into plastic bag and plastic crate. A total of 1 per cent traders sorted red amaranth and 57 per cent traders washed it by hand and packed into Bamboo basket. A total of 43 per cent traders sorted and washed brinjal by hand and packed into jute bag (Table 10).

Jashore District

The farmers did not sort and washed carrots. A total of 66 per cent farmers sorted red amaranth and 100 per cent farmers washed it and packed into bamboo basket. A total of 100 per cent farmers sorted brinjal and none washed it. A total of 20 per cent traders sorted and washed carrot by hand and packed into plastic bag. Any traders did not sort and washed red amaranth. A total of 20 per cent traders sorted and 40 per cent washed brinjal and packed into jute bag and plastic bag (Table 10).

Pabna District

A total of 50 per cent farmers sorted and 87 per cent farmers washed carrots by hand and packed them into plastic bag and jute bag (Table 10).

Table 11. Economic Analysis of Washing and Grading of Country Bean at Traders' Level

Sl No.	Particulars	Quantity (kg)	Unit Price (Tk/kg)	Total Cost (Tk)
	Cost			
1	Country bean (non-graded)	1,000	10	10,000
2	Cost of washing and cleaning	1,000		150
3	Cost of grading	1,000		150
4	Quantity loss	10	10	100
5	Cost of water container			100
6	**Total cost**			**10,500**
	Return			
7	Non-graded bean	1,000	13	13,000
8	Graded bean (Grade 1)	900	15	13,500
9	Graded bean (Grade 2)	90	12	1,080
	Profit			
10	Net profit (non-graded) (8–1)	1,000		3,000
11	Net profit (graded) (9+10–6)	990		4,080
12	Value addition			1,080

Source: The authors.

Financial Benefit of Washing and Grading of Vegetables

An attempt was made to estimate the financial benefit of washing and grading/sorting of country bean at different types of traders. The study revealed that the total cost of washing and grading of country bean was Tk 500 per tonne which included the cost of washing, grading, loss of vegetables and water container. The net profit of grading and washing country bean was found to be Tk 4,080 per ton and for non-graded country bean, it was estimated at Tk 3,000 per ton. Finally, the total value addition per ton was Tk 1,080 (Table 11).

Another attempt was made to estimate the financial benefit of washing and grading/sorting of carrot at different types of traders. The analysis revealed that the total cost of washing and grading of carrot was Tk 3,400 per ton which included the cost of washing, grading, loss of carrot and water container. The estimated net profit of grading and washing of carrot was Tk 4,600 per ton and it was Tk 2,000 per ton for non-graded carrot. The estimated total value addition was Tk 2,600 per ton (Table 12).

The study revealed that the total cost of washing and grading of radish was Tk 2,875 per ton which included the cost of washing, grading, loss of vegetables and water container. The net profit of grading and washing of radish was found to be Tk 3,825 per ton for graded radish and for non-graded radish, it was estimated at Tk 1,000 per ton. Finally, the total value addition per ton was Tk 2,825 (Table 13).

Table 12. Economic Analysis of Washing and Grading Carrot at Traders' Level

Sl No.	Particulars	Quantity (kg)	Unit Price (Tk/kg)	Total Cost (Tk)
	Cost			
1	Carrot (non-graded)	1,000	20	20,000
2	Cost of washing	1,000		900
3	Cost of grading	1,000		500
4	Quantity loss	50	20	1,000
5	Cost of water container			1,000
6	**Total cost**			**23,400**
	Return			
7	Non-graded carrot	1,000	22	22,000
8	Graded carrot (Grade 1)	850	30	25,500
9	Graded carrot (Grade 2)	100	25	2,500
	Profit			
10	Net profit (non-graded) (8–1)	1,000		2,000
11	Net profit (graded) (9+10–6)	950		4,600
12	Value addition			**2,600**

Source: The authors.

Table 13. Economic Analysis of Washing and Grading Radish at Traders' Level

Sl No.	Particulars	Quantity (kg)	Unit Price (Tk/kg)	Total Cost (Tk)
	Cost			
1	Carrot (non-graded)	1,000	15	15,000
2	Cost of washing	1,000	1	1,000
3	Cost of grading	1,000	0.50	500
4	Quantity loss	25	15	375
5	Cost of water container			1,000
6	**Total cost**			**17,875**
	Return			
7	Non-graded carrot	1,000	16	16,000
8	Graded carrot (Grade 1)	900	23	20,700
9	Graded carrot (Grade 2)	50	20	1,000
	Profit			
10	Net profit (non-graded) (8–1)	1,000		1,000
11	Net profit (graded) (9+10–6)	950		3,825
12	Value addition			**2,825**

Source: The authors.

Conclusion

A baseline study was conducted to explore the current status of sorting, washing and packaging done for different vegetables at the farmers' and traders' level in order to generate some indicators and the economics behind it. These indicators are later used to design a mechanical device for washing vegetables. The study reveals that in all locations, red amaranth and root crops (carrots and radish) are manually washed with freshwater by farmers and traders to get a better price. Farmers and traders used bamboo basket, plastic crate, plastic bag and jute sack for packaging of vegetables. In financial point of view, washing and grading are a profitable activity to the traders.

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Article

Challenges Faced by Entrepreneurial Fishermen Communities in Bangladesh: Realities from the Ground

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Abstract

In Bangladesh, there are more than 30 indigenous fishing communities who depend on fishing as their chief sources of livelihood. In the past, they faced no problems for accessing the open water bodies. During the last few decades, due to siltation of rivers, wetlands, involvement of non-indigenous fishermen in fishing, lack of appropriate entrepreneurship development policies, indigenous fishermen are shifting their traditional occupations at an alarming rate and facing a very measurable economic condition. Based on sample surveys (250 respondents), focus group discussion and case studies among the five fishermen communities, this article has been prepared.

Keywords

Extreme poverty, indigenous fishermen, livelihoods, water bodies

Introduction

Bangladesh emerged as the fifth largest aquaculture producing country with its estimated aquaculture production of 2,203,554 mt in 2015–2016 (DOF, 2017). The people normally associated to earn their bread depending upon catching fish are called the fisherman (locally *jailla*/*jele* in Bangladesh. They are one of the most vulnerable and poor communities in Bangladesh due to having the income below the marginal line (Alam & Bashar, 1995; Kabir, Adhikary, Hossain, &

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Minar, 2012). For the development of an economically backward sector, information about the fisherman of a particular region is necessary and vital (Ofuoku, Emah, & Itedjere, 2008). But sustainable livelihood has the ability to cope with and recover from stress and shocks by assessing present and future assets but not undermining the natural resource base. Not only the natural resources but also river resources are essential to meet up the challenge of life as the fisherman solely depends upon river resources (Khan et al., 2013).

Bangladesh is situated in the delta of the Brahmaputra, Meghna River and Ganges rivers. The total land area of Bangladesh is 147,570 sq. km and out of it, 4,714,449 hectares is covered with water bodies in the form of ponds, natural depressions (*haors* and *beels*), lakes, canals, rivers and estuaries (DOF, 2017). And from time immemorial, a large number of freshwater-based Bengali indigenous fishermen have depended for their livelihood on fishing and related activities. The approximate number of these indigenous fishermen is 146.97 lakhs (DOF, 2017). Indigenous fishermen in rural Bangladesh usually live a community life in neighbourhoods or villages around the water bodies. They cooperate closely with one another not only in fishing, or in the cooperative utilisation of fishing grounds, but also in economic activities, such as marketing and purchasing, and social life and family affairs. They have lived communally for many generations, creating in the process of their own history, distinct traditions and patterns of daily life. Consequently, this type of indigenous fishermen communities have gained a lot of indigenous knowledge.

> Indigenous knowledge means the functional knowledge of local people inhabiting in a particular ethno cultural and agro ecological condition. It develops through experience sharing and normally passes on through generations by oral expressions and it operates in all aspects of community life and persists there in as unwritten forms. (Khan & Sen, 2000, p. 35)

Traditionally, indigenous fishermen have been Hindus. For Hindus, fishing is generally hereditary and has a traditional link with the caste system. Hindu fishermen believe their occupation to be sacred, although in the cast hierarchy, the fishermen are ranked the lowest of all occupational groups. People who pursue fishing or related occupations can be grouped into different social categories. Hindu fishermen are formed into separate and distinct castes. The indigenous fishermen communities that are found among the Hindus are: Kaibartta/Kavivarta, Kewat, Mala/Jhala/Malo/Jhala, Tiyar/Tiwar (Rajbangshi), Das Shikari (Rajbanshi origin), Berua (Namasudra sub-caste), Jiani (Namasudra sub-caste in Bakarganj and Faridpur), Karal/Charal (sub-caste of Namasudra)*, Bind/Bindu, Bagdi, Patni (ferrymen), Nadial, Mali/Bhuimali, Gonrhi/Gunhri/Mallah, Banpar (sub-caste of Gonrhi), Lohait/Lohait-Kuri, Muriari/Mariyari/Mariyari, Mala (possible Kewat connection) and Surahiya/Kalwat-Mallah. On the other hand, the indigenous fishermen communities that are found among the Muslims are Mahefarosh*, Chaklai*, Datiya/Dalatiya*, Dhawa/Katwar, Gutiya Jelia, Nikari*, Jiani (Nikari in Rajshahi)*, Abdal (branch of Bebajiya), Bebajiya/Bediya/Mal Baidya, Dohuriya, Kunjara/Kunjra*, Dom-Patni, Dohariya/Dohuriya*, Pajar/Pajhra/

Pajara (possibly Nikari), Chandali/Musulman Bagdi, Machhua, Mahimal/Maimal/Mahemahol. Here * denotes the fish sellers-based communities (Chu-fa Tsai & M. Youssouf Ali, 1997, p. 30). Freshwater-based indigenous fishermen of Bangladesh depend on both fishing and crop cultivation for their living. However, most fishermen are primarily dependent on fishing. They use simple and traditional fishing equipment. For fishing in the inland waters, the fishermen use non-motorised boats and traditional nets. The only touch of modern technology is the recent use of nylon nets.

Indigenous fishermen are very conscious of their cultural unity and distinctness. They have a strong regard for their institutions and a belief in the rightness of their values. In their social life, they maintain a strong bond of kinship. It is their belief that kins are more dependable than others during their work in the rivers. Hindu indigenous fishermen believe that God has entrusted them with the sacred duty of fishing to serve others with the supply of fish. So any sort of deviation from their *jati-pesha* (caste occupation) will be a sin for them. The religious beliefs of fishermen are supplemented by some particular types of rituals and ceremonies. Thus, they propitiate the Ma Ganga (Mother Ganges) not only for helping them make a good catch but also for keeping them safe while they are fishing. Fishermen also have their own folklore, history and literature. But they are usually ranked very low in the social hierarchy.

It is a cultural paradox that although fish is highly valued in Bangladesh, people who catch it are generally despised. However, due to the introduction of export-oriented fishing economy, the perceived status gap between fishermen and 'higher-class' people has been reducing in recent years. The community life of indigenous fishermen of Bangladesh has changed gradually. Due to the decrease in fishing grounds and fishery resources, members of the fishing communities have tended to leave their traditional occupation in search of other jobs. Moreover, they are subject to overwhelming and disruptive pressures and various attractions from within and outside. The high growth of population presses on inadequate and often deteriorating water resources; mass communications and the population movements stimulate new demands for consumer goods and social benefits; and introduction of export-oriented fisheries have created wider opportunities to produce for the market rather than for subsistence. The traditional subculture of the indigenous fishermen community has tended to break down under these pressures, leading to declining integration and growing dependence on national institutions and the wider economy. Keeping the above statement in view, the present study will highlight the major challenges of five freshwater-based indigenous fishermen communities in Bangladesh to understand their reality.

Literature Review

The prime objective of this study is to analyse the condition of socio-economic changes and the potentials of the indigenous fishermen communities in Chittagong and Dhaka division. In this chapter, an attempt is made to review some relevant

studies in the field of fishermen. This review would facilitate the researcher to have a comprehensive knowledge of the concepts used in earlier studies and to adopt, modify and formulate an improved conceptual framework for the present study.

The few studies on fisheries have been conducted only on short field trips, and in some cases not easily available to the scholarly community. The few studies on fisheries have been conducted only with coastal communities in West Bengal (Pramanik, 1993; Raychaudhuri, 1980). No historical ethnographic studies have been done on either coastal or inland West Bengali and Bangladeshi fishers. Hunter (1877) in his *A Statistical Account of Bengal*, Vols. 1–XX, mentioned that Muslims clung closer to the land and did not follow any trade in sowing or harvesting seasons to supplement their income.

Information about the fishermen community of Bangladesh was first made by FAO through a household survey. This report stated that the number of fishermen villages in Bangladesh was around 706. Actually, a few studies on the fisheries studies that have been done which are limited in scope, a historical, often based on short field trips, and in some cases not easily available to the scholarly community. The few detailed contemporary ethnographies available deal with coastal communities in West Bengal (Pramanik, 1993; Raychaudhuri, 1980). No historical ethnographic studies have been done on either coastal or inland West Bengali and Bangladeshi fishers.

In, most cases, more than 50 per cent of the fishermen have not sufficient valuable assets including land. Fishing is considered as a low-class profession and fishermen are traditionally poor. They lived from hand to mouth. Mahabubullah (1986) studied the polder fishing community of Bangladesh. He reported that 64 per cent had no boat and 61 per cent had no gear. While 98 per cent reported fishing as their main source of income and 71 per cent earned 400 takas per month or above. These fishermen are socially, economically and educationally disadvantaged communities and lack their own financial resources. Fishermen and their families in the South and South East Asia often are considered to be among the poorest of the poor. In Bangladesh, most of the fishermen are illiterate and few have a primary level of education.

According to Ali (1997), from 1950 to 1965, anybody could participate in the auction to bid for the open water bodies (*jalmohals*) lease which involved many non-fishermen, rich and influential landlords (*ijaradar*) in this business. In the late 1960s, the Board of Revenue gave preference to the fishermen's cooperatives society by making lease settlements in order to help the poor fishermen community. After independence, the Government of Bangladesh decided to restrict the auction only to the registered fishermen's cooperatives. Al-Muhit (2000) carried out a study on the fishermen communities of Bangladesh. This study reported that maximum fishermen caught fish individually, and more than 97 per cent fishermen were members of different associations. Siddique (2000) in his book *Life Struggle of Marine Fishermen* highlighted the life struggle of the coastal fishermen communities of Bangladesh.

Azam and Hasan (2001) conducted a detailed study on 'Present Status of Post Harvest Fishery Activities in the South Western Region of Bangladesh'. This

study reported the present fisheries activities in greater Khulna region, that is, fisheries activities in the Sunderbans Reserve Forest, fish marketing channel, fish landing centre and wholesaler involved in fish trading.

Kabir et al. (2012) in their study named 'Livelihood Status of Fishermen of the Old Brahmaputra River, Bangladesh' mentioned that the government provides no kind of Vulnerable Group Feeding cards for them in those areas. Lack of scientific knowledge, illiteracy and lack of government support were the major constraints. As for it, most of them are getting fishing facilities such as boat, net, credit from mahajan. They were the poorest of the poor in the society and they have no alternative livelihood options to earn their bread other than fishing in the area.

Khan et al. (2013) in their study named 'Fish Biodiversity and Livelihood Status of Fishing Community of Tista River, Bangladesh' mentioned that that the fishermen of Tista River were mostly illiterate, lack of training exposure, lack of awareness about health facilities, sanitation and fish biodiversity of the Tista River has also declined day by day due to over-exploitation and natural causes. Various recommendations and measures have been suggested to improve the fish biodiversity and livelihood status of fishers in the Tista River area.

Ali, Hossain, Minar, Rahman, and Islam (2014) conducted a study named 'Socio-Economic Aspects of the Fishermen of Lohalia River, Bangladesh'. In this study, they mentioned that most of the fishermen (60%) belonged to the age class 21–40 years and dominated by Muslims (75%). Lack of scientific knowledge, illiteracy and lack of governmental support were the major constraints. They did not any alternative livelihood options to earn their bread other than fishing in the area.

Different researchers used different methods of measuring the condition of fishermen community particularly the use of different scaling system. This implies that there is also a need for developing a scale-free method combining different indicators for measuring the trends of socio-economic change and their potentialities of indigenous fishermen communities in some indigenous fishermen communities' prone area of Bangladesh.

The Rationale of the Study

Proper knowledge of indigenous fishermen community can help to promote entrepreneurship development on fishermen non-discrimination society by scientific investigation. To achieve the Sustainable Development Goals (SDGs), it is high time to conduct this kind of study. There is a few systematic or in-depth research on the problem and prospects of indigenous knowledge and skill of fishermen community linked with their cultural heritage and entrepreneurship development for improving their better socio-economic condition. The study has enormous importance for the following reasons:

- Development practitioner's attention has not received a lot in this particular area. Therefore, aforementioned theme would be more relevant and significant for conducting a study.

- This study will also help other researchers to study further on the prospects of fishing diversity in Bangladesh.

The overall findings of the study will help to know more about the indigenous fishermen communities and the process of the market system and its contribution to the national economy of Bangladesh.

Objectives of the Study

The overall objective of this article is to assess the contemporary situation of some freshwater-based indigenous fisherman communities. The specific objectives of the study are to know:

- the present economic condition of indigenous fishermen community,
- the key barriers and driving forces in changing trend of occupation and
- The ways for uplifting the potentialities of these indigenous fishermen communities.

Research Methodology

This article is based on a study conducted among the lower-caste Hindu indigenous fishermen communities of Bangladesh. In this study, several techniques of data collection were followed to collect information. These were case studies, informal interviews, in-depth observations. At the same time, a survey was also carried out on sample respondents to collect certain demographic and related information. The sample size of the study was 250 as primary respondents and two stages stratified random sampling method was used. The first stage was Upazilas of selected districts and the second stage was the villages. After selecting villages, all the households of indigenous fishermen were listed by with respects to villagers. Thus, the study covered a total of five indigenous fishermen occupied villages. Among these indigenous fishermen communities, Bagdi, Rajbonshi and Malo community were covered in Manikganj District of Dhaka division and Julla and Barman community were selected in Comilla district of Chittagong Division. The main objective of the study was to find out the key challenges that are faced by the freshwater-based fishermen communities. In order to generate data on the research issues, freshwater-based five indigenous fishermen communities were selected—Bagdi, Rajbonshi, Malo, Julla and Barman. In order to go deep into the problem, it is necessary to have a clear idea about these communities covered under the study.

Bagdi

Bagdi is a cultivating, fishing and menial caste of Dravidian descent and a kin to the aboriginal tribes of the subcontinent. There are different sub-castes of Bagdis

living in different regions. All sub-caste of Bagdi admits into their circle members of any other caste higher than themselves in social standing. The religious practices of Bagdis combine orthodox Hinduism and nature worship of their ancestors. They worship the snake goddess Manasa Devi. Legal transactions of Bagdis in the past were of a very simple nature and were supervised by some elder caste members. Currently, they have been absorbed into formal institutions. The occupation of Bagdis differs from region to region and from sub-caste to sub-caste. Some Bagdi still work in fishing, some as Palanquin bearers, lime producers, gunny bag makers and cotton weavers. Some Bagdis are also engaged in agriculture usually as under *raiyats*, and a few of them have attained the position of occupancy tenants. From the olden times, a large number of Bagdis in Bengal worked as day labourers and were paid in cash or kind. Many worked as nomadic cultivators, tilling other men's land on the bhag jot system, under which one half or less the share of remunerated them produced. Bagdis are socially ranked very low and are treated by others as dwellers on the outskirts of Hinduism. Many of them eat beef or pork, though according to the prevailing Hindu custom, some of them abstain from all sorts of flesh. With the dispersion of modern amenities, customs and values among all strata of society, Bagdis are currently able to change their social standing along with their lifestyle and are able to engage in several occupations.

Rajbangshi

Rajbangshi is a small fishing community of the Bhotbarmi group. They entered Bangladesh territory from the Himalayan region and the Brahmaputra valley. Rajbangshis are people of a mixed race, although identified by many as a branch of the Ksatriyas known as the Kotch. They are short and have flat noses and raised jaws. They are followers of Vaisnavism. Some of them now adopted Islam and some Christianity. In Bangladesh, they live mostly in Rangpur, Dinajpur, and Rajshahi districts and a small number of them in the districts of Bogra and Mymensingh. In the censuses conducted in 1941 and later, they were treated as part of the Hindu community and, as a result, their number could not be properly ascertained. Rajbangshis are now a declining community in Bangladesh area. In 1991, their total population was a little higher than 5,000. Catching and selling fish is the main profession of Rajbangshis. Rajbangshi women are skilled in handicrafts and cottage industry. In their community, the father is the head of the family. Only male children inherit the property of their father after his death. But most of the Rajbangshis have no ownership of land.

Malo

Mala, Mal Malo or Mallah are the same meaning. Malo may originally have been boatmen who shifted to fishing as the population increased and as other forms of transport competed with boats. Certainly many Malo work as helmsmen (Majhis) and boat pliers (Mallahs) hired to carry cargo and passengers. Not all Malo were fishers or boatmen; some farmed, others traded in fish, vegetables and grain, while

others manufactured twine. In Mughal times, they acted as boatmen, mace bearers and staff bearers during processions and transported treasure from Dhaka to Murshidabad (Risley, 1981). Malo fished from boats with nets in rivers and large beels and used a short Jalka boat, sometimes using two when they fished for large fish such as Katla and Rui with the large case nets called *uthar* or *othar* in Rajshahi, Dinajpur and Faridpur. Malo women were free to sell fish in hats and markets although this was restricted to older women and widows in some areas (Risley, 1981). In certain districts, such as Pabna in the early 1900s, Malos began to prevent widows from selling fish in the market, and their relatives were fined and ritually degraded if they allowed such a practice (O'Malley, 1923). Besides trading and hawking, women repaired nets and carried out other ancillary tasks. They also fished but usually with traps and by hand. There were anywhere between 170,000 and 450,000 Malos in Bengal in the early 20th century (Gupta, 1908).

Julla or Jaladas

Traditionally *jal* means water and *das* means servant, so the word *jal das* together means the servant of water. Actually, jaladas is a sub-caste or the members of a single endogamous group of the Hindu caste system with strong kindred of recognition of kinship and affinity have been engaged in the profession of fishing since ancient times. They believed the occupation to be sacred and God has entrusted them to serve others with the supply of fish. Their occupations are determined by their birth. In different regions, there are different names of jaladas and these are: Kaibartta Das, Kaibartta Jele, Jalia Kaibartta and so on. They numbered over two million of which at least a quarter million were fishers concentrated in Midnapur, Dhaka, Mymensingh, Tippera, Sylhet and Kamrup.

Barman Community

The Barman, a lower-class Hindu sect is one of the indigenous fishing communities of Bangladesh. They are principally group fishers and use seine nets in group fishing. The catches are normally sold to middlemen who in turn sells them to the consumers via several other intermediaries. They earn their subsistence by catching fish and collecting carp fry in the river and its adjacent floodplains. The fishermen of this community are socially, economically and educationally disadvantaged and lack their own financial resources. Moreover, the caste system of Hindu communities limits or precludes occupational mobility and employment opportunities, as does a lack of education and access to basic information. The gradually declining riverine fish production in recent years has added to their adversities. To maintain their livelihood intact, the subsistence fisherfolk have resorted to increased and indiscriminate fishing using different types of destructive gears. The fine-meshed seine nets are the most extensively used destructive gears in the locality.

Table 1. Main Occupational Patten of the Household Members

Occupational Status	Freshwater-based Indigenous Fishermen Community					Total Number (%)
	Bagdi (%)	Rajbonshi (%)	Malo (%)	Julla (%)	Barman (%)	
Catching fish	53 (24.31)	57 (28.08)	51 (27.27)	73 (31.60)	73 (29.55)	307 (28.27)
Making fish equipment with bamboo (Banari)	1 (0.46)	24 (11.82)	–	–	–	25 (2.30)
Student	23 (10.55)	61 (30.05)	52 (27.81)	47 (20.35)	56 (22.67)	239 (22.01)
Housewife	72 (33.03)	26 (12.81)	53 (28.34)	67 (29)	67 (27.13)	285 (26.24)
Petty business	2 (0.92)	8 (3.94)	5 (2.67)	8 (3.46)	10 (4.05)	33 (3.04)
Service	5 (2.29)	2 (0.99)	10 (5.35)	4 (1.73)	5 (2.02)	26 (2.39)
Masonry	2 (0.92)	1 (0.49)	–	–	2 (0.81)	5 (0.46)
Remittance	2 (0.92)	1 (0.49)	–	2 (0.87)	2 (0.81)	7 (0.64)
Day labourer	6 (2.75)	0 (0)	–	14 (6.06)	9 (3.64)	29 (2.67)
Rickshaw/van/CNG driver	1 (0.46)	1 (0.49)	–	1 (0.43)	3 (1.21)	6 (0.55)
Blacksmith	3 (1.38)	–	–	–	–	3 (0.28)
Carpenter	6 (2.75)	–	2 (1.07)	–	–	8 (0.74)
Barber	13 (5.96)	–	–	–	–	13 (1.20)
Agriculture	3 (1.38)	–	2 (1.07)	–	–	5 (0.46)
Unemployment	1 (0.46)	1 (0.49)	–	2 (0.87)	5 (2.02)	9 (0.83)
Children	25 (11.47)	21 (10.34)	12 (6.42)	13 (5.63)	15 (6.07)	86 (7.92)
Total	**218 (100)**	**203 (100)**	**187 (100)**	**231 (100)**	**247 (100)**	**1,086 (100)**

Source: Field survey (2018).

The Economic Condition of the Indigenous Fisherman

Occupation and Land Ownership

There is a correlation between traditional occupation and poor economic condition. In the past, the professional activities of indigenous fishermen were limited to certain specific professions. They had little scope to come out of that professional circle because of their social and economic position in the society. Once upon a time, they solely depended on the fishing but nowadays they are involved in many non-fishing activities as a main source of income. Table 1 presents the main professional activities of indigenous fishermen communities.

In the present time, the study respondents have shifted to various professions for their livelihood. Earlier they had limited scope to choose alternative professions. From Table 1 it is understandable that most of the fishermen's main source of income and livelihoods are either agriculture or fishing. Some of them have other occupations. From Table 1, we can find that out of 1,086 family members, 28.27 per cent are directly involved in catching fish. Nearly 50 per cent of the total family members are housewives and students and they spend a significant amount of time for fish-related diverse occupations such as making nets or helping during catching fish. The significant aspect of Table 1 is that 11.82 per cent family members among the Rajbonshi depend on making fish equipment with bamboo. A total of 3.04 per cent depend on the petty business, 2.67 per cent on day labour and only 2.39 per cent on services. The occupation of masonry, compressed natural gas (CNG) driving, barbering, carpenter was also found among the fishermen community but the ratio was very poor. It is clear that the members of all the five surveyed communities had a major shift in their profession but they still could not improve their social or economic condition from these new sources of earning. Their social status remained the same and their economy is still no better than a subsistence economy. For their marginal economic condition, they are still looked down upon, and it is still difficult for them to run their family affairs.

From Table 2, we can find that most of the family members are involved in catching fish and preparing the fishing equipment as the secondary source of income. The petty business that is mostly related to fishing is another secondary source of income of 9.28 per cent family members. Most of the fishermen have skill of repairing the net instantly. It is evident from the above data that these communities had very little scope for economic activities for earning their livelihood. Their earning activities centred on the traditional profession of their forefathers. With the changing scenario of the country, these professional minorities gradually have diversified their earning activities by adopting some secondary professions too.

Ownership of homestead land is very scarce among all the studied communities (see Table 3). Most of the respondents of the studied communities own less than three decimals of land which indicates that the communities' homesteads are very limited. Very few households own 4–11 decimals of land.

Table 2. Secondary Occupational Status of the Household Members

Occupational Status	Freshwater-based Indigenous Fishermen Community					Total Number (%)
	Bagdi (%)	Rajbonshi (%)	Malo (%)	Julla (%)	Barman (%)	
Preparing Banari	–	52 (75.36)	–	–	–	52 (26.80)
Catching fish	63 (86.30)	8 (11.59)	7 (36.84)	4 (18.18)	2 (18.18)	84 (43.30)
Carpenter	–	2 (2.90)	0 (0)	–	–	2 (1.03)
Petty business	–	1 (1.45)	9 (47.37)	4 (18.18)	4 (36.36)	18 (9.28)
Masonry	–	1 (1.45)	0 (0)	1 (4.55)	0 (0)	2 (1.03)
Day labourer	5 (6.85)	–	1 (5.26)	12 (54.55)	2 (18.18)	20 (10.31)
Rickshaw/van/ CNG	1 (1.37)	–	2 (10.53)	1 (4.55)	1 (9.09)	5 (2.58)
Agriculture	2 (2.74)	5 (7.25)	–	–	–	7 (3.61)
Poultry rearing	1 (1.37)	–	–	–	–	1 (0.52)
Service	–	–	–	–	1 (9.09)	1 (0.52)
Making net	1 (1.37)	–	–	–	–	1 (0.52)
Fish drying	–	–	–	–	1 (9.09)	1 (0.52)
Total	**73 (100)**	**69 (100)**	**19 (100)**	**22 (100)**	**11 (100)**	**194 (100)**

Source: Field survey (2018).

Table 3. Land Ownership Pattern of Respondents

Land in Decimal	Freshwater-based Indigenous Fishermen Community					Total Number (%)
	Bagdi (%)	Rajbonshi (%)	Malo (%)	Julla (%)	Barman (%)	
Below 3	38 (76)	2 (4)	44 (88)	27 (54)	22 (44)	133 (53.20)
4–6	5 (10)	27 (54)	4 (8)	18 (36)	23 (46)	77 (30.80)
7–10	3 (6)	19 (38)	0 (0)	4 (8)	3 (6)	29 (11.60)
11+	4 (8)	2 (4)	2 (4)	1 (2)	2 (4)	11 (4.40)
Total	50 (100)	50 (100)	50 (100)	50 (100)	50 (100)	250 (100)

Source: Field survey (2018).

Table 4. Agricultural Land Ownership of the Respondents

Land in Decimal	Freshwater-based Indigenous Fishermen Community					Total Number (%)
	Bagdi (%)	Rajbonshi (%)	Malo (%)	Julla (%)	Barman (%)	
No agro-land	50 (100)	43 (86)	48 (96)	42 (84)	43 (86)	226 (90.40)
1–20		6 (12)	–	7 (14)	2 (4)	15 (6)
21–40		1 (2)	1 (2)	–	3 (6)	5 (2)
41–60		–	–	–	1 (2)	1 (0.40)
61–80		–	–	1 (2)	–	1 (0.40)
81–100		–	1 (2)	–	1 (2)	2 (0.80)
Total	50 (100)	50 (100)	50 (100)	50 (100)	50 (100)	250 (100)

Source: Field survey (2018).

Table 5. Pond/Wetland Ownership of the Respondents

	Freshwater-based Indigenous Fishermen Community					Total Number
Type	**Bagdi (%)**	**Rajbonshi (%)**	**Malo (%)**	**Julla (%)**	**Barman (%)**	**(%)**
No wetland	49 (98)	49 (98)	50 (100)	40 (80)	42 (84)	230 (92)
1 to 10	–	1 (2)	–	9 (18)	5 (10)	15 (6)
11 to 20	1 (2)	–	–	–	2 (4)	3 (1.20)
21+	–	–	–	1 (2)	1 (2)	2 (0.80)
Total	50 (100)	50 (100)	50 (100)	50 (100)	50 (100)	250 (100)

Source: Field survey (2018).

Table 6. Education Status of the Indigenous Fishermen Communities

	Freshwater-based Indigenous Fishermen Community					Total Number
Education Status	**Bagdi (%)**	**Rajbonshi (%)**	**Malo (%)**	**Julla (%)**	**Barman (%)**	**(%)**
Below 5	25 (11.47)	21 (10.34)	12 (6.42)	13 (5.63)	15 (6.07)	86 (7.92)
Illiterate	94 (43.12)	12 (5.91)	2 (1.07)	56 (24.24)	40 (16.19)	204 (18.78)
Can sign only	14 (6.42)	9 (4.43)	51 (27.27)	22 (9.52)	37 (14.98)	133 (12.25)
Can read and write	49 (22.48)	60 (29.56)	55 (29.41)	98 (42.42)	85 (34.41)	347 (31.95)
Primary	32 (14.68)	85 (41.87)	39 (20.86)	37 (16.02)	54 (21.86)	247 (22.74)
Secondary	2 (0.92)	7 (3.45)	12 (6.42)	4 (1.73)	14 (5.67)	39 (3.59)
SSC	2 (0.92)	5 (2.46)	11 (5.88)	–	–	18 (1.66)
HSC	–	2 (0.99)	3 (1.60)	1 (0.43)	2 (0.81)	8 (0.74)
BA/BSS/BSC	–	2 (0.99)	2 (1.07)	–	–	4 (0.37)
Total	**218 (100)**	**203 (100)**	**187 (100)**	**231 (100)**	**247 (100)**	**1,086 (100)**

Source: Field survey (2018).

From Table 4, we can see that nearly 90 per cent of the respondents have no agricultural land. Only less than 10 per cent families of studied communities own very limited amount of agricultural land. Julla and Rajbonshi communities adapt agriculture in a very limited level where Bagdi community still fully depends on fishing although they do not own a single decimal of agriculture land.

It is observed from Table 5 that 92 per cent respondents have no wetland. A very few respondents have a poor amount of wetland. Out of 250 respondents, only 2 respondents have 21 to 30 decimal of wetland or pond. Table 5 indicates that most of the indigenous fishermen traditionally depend on open waterbody, river, beel, baor, marshy area or wetland, and these types of property are commonly identified as the communal property. But their access to the wetland is gradually decreasing due to siltation of river and pouring the wetland.

Involvement in Traditional Education

If we go through the history of our educational system, we can conclude that the history of informal education is much older than the history of formal education. In fact, the modem formal education was introduced in this sub-continent of India, Pakistan and Bangladesh largely by the British government. The British government took a lot of initiatives to set up many educational institutions for the larger Hindu and Muslim communities of Bangladesh. It is mentionable that among the freshwater-based indigenous fishermen, the rate of literacy is not satisfactory. The survey conducted during the fieldwork generated data on the status of the educational level of the five indigenous fishermen is presented in Table 6.

Table 6 shows that over 18.78 per cent of the population of these indigenous fishermen communities did never receive any education and remained illiterate. The data show that nearly 23 per cent of the population surveyed received primary level education while slightly over 3.5 per cent could reach up to the secondary level, and less than 1 per cent received higher secondary certificates. Among these indigenous fishermen communities, the condition of Bagdis is the worst. In terms of educational attainments, Malos are in a better position with literacy. But the saddest part is that among Bagdi, Julla or Barman community, no person was found who could go above the higher secondary level of education.

Challenges Faced by the Indigenous Fishermen

At present destructive use of fishing gear, water pollution, siltation, rapid urbanisation and human encroachment major challenges for the indigenous. The government and non-government initiatives also should come forward to consider these negative impacts and develop such techniques or alternatives that may help at least the poor fishermen to uphold the present profession of fishing. Some obstacles that are faced by the fishermen are presented in Table 7.

Table 7. Problems in Fishing

Problems	Freshwater-based Indigenous Fishermen Community					Total Number (%)
	Bagdi (%)	Rajbonshi (%)	Malo (%)	Julla (%)	Barman (%)	
Not applicable	–	18 (21.69)	1 (2)	2 (2.06)	3 (5.17)	24 (6.67)
Fishing by the other caste	7 (9.72)	7 (8.43)	4 (8)	15 (15.46)	6 (10.34)	39 (10.83)
High fund needed for lease	3 (4.17)	12 (14.46)	3 (6)	12 (12.37)	3 (5.17)	33 (9.17)
Other caste people also participate in the process of taking lease	2 (2.78)	10 (12.05)	2 (4)	14 (14.43)	4 (6.90)	32 (8.89)
Seine net used for fishing in various places	–	4 (4.82)	4 (8)	11 (11.34)	2 (3.45)	21 (5.83)
Faced by the influential	6 (8.33)	16 (19.28)	9 (18)	15 (15.46)	5 (8.62)	51 (14.17)
Pay of extra tax in case of fishing	–	2 (2.41)	3 (6)	8 (8.25)	–	13 (3.61)
Blockage by leaser	23 (31.94)	–	3 (6)	–	–	26 (7.22)
Lack of modern fishing equipment	17 (23.61)	–	–	–	–	17 (4.72)
Less fish in water	4 (5.56)	–	–	–	–	4 (1.11)
Problem of minority	5 (6.94)	2 (2.41)	3 (6)	3 (3.09)	4 (6.90)	17 (4.72)
There is no problem	5 (6.94)	12 (14.46)	18 (36)	17 (17.53)	31 (53.45)	83 (23.06)
Total	**72 (100)**	**83 (100)**	**50 (100)**	**97 (100)**	**58 (100)**	**360 (100)**

Source: Field survey (2018).

From Table 7, it is found that out of 250 respondents, nearly 14 per cent faced by local elites 10.83 per cent of the respondents mention that nowaday's fish is caught by other segments of people. A total of 9.17 per cent of the respondents mention that a huge amount of funds is needed during lease. Because of poverty, they are incapable of meeting the expected lease demand. About 9 per cent respondents point out that other castes of people also participate in the process of taking lease. The rest of the respondents mention other difficulties including blockage by leaser, seine net used for fishing in various places, lack of modern fishing equipment, paying extra tax in case of fishing, problem of minority, insufficient fish in water bodies and so on. The interesting point is that nearly 23 per cent respondents identify that they have no problem regarding fish and 6.67 per cent of the respondents kept silent on this issue.

Table 8 indicates that nearly 82 per cent of the respondents mentioned that they do not face any problem for selling fish, while 9.38 per cent of the respondents chose not to answer this question. And rest of the respondents (10%) pointed out many difficulties for selling fish, that is, lack of icing facilities on boat/vessel, stealing by the labourer, lack of cold storage, absence of fair price in local fish markets, lack of ice plant and stockiest or wholesale pay low price. Side by side, indigenous fishermen identify some root causes for poor fish marketing through focus group discussion (FGD) and these are:

- Inappropriate environment for fishing,
- Real fishermen are deprived by other castes of people/Muslims who participate in the process of leasing system,
- No regulation for illegal fishing by other castes of people/ Muslims,
- Low price of produced fishes and
- Lack of reservation or preservation.

Access to open waterbody is another important phenomenon for catching fish. Table 9 will highlight the current accessing status of the indigenous fishermen for going to the outside area of their own territory for fishing.

From Table 9, we can understand that the accessing power of regular fishermen to the outside area for fishing is reducing day by day. Table 9 highlights that 45.6 per cent of respondents comment that they do not have the access to outside area for fishing but 44.8 per cent respondents mention that they have no difficulties for entering the outside area for fishing. The notable aspect of Table 9 is that nearly 9.6 per cent respondents point out that this issue is not applicable for them meaning that they are not involved in the process of catching fish. In the near past, frequently roaming was not the problem for indigenous fishermen. They moved freely in bogs, rivers, marshy or wetland area all the year round. But nowadays, they face many difficulties for going to the outside areas and these are:

- Blockade by leaser or problems created by leaser,
- Hard competition for catching fish with comparatively modern equipped non- traditional fishermen for fishing,
- The dwindling areas of wetland for fishing and
- Lack of modern fishing equipment.

Table 8. Faced Difficulties in Fish Selling

Problems	Freshwater-based Indigenous Fishermen Community					Total Number (%)
	Bagdi (%)	Rajbonshi (%)	Malo (%)	Julla (%)	Barman (%)	
There is no problem	49 (98)	32 (64)	42 (77.78)	43 (86)	44 (84.62)	210 (82.03)
Stealing by labourer	1 (2)	–	–	2 (4)	–	3 (1.17)
Lack of ice plant	–	–	–	2 (4)	–	2 (0.78)
Low price	–	–	4 (7.41)	1 (2)	–	5 (1.95)
Lack of cold storage	–	–	3 (5.56)	–	–	3 (1.17)
Lack of icing facilities on boat/vessel	–	–	4 (7.41)	–	–	4 (1.56)
Local vendors do not offer the fair price	–	–	–	–	3 (5.77)	3 (1.17)
Stockiest or wholesale pay low price	–	–	–	–	2 (3.85)	2 (0.78)
Not applicable	–	18 (36)	1 (1.85)	2 (4)	3 (5.7)7	24 (9.38)
Total	**50 (100)**	**50 (100)**	**54 (100)**	**50 (100)**	**52 (100)**	**256 (100)**

Source: Field survey (2018).

Table 9. Access to an Outside Area for Fishing

Access	Freshwater-based Indigenous Fishermen Community					Total Number (%)
	Bagdi (%)	Rajbonshi (%)	Malo (%)	Julla (%)	Barman (%)	
Not applicable	–	18 (36)	1 (2)	2 (4)	3 (6)	24 (9.6)
Yes	39 (78)	10 (20)	19 (38)	13 (26)	31 (62)	112 (44.8)
No	11 (22)	22 (44)	30 (60)	35 (70)	16 (32)	114 (45.6)
Total	**50 (100)**	**50 (100)**	**50 (100)**	**50 (100)**	**50 (100)**	**250 (100)**

Source: Field survey (2018).

Table 10. Main Hindrance of Fishery Occupation

Major Obstacles	Freshwater-based Indigenous Fishermen Community					Total Number (%)
	Bagdi (%)	Rajbonshi (%)	Malo (%)	Julla (%)	Barman (%)	
Lack of proper equipment	43 (22.63)	30 (19.11)	21 (10.61)	7 (3.63)	13 (6.84)	114 (12.28)
Fish scarcity in river or marshy area	49 (25.79)	50 (31.85)	50 (25.25)	49 (25.39)	49 (25.79)	247 (26.62)
This is a hard task	9 (4.74)	15 (9.55)	45 (22.73)	43 (22.28)	39 (20.53)	151 (16.27)
Siltation of canal (ca) and bogs	49 (25.79)	50 (31.85)	45 (22.73)	47 (24.35)	50 (26.32)	241 (25.97)
Fishing is comparatively less profitable than others	11 (5.79)	12 (7.64)	37 (18.69)	47 (24.35)	39 (20.53)	146 (15.73)
Leaseholder' oppression	29 (15.26)	–	–	–	–	29 (3.13)
Total	**190 (100)**	**157 (100)**	**198 (100)**	**193 (100)**	**190 (100)**	**928 (100)**

Source: Field survey (2018).* One respondent answers more than one.

Major Hindrance of Fishery Occupation

Indigenous fishermen face many hindrances to fishing. Some of the major hindrances that they face are mentioned in Table 10.

The major hindrances of fishing are lack of improvement in the traditional method of fishing and dominance of non-mechanised boats in riverine fishing. It was found in the study that lack of proper or modern equipment has a negative impact on almost all the studied communities. The other issues are fish scarcity in river or marshy area, challenging and hard-working fishing environment, siltation, absence of adequate marketing facilities which makes fishing comparatively less profitable than other professions. Another important issue that came out in the study was leaseholder' oppression. During FGD, fishermen from the five respective communities mentioned the following socio-economic hindrances:

- Absence of effective production-/marketing-related cooperatives for fishermen,
- Absence of institutional credit facilities,
- Dependency of fishermen on traders, local storage keepers, village moneylenders, boat owners for loans at usurious rates of interest,
- Loans of *aratdars* and traders are tied up with compulsory sell to them,
- Dissatisfaction of fishermen about the existing system of cash support as remuneration in riverine fishing,
- Lack of capacity to procure fishing inputs such as boats and nets from own financial resources,
- Lack of preservation facilities resulting in spoilage/wastage particularly at the time of bumper catch,
- No insurance coverage for life and fishing equipment,
- Prevalence of the leasing-out system of water bodies and creation of large number of intermediaries between first lessee and ultimate user, the fishermen,
- Unlicensed fishing and use of the destructive gear,
- Increasing inflow of fishermen to the fishery versus a gradual decline of production due to over-exploitation of fishery and decline of productivity,
- Pollution resulting from the use of agrochemicals and discharge of industrial effluent and the resulting threat to the existence of fish resources.

Understanding the Ground Realities of Indigenous Fishermen through Some Case Studies

To go deep into the problem and to supplement the findings, a few studies were conducted. Students from each of the surveyed community, that is, Rishi, Kaiputtra and Behara, were selected for the case studies. The findings of these case studies are presented below:

Case 1. Occupation Change is a Very Common Phenomenon of Kanu's (Bagdi) Life

Kanu Biswas (55) lives in Sridhorgang village of Pohela union under Geor Upazila of Manikganj District. According to Kanu, his forefather came in this particular part from the Kusbehar of India. He mentioned that the previous history of Bagdi was the golden era and that time, they led their lives very peacefully. At the age of 15 or 16, Kanu became an expert in catching fish from the knowledge he learnt from his father Juddho Biswas. After his father's death, Kanu took this profession as a prime source of income. That time, he frequently moved for hunting fish in different bogs or bills of Nimaikhali, Based Bepari, Shampur (Douloutpur), Nilua, Companir area and so on. Kanu observed closely that the stock of fish species was decreasing day by day in these wetlands or Haor, Baor areas due to pouring the marshy area and environmental degradation from the use of pesticides and chemical fertiliser in their cultivable land. In this process, when fish species started getting depleted in these marshy areas, he faced serious hardship in maintaining his family. In these changing circumstances, he did not use various fish-catching related equipment such as *nal barshi*, *bana*, *goje*, net and so on. To support his six family members (wife, three daughters, one son and himself), he was bound to shift his traditional profession and led his life as a *kuli* (bearer) in a local bus stand. When he became aged, he found it very difficult to continue as a bearer. He also got sick and thus faced acute problem for running the expenses of his family members. That time, local chairman (elected village head) noticed his miserable condition and arranged a new job (*chowkider* or village police) for him. For nearly 17 years, he is earning his livelihood as a *chowkider* and with this income (nearly 20 euros a month), he somehow maintains his family. According to Kanu, this is the general picture of the whole Bagdi community; actually, Bagdi people lead their lives in a very poor condition. There is insufficient fish in the wetland, river or open water-bodies; consequently, the fishermen have no food in their home for their survival. Want, poverty, indigence and malnutrition are now their eternal company. Kanu's dwelling unit is constructed with thatch and tin on the fellow land of the Government. He mentioned that like him, most Bagdis do not possess any land for cultivation. He added that due to fish scarcity, many Bagdis are now leading their lives by cultivating and catching earthworm in a certain period of a year. Per kilogram earthworm is sold at the 200–250 takas (1 dollar = 79 takas). And the rest of the year, they lead their livelihoods as an agri-day labourer or as drivers of rickshaws or vans. He exclaimed with sorrow that the entrance of any government official from the Department of Fisheries (DOF) is very rare among their community. At the end of the speech, Kanu pointed out that they receive very little support from the Government of Bangladesh or non-governmental organization (NGOs). As a citizen of Bangladesh, they have the voting right but after the election, the representatives of local elected bodies (LEBs) do not enter their community. As a result, year after year their fate remains unchanged.

Case 2. Instead of Fishing, Renting Net is the Main Profession of Preyo Lal (Barman)

Preyo Lal Barman is now 60 years old. He resides in Ariora village under Durgapur union of Commilla Sadar Upazila. He has two sons and two daughters. All daughters are married. His younger son is in Dubai and elder son is separated from his family. Preyo Lal has two big nets. One net is 10 sora and another is 5 sora (1 sora means 10 yields long). By renting 10 sora net, he earns 3,200 takas (1 euros = 104 takas) per day and the rent of 5 sora is 1,600 takas per day. Almost all days in every month he gets the opportunity for renting his nets. He has a pond of 57 decimals but it is leased. According to Preyo, though fish cultivation in the pond is profitable but there are many difficulties to run this business such as stealing and looting of fish, hostility and so on. Huge level of pond cultivation is comparatively a new phenomenon and in the past, varieties of fishes were available in the open water bodies especially in Gomti River. He with his forefather caught fish with the help of boat and net in this river. But nowadays, many varieties of fishes are cultivated in the pond. His net is normally used in the pond. He has a lot of knowledge about fish cultivation in the pond. He mentions that in the past, they collected fry from the river, and before collecting the fry, they visited the *mazar* of Badar Sha to protect themselves from the bad omen. At present, all types of fry are collected from the hatchery. This fry is cultivated in the pond and the growth of this fry totally depends on artificial food supply. To get rid of this problem, it is better to run the nets in the pond at least once every month. He views that due to water scarcity in winter, fish species normally take insufficient food and in summer, fishes take sufficient food. So, in winter, it should provide very little amount of food in the pond. In winter, many diseases are found and to prevent them, it is better to spray lime, salt and potassium in the pond. During harvesting time, many fishes are looted. Preyo Lal adds that in catching fish, especially in the daytime, many problems are faced. Considering this it is better to catch fish in the pond very early in the morning. Though they are traditional fishermen, they are not interested in cooperative fish cultivation because they think that for taking benefits from the government, some local leaders form fishermen groups with their help. But when benefits come, they are deprived of those facilities. According to him, for fish cultivation in the pond, the government should provide loan during the period of fry release. To avoid all the disturbances, Preyo Lal is not involved in direct fish cultivation. By renting net, he and his wife are somehow maintaining their lives.

Case 3. Rajbonshi Has Lost their Golden Opportunity of Catching Fish—Lakhan Rajbanshi

Lakhan Rajbanshi (50) lives in Zabra village under Baniajuri union of Gheor Upazila. He has five family members: one son and two daughters, and all are going to school. He and his wife studied up to Class 8 and Class 5, respectively. He has only 10 decimals of land. He engages in different types of activities

such as catching fish in the river, making banner (equipment for catching fish), purchasing fish from the local market and also selling the fish as a retailer. He mentions that once upon a time, catching fish was the main source of income for the Rajbanshis and that time, they moved frequently in the open water bodies without any barrier. That time fish was abundant, and in the last date of the months of Pouch and the first week of Magh of Bengali calendar, worship of the river Ganges was arranged before the start of formal fish catching. That time, catching fish was the monopoly business for them; no Muslims were engaged in this activity. Nowadays many Muslims are engaged in this activity. Sometimes they have to contact with the influential Muslims for catching fish in the river. The informal contact is 60 per cent for Rajbanjis and the rest 40 per cent for influential. Not only that, due to river siltation, pesticide use and wastage from the industries, catching the breeding fish, insufficient fish sanctuary, involving fishing of the Muslim community, they are not in a good position. Besides fishing, they are busy for making banari (fish catching instrument) for their livelihood. Once upon a time, they dug a hole in their cultivable land beside the canals, and in this process, a certain time in a year, they got many fishes in that hole. But due to pesticide uses, that opportunity is no more available. Normally, Rajbanshis are not interested to involve their children in this profession. According to Lakhan, if they get the leasing opportunity from the officials including training facilities, they can play a vital role for fishing.

Case 4. Like Mine Many Malos Face Difficulties for Paying the NGOs' Loan: Says Urmila

Urmila Halder is now 40 years old. Her husband's name is Biran Halder who leads his livelihood as a day labourer along with his four children. At the age of only 14, she was married. Her hut is made of mud and thatch in the fellow land of the government. She has only one fish catching instrument (*anty*) for catching specific fish named kucha. Urmila rears some poultries for running her family. Sometimes, Urmila goes to her husband in the marshy area for catching kucha fish. Urmila mentions that in her early life, she went to catch fishes with her father in the river or wetland areas. Due to changing circumstances of the surrounding environment, a significant number of Malos have changed their traditional occupation. Like Urmila, many women from the Malo community lead their life as a maid or domestic worker. Urmila mentions that as a citizen of Bangladesh, she has the voting right but her community people are frequently deprived of getting many social privileges. They have no coverage of the social safety net programme. Some local NGOs are providing loans and it is very tough for them to pay the return of loan. These poor fisherman communities as well individual families can enhance their income by using their traditional knowledge if concerned departments of the government can supply fish catching and rearing instrument, access to water bodies and also capital for them.

Case 5. Pramananda Mentions that Shifting Occupation Is the Normal Phenomenon of Julla Community

Pramananda resides in Bancharampur; his main profession is fry business. He is now 51 years old. His father was a traditional fisherman and he hunted fishes in the river or beel areas and sold them in the local markets. Pramananda assisted his father for catching and selling fish and this is how he lived for 30 years. But nowadays, they have limited access to the water bodies. At present, he is engaged in fishing in different forms. He contracts the diverse types of ponds, marshy area and there he nurses and cultivates both fry and fish. He does not want to engage their children in this activity. His one son is trying to go abroad as this occupation is not profitable. The waterbodies that were freely accessed by the traditional fishermen are now leased with the other caste of people especially Muslims. Consequently, traditional fishermen have shifted their occupations quickly. For this reason, like Pramananda, many Jullas demand the proper utilisation of the policy of *jal jar jola tar* (who possess the net he/she possess the swamp area). Real fishermen do not get the opportunity to take the lease of swamp area; actually they are playing the role of catching fish only for day-wise payment. As a result, they face difficulties for running their family, and many of them are engaged in different types of livelihoods instead of fishing such as day labourer, CNG driver, petty businessman, mechanised labour, construction worker and so on. Like many Julla, Pramananda mentions that the social status of their community is not in good shape; socially they are deprived. Traditionally they are engaged in this activity but nowadays who are involved in activities they have no traditional or inherited knowledge.

Case 6: A Story of Chokbosta Bill (Wetland)

Dashpara (Jullapara) is situated at the corner part of Bancharampur Upazila under Comilla District. This *para* is known as Fordabad Dashpara. The community is at the floodplain of Meghna River, where the Titas River flows on the western part of the village. This *para* is consisted of 130 to 150 families, who mostly depend on the activities related to fish processing and marketing of fish. This is a traditional village surrounded by the Muslim peasants. The history of the settlement of this community is more than 150 years old. Historically, this place was abundant with natural fishes, the zamindar (local tax collector) of the then period supported them to form the fishing-based community. The community people have been practicing the traditional method of fishing but in recent time, the quantity of natural fish resources have decreased. At present, the only fishing area where the community has access is the Chokbosta bill which is situated at the eastern part of the village. As the bill (waterbody) is owned by the government, the fishermen cooperative society has taken it as lease from the government for five years and they treat this system as a treaty. The amount of money needed for the lease is about 800,000 takas. This is the only natural waterbody where the community people have easy access as the bill (open water bodies) is taken on a

lease by the fishermen community themselves. But if anyone wants to catch fish by net, he has to pay an amount of money to the society before going for fishing. But at present, the amount of fish is decreasing. As a result, the community has been transferring their livelihood into different types of fishing, fishing in pond, in fish culture activities and in selling fish. According to the community people, the business has now been owned and controlled by the people who do not have a family background of fishing.

From the analysis of the above case studies, it can be clear that shifting traditional occupations are very common phenomenon among the freshwater-based indigenous fishermen communities in Bangladesh. During FGD, indigenous fishermen informed many reasons for shifting their traditional occupation and these are:

- Breeding and roaming zone of fish have been reduced significantly,
- The number of natural fishes such as *koi, bowel, shing, taki showl* is declining,
- Heavy use of pesticides and chemical fertiliser in the field of agriculture,
- Providing lease of haor, baor to the non-fishermen,
- Fish scarcity in the *waterbodies resulting a decline in* fish-related income and
- Lack of self-help group (SHG) among the fishermen

Traditional fishermen opine that if the government and NGO can address the following issues, the traditional fishermen can revive their glorious past:

- Government initiatives should focus on educating the indigenous fishermen communities,
- Providing training for small-scale fish cultivation,
- Supplying fish-catching related diverse equipment,
- Providing interest-free loan among the indigenous fishermen communities,
- Certain portion of wetland should not be leased, it should be leased among the real or traditional fishermen,
- Natural fertiliser should be used in the agricultural land, less chemical fertiliser should be used in the agricultural field and
- Various government initiatives should be implemented for developing entrepreneurship development as well as reviving their social status.

Conclusion and Policy Implications

The gradual but definite extinction of such indigenous communities is a great loss to the country. The findings of this article can help the development organisations, development practitioners and policymakers with a number of directions for developing entrepreneurship for eradicating extreme poverty and hunger among these indigenous fishermen communities. For combating extreme poverty and hunger, these communities may be empowered through the

entrepreneurship development in diverse fish-related livelihood occupations. Indigenous fishermen often have a weak or indirect influence on policies that affect their livelihoods. Policies developed at the central level are often not in tune with indigenous fishermen needs; therefore it may not enable access to the indigenous fishermen with needed resources and services. With the changes that are taking place in the external world, there has been a paradigm shift in the job or livelihood options. It is true that because of their social and economic backwardness, these freshwater-based indigenous fishermen communities are gradually becoming marginalised. While, traditionally, the larger community always maintains a distance from them, lack of appropriate policies and laws related to the entrepreneurship also keep them confined in their restricted, disadvantaged position. If this situation continues, time will come when members of these freshwater-based indigenous communities will disappear. In this respect, we can say that for uplifting the fisherman communities, the government of Bangladesh should implement the specific schemes. Under these schemes, the fishermen may come together as SHGs and thereafter would constitute themselves into cooperative societies. The scheme would try to facilitate skill upgradation and infrastructure with a view to enhance quality and productivity. The scheme can focus on encouraging a self-help and participatory approach among fishermen, empower the community and fosters the evolving of economically viable operations. Thus, it is high time to initiate measures both by the government and non-government agencies to provide meaningful intervention through entrepreneurship development among these indigenous communities. But it is not always easy to provide such supports to them because the problem is related to the overall social and economic structure of the society. Unless the system is changed, nothing positive could be for these underprivileged sections of the population. In spite of this, we may say that there should be an awareness-raising campaign among the indigenous fishermen communities to encourage them to come forward to take part in diverse government and nongovernment support programme which is their fundamental right. At the same time, campaigns should also be there among the general population as well as LEBs to make them aware of the rights of indigenous fishermen communities of Bangladesh. The government should also take strict punitive measures against all discriminatory acts that might negatively affect the development of these indigenous fishermen communities. It should be remembered that the people of these freshwater-based indigenous fishermen communities are the cultural assets of the country, and it is the moral responsibility of the greater community to support these groups so as to enable them to upgrade their social position through proper government support and interventions to combat extreme poverty and hunger. Other important areas include providing insurance cover to fishermen in terms of health and life, and creating housing and work shed facilities for indigenous fishermen. The process of developing indigenous fishermen as entrepreneurs, hence, should call for due recognition, and efforts should be directed at helping indigenous fishermen recognise their priorities to facilitate the transformation of their roles.

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Article

Transitional Phase in Agriculture Towards Modernisation: A Perspective on Paddy Cultivation

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Abstract

The contribution of agriculture in GDP of India is dramatically reduced though a large number of people are associated with this occupation. To increase the GDP contribution of agriculture and to raise the income of farmers, the use of modern machineries is an utmost necessity. The aim of this study is to identify the status of mechanisation of agriculture at Rampurhat: I block in Birbhum district to assess the impact of modern machineries on farming and livelihood status of farmers and agricultural labourers. To reduce the cost of agricultural production, farmers resort to farm mechanisation without changing the overall cultivation practice in this area. This region is in a transitional stage of modernisation of agriculture. This research also investigates and discusses the problems associated with the prospects of mechanisation of agriculture in this area.

Keywords

Mechanisation, system of rice intensification, traditional agriculture, unemployment, minimum support price

Introduction

Agriculture is the largest source of livelihood in India accounting for about 70 per cent of rural households. The GDP contribution of agriculture has considerably declined since independence though the production has steadily increased from 50 million tons in 1951 to 268 million tons in 2013–2014. Farmers have dramatically increased the use of certified quality seed, fertiliser and tractor after

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green revolution (Pray & Nagarajan, 2014). Modern agriculture involves direct commercial benefit which is the main criteria for the choice of a crop by a farmer (Singh, 2004). Indian agriculture has gone through several transformations but the production is resource intensive, cereal centric and regionally biased (FAO). The average size of landholdings of India was reduced only to 1.16 hectare in 2011 (Singh, 2015). Government of India is aiming at a twofold increase in the income of the farmers by the year 2022 (Chand, 2017). It has also been predicted in World Bank report that the percentage of agricultural workers to total working population of India would drop to 25.7 per cent by 2050 from that of 58.2 per cent in 2001 (*Economic Survey 2017–18*). The transitional phase from labour-intensive cultivation to farm mechanisation has a dualistic impact, that is, wealthy farmers realising higher profit from agriculture and the agricultural labourers losing jobs. This study investigates the impact of modern machineries on agriculture along with the cost assessment of such mechanisation and the potential solution to the bottleneck of mechanisation.

Materials and Methods

To collect data, a multistage random sampling method has been applied here. Four villages (Balia-Mrityunjoypur, Narayanpur of Narayanpur Gram Panchayat, Panisail village of Ayas Gram Panchayat and Garia village of Mashra Gram Panchayat) have been selected for the survey. For the survey, 15 farmers have been randomly selected from each of the villages selected. So, the total sample size is 60. In addition, owners of the harvesters, owner of the tractors, fertiliser shopkeepers, paddy traders, officials of Agro-Irrigation Department, officials of Institutional Strengthening of Gram Panchayats programme (ISGPP) and officials of Kishan Mandi were interviewed during the survey to understand the agricultural practices there and to assess the cost of inputs in paddy cultivation. About 70 per cent of gross cultivated area of Rampurhat-I block is cultivated by paddy (Assistant Directorate of Agriculture (Admin), Rampurhat I, Birbhum). Cost of paddy cultivation has been estimated to identify the impact of modern machineries on the stakeholders. Wage rate of agricultural labourers is not found equal across different parts of the block. Wage varies from ₹180 to ₹220. So the wage rate of ₹200 in the middle has been used for analysis. The cost of manual and mechanical process of cultivation has been computed based on the average production of Aman paddy per hectare. Cost of machineries has been computed based on rentals because most of the farmers used machineries on rent.

Result Obtained

Process of Paddy Cultivation

Process of Ploughing

About 81.66 per cent agricultural lands are ploughed by the tractors, 15 per cent by drought animal and the rest 3.33 per cent by power tiller. A tractor takes 1 hour

to plough 0.32 hectare of land whereas a power tiller takes 1 hour to plough 0.16 hectare of land. In contrast, 0.16 hectare of land can be ploughed on average by draught animal in 7–8 hours. The farmers who have drought animals or power tiller generally use them for cultivation of a small parcel of land (Julius, 2014; Phaniraja & Panchasara, 2009). The use of animal power is being reduced over the year, and tractors are widely utilised due to low cost of ploughing (Singh, Singh, & Singh, 2011). The share of tractor in farm power availability increased from 6.8 per cent in 1971–1972 to 45.8 per cent in 2012–2013 (Government of India, 2016). It is estimated that if they use drought animal they have to pay ₹1,600, but in case of the tractor and power tiller they have to spend ₹700 and ₹1,000, respectively, to prepare the same 0.16 hectare of land. For the purpose of land preparation, three labourers (₹600) are required per hectare of land.

Process of Transplantation

As shown in Table 1, all the farmers have been found to use traditional method and manual process for paddy transplantation. The system of rice intensification (SRI) method of cultivation is not adopted by the farmers. They use random method of transplantation instead of straight-row method. Figure 1 illustrates the causes of preferring traditional method to SRI method. *First*, all the interviewed farmers have opined that SRI method is labour intensive. This method involves careful transplantation process and thus utilises more labours than traditional method (Basavaraja, Mahajanashetti, & Sivanagaraju, 2008). *Second*, lack of awareness of 80 per cent respondents has been identified as the vital cause in this regard. *Third*, lack of proper training among farmers is another reason behind this. Some training programmes have been organised by the local governing bodies, but they seem to be insufficient. The non-governmental organisations (NGOs) are not well equipped and self-sufficient for imparting training. But some of the farmers could not accept it instead of traditional one despite their exposure to necessary training. *Fourth*, lack of assured irrigation is another cause for the rejection of this method. *Finally*, 83 per cent farmers have argued that they are relatively more comfortable with the traditional paddy cultivation procedure. Farmers have difficulties in adoption of SRI method due to their mindset or due to their traditional habit (Sarkar, 2017). S. N. Sinha wrote in his paper 'Economics of Cropping Pattern' that in a tradition-ridden country with a very low level of knowledge, the farmers are unwilling to do experiments.

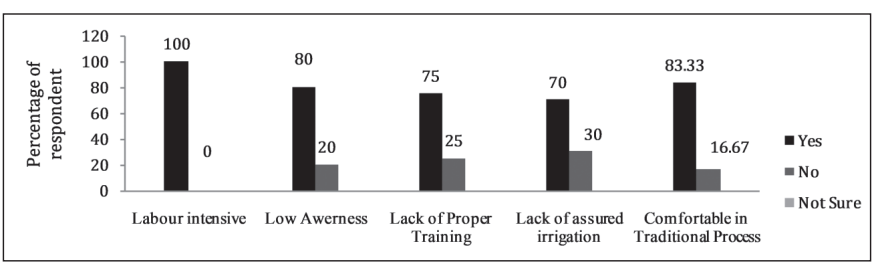

Figure 1. Causes of Unwillingness to Adopt System of Rice Intensification (SRI) Method

Source: Field survey 2018–2019.

Table 1. Process of Cultivation (%)

Transplanting	Manual	Mechanical	Semi mechanical
	100	0	0
	Random method	Straight-row method	–
	100	0	–
Weeding	Manual	Mechanical	Semi mechanical
	100	0	0
Harvesting	Manual	Mechanical	Semi mechanical
	43.33	48.33	8.33

Source: Field survey 2018–2019.

As they use traditional methods, 37 person-days (₹7,400 at the rate of ₹200 per labourer) are required for transplantation of paddy per hectare. The farmers have reported that they transplant 4–5 seedlings at a time within a gap of 4 inches in case of Boro Paddy and 6 inches in case of Aman paddy, and hence they need to use on average 37.5 kg seeds per hectare. Eighty per cent farmers buy new seed for cultivation, and rest of them make seed by selecting the best plant in the field for next season. The market price of seed is approximately ₹30 per kilogram with total cost equalling ₹1,125. They prefer to buy seed from markets because seed production at home is very time-consuming and laborious. So it can be understood that total cost of transplantation in manual process will be ₹8,525 per hectare. Recently, 'rice transplantation machine' has introduced in Birbhum to tackle the labour shortage in paddy cultivation. It takes only 5 hours to transplant 1 hectare of paddy field. If they use the 'walk behind rice transplantation machine', then it costs ₹3,000 per hectare including rent and fuel expenses. This technique requires two skilled agricultural labourers which costs ₹700 (₹350 per labourer). So, the total cost of mechanical process of transplantation will be ₹4,825 per hectare.

Process of Weeding

Weeding is one of the important processes of paddy cultivation which is done manually in this area, as they use traditional process, and the hiatus within the plants is short. So, the farmers are not able to use machineries (Table 1). The agricultural labourers are paid ₹100 per day roughly for it because they are unable to work full day due to hot and humid condition. On an average 19 agricultural labourers are needed for weeding 1 hectare of land which will cost ₹1,900 but if a farmer uses weeding machine then two labourers can complete the same task efficiently within a day which will cost approximately ₹600 including the rent of weeding machine of ₹200.

Application of Fertiliser and Insecticide

Farmers depend mostly on chemical fertiliser. No one cultivates paddy fully on the basis of organic fertiliser. About 82 per cent farmers use both organic and chemical fertiliser and 18 per cent are fully based on chemical fertiliser. Those who have domestic animals, such as cow, bullock and buffalo, generally use the animal

excrement as organic fertiliser. Those who have no such source use technologically developed 'organic fertiliser' which costs ₹625 per hectare for the amount of 155 kg. Some of the farmers also use the exchange process in this regard. They provide paddy straw to the owners of the draught animal and get the animal excrement which is further used as organic fertiliser. Due to high input cost, organic farming is not widely accepted here. Usually, farmers use chemical fertiliser such as Diammonium Phosphate (DAP) or Nitrogen Phosohorus Potassium (NPK grade 10:26:26) and urea for cultivation. For Aman paddy cultivation 13 kg of urea (₹7 per kilogram) and 20 kg of nitrogen, phosphorous and potassium (NPK)-based fertiliser (₹21 per kilogram) are used which cost ₹511 [(7 × 13) + (20 × 21) = 511] per 0.16 hectare. So the final estimation of expenditure on fertiliser use per hectare will be ₹3,818.75. Besides, farmers generally spend about ₹625 (₹500 to ₹750) per hectare on insecticides. To apply these and for maintenance of the crop, 5 person-days will be required which will cost ₹1,000 per hectare.

Process of Irrigation

In this block, farmers use flood irrigation method. It is a traditional irrigation method where water level cannot be maintained and excessive water is used due to the lack of awareness and proper knowledge (Srivastava, Kumar, & Singh, 2009). Due to distributional loss, the efficiency level of conventional flood irrigation is very low (Shivay & Singh, 2018). About 42 per cent of total cultivated lands of this block have irrigation facilities. According to *District statistical handbook*, Birbhum (2014), in this block 72.44 per cent of total irrigated area is facilitated by canal followed by the tank (18.11 per cent), shallow tub well (STW), deep tub well (DTW), etc. (Table 2).

From the field survey, it is found that about 61.67 per cent farmers prefer to use STW and DTW as irrigation followed by canal (21.67 per cent), pond/tank (15 per cent), etc. (Table 3).

The supply of canal irrigation is subject to adequate rainfall and sufficient storage of water. The supply of water through canals is irregular in most parts. The problems of this irrigation system are siltation and low maintenance due to lack of resources. Farmers reported that ponds/tanks are inadequate for cultivation. Implementation of MGNREGA has created and renovated several ponds/tanks but still the amount of water for irrigation is inadequate. Similar results are found

Table 2. Percentage of Lands Having Different Source of Irrigation

Canal	Tank/Pond	River Lift	DTW	STW	Open Dug Well	Others
72.44	18.11	2.41	2.75	3.02	0.06	1.21

Source: Department of Planning & Statistics (n.d.).

Table 3. Preferable Source of Irrigation Used by Farmers (%)

Pond/Tank	STW/DTW	Canal	Others
15	61.67	21.67	1.67

Source: Field survey 2018–2019.

in the study by Bassi and Kumar (2010). The cost of tank/pond and STW/DTW irrigation is close to ₹550 and ₹500 for each time of irrigation per 0.16 hectare, respectively. The pond/tank water irrigation has some limitations. The farmers who have partial ownership of pond are only eligible for irrigation with the permission from the other owners. The owners of STW/DTW charge ₹1,800 on contract basis per 0.16 hectare for Boro paddy cultivation. Irrigation has become a typical business for some big farmers, and majority of small and marginal farmers are generally water buyers (Srivastava et al., 2009). The ground water level is high in the eastern side of this block due to the availability of a huge number of STW/DTW but the farmers face difficulties in the western part of this block due to coarse grain soil, low water retention capacity and low level of ground water in these areas. Farmers of this block are very much affected by the variability of monsoons. In most cases, they have to irrigate during the sprout of panicles of the paddy spending ₹3,437.50 per hectare on average.

Process of Harvesting

About 48.33 per cent paddy fields have been harvested by combined harvester (Table 1). Of note, 8.33 per cent farmers use semi-mechanical process, that is, they use sickle for cutting and axial flow paddy thresher for threshing.

Benefits of Combine Harvester

All the farmers who had used mechanisation for harvesting told that the manual harvesting was very labour intensive leading to high production cost. As shown in Figure 2, 88.24 per cent farmers said that health problems among the agricultural labourers had been reduced to a great extent with the introduction of mechanisation. When labourers thrash and clean the dust of paddy/wheat manually, they sometimes face diseases such as respiratory allergy, eczema, etc. Of note, 88.24 per cent farmers said that transport cost has been reduced because they harvest paddy in the field and then send the products directly to the buyer's house. Earlier they have to bring the paddy along with straw to the thrashing floor, and after thrashing and winnowing the paddy was transported to the paddy vendors incurring additional transport cost. The field survey shows that in case of manual harvesting the post-harvest loss of paddy used to be 2.25 per cent on average of total paddy production. Alizadeh and Allameh (2013) have investigated that loss of paddy in manual harvesting process is higher than mechanised harvesting.

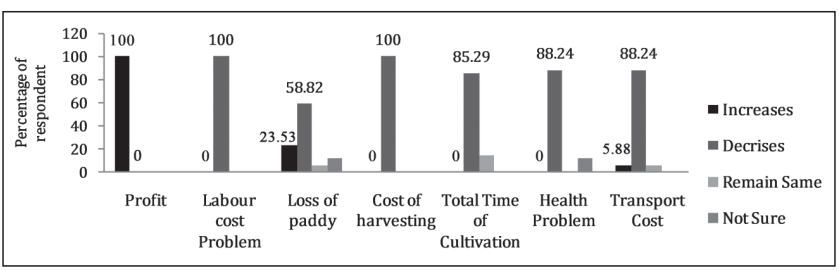

Figure 2. Benefits of Combine Harvester

Source: Field survey 2018–2019.

According to Directorate of Marketing and Inspection, Nagpur, 2002, the total post-harvest loss of paddy at the producers' level was about 2.71 per cent of total production in India. Of note, 58.82 per cent farmers said that after the use of combined harvester, losses of paddy have been reduced, but 23.53 per cent farmers opined that sometimes the losses of paddy would be higher than that in the manual one due to fewer number of harvesters available in the area. In such case, farmers have to wait for few days to harvest and due to this waiting period the paddy becomes extremely dry. The excessive drying and sometimes rewetting of grain causes more broken rice. According to 85.29 per cent farmers, harvesters have reduced the harvesting time because the entire process is done on the field in a single day, but 14.71 per cent farmers have mentioned that the time requirement is the same as earlier. All the farmers unanimously claimed that the profit has increased significantly by using modern machineries in agriculture. The change in agricultural practices helps to increase the efficiency of cultivation reducing the cultivation cost and generating more income and savings for the farmers (FICCI, 2015).

Problems Related to Combined Harvester

At present, the use of combined harvester is on the rise because of very limited domestication of drought animals. Due to the increasing demand of tin, asbestos and the effect of Pradhan Mantri Awas Yojana (PMAY) have significantly reduced the use of paddy straw for thatching, but those still engaged in animal husbandry are still using manual harvesting. As shown in Figure 3, 96.15 per cent respondents said that they were not using combined harvester because the straws were cut into small pieces in the process which had been very difficult for them to store as fodder. Of note, 84.62 per cent of the respondents, especially small and marginal farmers, are still using manual harvesting for income generation. About 84.62 per cent opined that the small field size became a significant problem in using combined harvest. Of the respondents, 53.85 per cent have mentioned that inadequate number of combined harvesters created a high demand and thus increased the rentals. Moreover, 38.46 per cent of respondents said that they were unable to use the machine until the neighbouring lands had been harvested. About 65.38 per cent of respondents said that harvesters are not suitable for swampy land. If rain occurs during the time of harvesting, the manual process has to be resorted.

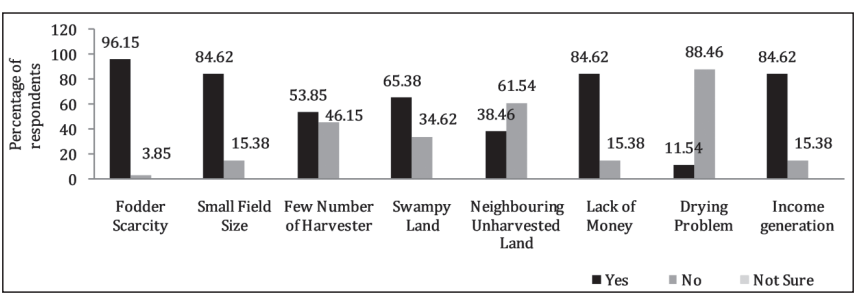

Figure 3. Problems Related to Combine Harvester

Source: Field survey 2018–2019.

Cost Assessment of Paddy Harvesting

It is estimated that manual harvesting requires six labourers for cutting, five labourers for stacking and five more labourers for threshing, cleaning and hauling per 0.16 hectares (total 100 agricultural labourers per hectare) on average. In this case, the total labour cost of harvesting is close to ₹20,000 per hectare. It requires 7 days on average to thresh 37.5 quintal of paddy and the rent of a paddle thresher machine is ₹1,050 at the rate of ₹150 per day. If a farmer uses a manual process for harvesting, the total cost of harvesting is ₹21,050 per hectare. But in case of a combined harvester, the rent would come around ₹4,218.75 per hectare on average. The rent of a combined harvester is ₹2,700 per hour, which can harvest 0.64 hectares of paddy field in just 1 hour. Edge and corner portion of the field may not be accessed by it; therefore, one labourer is required to work over there. In this case, the total harvesting cost is around ₹4,418.75 per hectare. Sometimes, farmers face difficulties in using harvester when the land is swampy. At that time, farmers use labourer for cutting, and to reduce the labour cost for staking, threshing, cleaning and hauling they use 'axial flow paddy thresher'. The rent of 'axial flow paddy thresher' is ₹5,625 per hectare (at the rate of ₹900 per 0.16 hectare) on average, and some owners of such machine charge 10 kg of paddy per quintal. In this case, the total cost of harvesting would be approximately ₹13,025 per hectare (₹7,400 for 37 labourers required for cutting the paddy manually and ₹5,625 as the rent of the thresher).

Discussion

Cost Assessment of Paddy Cultivation

On the basis of mechanisation, five cases of kharif paddy cultivation have been identified (Table 4). On an average 37.5 quintal paddy per hectare has been produced in kharif season. The income will be ₹58,125 (37.5 quintal × 1,550 rupees), if the farmers have sold the paddy on minimum support price (MSP) (₹1,550 per quintal in 2017–2018 for common variety). It is estimated that approximately 6 tons of paddy straw have been produced per hectare, which would have a market price of approximately ₹4,500 (₹750 per ton). If they use harvester or axial flow paddy thresher, the straw cuts into small pieces and market value of the paddy straw would be lower. Five cases based on MSP have been considered in this regard.

Case 1. If the farmers use draught animals for ploughing, manual process for plantation and harvesting and open dram paddle thresher, the production cost would be ₹50,956.25 approximately per hectare. The total income and the profit would be ₹62,625 and ₹11,668.75 per hectare, respectively.

Case 2. If the farmers use tractors for land preparation, manual processes for plantation and harvesting and open dram paddle thresher, the production cost of the paddy would be ₹45,331.25 per hectare. Total income and the profit would be ₹62,625 and ₹17,293.75 per hectare, respectively.

Case 3. If the farmers use tractors for ploughing, manual process for plantation and semi-mechanical process for harvesting (labour-intensive method for cutting and axial flow paddy thresher for threshing, cleaning and hauling), the production cost and income would be ₹37,306.25 and ₹58,125 per hectare. The profit would be ₹20,818.75 per hectare.

Case 4. If a farmer uses tractor, manual process for transplantation and combined harvester, the production cost of the paddy and income would be ₹28,700 and ₹58,125 per hectare. So, the profit would be ₹29,425 per hectare.

Case 5. If a farmer uses tractor for land development, walk behind rice transplantation machine and combined harvester, then the total cost and income become ₹23,700 and ₹58,125 per hectare, respectively. The profit is ₹34,425 per hectare.

In India, only 6 per cent of crops are purchased on MSP and remaining crops are purchased on 10 to 30 per cent lower prices (Sirohi, 2018). It has been observed that the price of the paddy was ₹1,320 at the beginning of harvesting season (Middle of November 2017) and it was increased to ₹1,480 per quintal in the first week of February 2018. The price fluctuates depending on fluctuations in the demand and supply of the crops. It is obvious that farmers earn more profit on average using tractors and harvesters, but who are not equipped with modern machineries are terribly affected by a low profit margin (Table 4).

Table 4. Cost Assessment of Paddy Production

Type of Expenditure	Case 1	Case 2	Case 3	Case 4	Case 5
Cost of paddy cultivation in rupees					
Cost of land development	10,600.00	4,975.00	4,975.00	4,975.00	4,975.00
Transplantation (labour/ machine and seed)	8,525.00	8,525.00	8,525.00	8,525.00	4,825.00
Weeding (labour/ machine)	1,900.00	1,900.00	1,900.00	1,900.00	600.00
Fertiliser and labour	4,418.75	4,418.75	4,418.75	4,418.75	4,418.75
Insecticide and labour	1,025.00	1,025.00	1,025.00	1,025.00	1,025.00
Irrigation	3,437.50	3,437.50	3,437.50	3,437.50	3,437.50
Cost of harvesting	21,050.00	21,050.00	13,025.00	4,418.75	4,418.75
Total cost	50,956.25	45,331.25	37,306.25	28,700.00	23,700.00
Income and profit/loss in rupees if the farmer sale the paddy on minimum support price					
Gross income by selling paddy (37.5 quintal at ₹1,550*)	58,125.00	58,125.00	58,125.00	58,125.00	58,125.00
Straw of paddy (6 tons at ₹750 per ton)	4,500.00	4,500.00	–	–	–

(Table 4 Continued)

(Table 4 Continued)

Type of Expenditure	Case 1	Case 2	Case 3	Case 4	Case 5
Total income	62,625.00	62,625.00	58,125.00	58,125.00	58,125.00
Profit/loss	11,668.75	17,293.75	20,818.75	29,425.00	34,425.00
Income and profit in rupees if the farmer sale the paddy on minimum price					
Gross income by selling Paddy (37.5 quintal at ₹1,320)	49,500.00	49,500.00	49,500.00	49,500.00	49,500.00
Straw of paddy (6 tons at ₹750 per ton)	4,500.00	4,500.00	–	–	–
Total income	54,000.00	54,000.00	49,500.00	49,500.00	49,500.00
Profit/loss	3,043.75	8,668.75	12,193.75	20,800.00	25,800.00
Income and profit in rupees if the farmer sale the paddy on maximum price					
Gross income by selling paddy (37.5 quintal at ₹1,480)	55,500.00	55,500.00	55,500.00	55,500.00	55,500.00
Straw of paddy (6 ton at ₹750 per ton)	4,500.00	4,500.00	–	–	–
Total income	60,000.00	60,000.00	55,500.00	55,500.00	55,500.00
Profit/loss	9,043.75	14,668.75	18,193.75	26,800.00	31,800.00

Source: Primary survey 2018–2019.

Note: *Common variety paddy in 2017–2018.

Problems of Modernisation and the Solutions

Contract-Based Agriculture

Machineries are used in agriculture to reduce production cost and labour-related problems (Medrano et al., 2016). Large farmers try to maximise their profits based on mechanisation indirectly creating challenges for the agricultural labourers in securing their livelihood. Majority of casual labours are experiencing occupational loss due to increased use of combined harvester (Aggarwal & Mishra, 1973). To counter this problem, the landowners can employ the agricultural labourers on contractual basis, that is, to take resort to share cropping. The cost of agriculture (excluding labour) is equally borne by the landowners and the family/group of agricultural labourers who are in the contract and then the production is also divided equally between them. Only tractor can be used for land preparation because drought animals are now significantly reduced in villages. Apart from that, other part of cultivation will be done manually to sustain the livelihood status of the agricultural labourers. The farmers can earn slightly higher profit by using modern machineries but it would create economic imbalance in the society. Land owners will make profit from their lands and agricultural labourers will generate income by converting their labour into money. The paddy should be sold on MSP for better profit.

Table 5. Material Cost of Each Party in Paddy Cultivation (Rs.)

	Material Cost	Labour Cost	Total
Cost of land development	4,375.00	600.00	
Material cost (seed, fertiliser, pesticide and irrigation) Labour cost (transplantation, weeding and maintenance)	9,006.25	10,300.00	45,331.25
Material cost (rent of machine for harvesting) Labour cost (harvesting)	1,050.00	20,000.00	
Total	14,431.25	30,900.00	
Material cost of each party	7,215.625		

Source: Primary survey 2018–2019.

Table 6. Income of Each Party in Paddy Cultivation

	Income from Paddy and Straw (Rs.)		Expenditure Excluding Labour Wage (Rs.)		Profit (Rs.)	
Category	**Individual**	**Total**	**Individual**	**Total**	**Individual**	**Total**
On the basis of minimum support price, ₹1,550.00 per quintal						
Landowner	31,312.50	62,625.00	7,215.625	14,431.25	24,096.875	48,193.75
Agricultural labourer	31,312.50		7,215.625		24,096.875	

Source: Primary survey 2018–2019.

The calculation has been made by considering 'Case 2' as an ideal agricultural practice (Table 4). In this case, out of total expenditure (₹45,331.25), the total input cost for paddy cultivation is ₹14,431.25 per hectare (Table 5). In terms of MSP prices, the income is ₹62,625 per hectare including paddy and the paddy straw. Hence the profit after deducting the input cost is ₹48,193.75 in total and ₹24,096.875 individually per hectare (Table 6).

Use of SRI Method

SRI method is suggested to be implemented in paddy cultivation which is likely to increase production and reduce the rate of ground water extraction. In SRI method, a single seedling is used to transplant at a time within a gap of 10 inches. SRI technique reduces the requirement of water by 25–30 per cent, but it needs frequent irrigation. 'Alternate wetting and drying' (AWD) irrigation system has been recommended for water management practice under SRI method (Pandian, Sampathkumar, & Chandrasekara, 2014). This method increases labour cost of transplantation but it helps to reduce huge occupational loss among agricultural labourers and also increase the profit of farmers by enhancing production. Using this method, the overall production can be

increased by 20–50 per cent than traditional method (Adusumilli & Laxmi, 2011; Pandian et al., 2014; Sarkar, 2017).

Crop Diversification

After the assured irrigation like DTW/STW, the farmers are much interested in paddy cultivation instead of pulses for greater profits. Mono cropping practice is shifted into crop diversification. Kharif paddy production has been affected by monsoon vagaries in the last 3–4 years. With the help of STW/DTW and canal facilities, the eastern part of the block had been cultivated on time (July) but in the rain-fed western part it is highly vulnerable (e.g., Mashra Gram Panchayat). Sometimes, the areas are transplanted in the last week of September and due to insufficient source of water the crops become parched. To reduce the over-exploitation of ground water, more attention should be given to surface water management. The drought-affected areas should be brought under lift irrigation facility. State Government is encouraging maize and pulses cultivation to reduce the overdependence on paddy cultivation.

Kisan Mandi

Kisan Mandi (Government sponsored Farmers' Market) are developed in the block level where farmers can sale their paddy and other crops on MSP. But all the farmers cannot benefit from it equally. Besides, the biggest problem is lack of storage in *Kisan Mandi* (Eapen, 2018). To increase the efficiency of it, Gram Panchayat level *kisan mandi* should be developed.

Proper Use of Paddy Straw

The farmers who use combined harvesters burn the straws after harvesting which causes air pollution. To prevent such environment-related problem and to maximise income sustainably, the residue of the paddy should be used properly. Small-scale *rice straw pellet* and *rice husk pellet* industry should be built in this regard which has great economic value in the international market.

Livelihood Security Through Government Schemes

The 100-day job guarantee under *Mahatma Gandhi National Rural Employment Guarantee Act* (MGNREGA) should be secured for the families who are facing challenges by agricultural mechanisation. Self-employment programmes like *National Rural Livelihood Mission* and skill development programmes should be implemented effectively in this region for employment generation.

Conclusion

It can be concluded that big farmers highly benefit from agricultural mechanisation. Small farmers are less interested to use it, and the agricultural labourers face livelihood shock due to such mechanisation. They may need to switch their occupation to non-agricultural activities by losing their job guarantee in

agriculture. Minimum uses of machineries will sustain the occupational security in this block until the alternative livelihood options are not intensified. The contract-based farming may help to produce a fallback option of employment along with stable income to the poor where job *opportunity* is inadequate and the unemployment rate is increasing at a galloping rate. In conclusion, it is necessary to say that this area is experiencing the transitional phase of agricultural modernisation in an unplanned manner. Ex-situ technologies are increasing its domain harshly, but local governing bodies and the non-profit organisations should analyse this situation and prepare some roadmaps for sustainable regional development. In contemporary context agricultural modernisation is indeed a wise choice, but its impact on that area is also a matter of concern. This study endeavours to develop a general equilibrium model in which balanced economic development can be achieved in rural areas.

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Declaration of Conflicting Interest

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Article

Decomposing Rural Income into Sectors to Identify Their Likely Contributions to Rural Poverty Reduction in Bangladesh

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Abstract

The article estimates the contribution of total income from each sector to the overall rural income. It tests if the poor, who are concentrated in the lower-income quintiles, gain most from farm or non-farm sources of income growth. Also, within the farm or non-farm income, what are the relative contributions of its different sources. The dominance of agriculture is still there for the lowest quintile of rural households, farming still being the dominant sub-category. Over 1991–2010, a 13 per cent decrease in per capita real income from agricultural wages for all rural households and a 41 per cent decrease in that for Quintile 1 rural households contradict the earlier finding that increases in real wages were one of the main contributors to poverty reduction. Quintile-wise decomposition suggests that a substantial income enhancement was realised at upper quintiles of rural households. It also appears from the quintile-wise decomposition that the efficiency enhancement was realised more at upper quintiles leaving a relatively smaller effect on poverty reduction.

Keywords

Decomposition of rural income, rural poverty, agricultural income, farming income, wage income

This article has been prepared based on the report entitled 'Decomposition of Rural Poverty Reduction in Bangladesh: The Recent Trend'.

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Introduction

Bangladesh was able to drastically reduce poverty rates during the last decade. On an average, poverty declined 1.74 percentage points per year until 2010 despite a series of adverse shocks that affected Bangladesh in 2007/2008. As of 2010, poverty was down to 31.5 per cent according to household income expenditure survey (HIES 2010) of Bangladesh Bureau of Statistics (BBS). Urban areas have achieved remarkable progress with a 39.5 per cent reduction in poverty by that time. However, extreme poverty which declined by 44 per cent in rural areas compared to 61 per cent in urban areas continues to be a significant rural phenomenon (Jolliffe, Sharif, Gimenez, & Ahmed, 2013). Along this line of reasoning, this World Bank report states that the rural poverty reduction was due to (a) increase in the demand for unskilled workers and (b) increase in real rural wages. However, adequate evidence for the increase in demand for unskilled labours in the rural areas was not provided in that report. Based on the data obtained from last three (2000, 2005 and 2010) HIES surveys, the report claims that labour income was the single most important contributor to poverty reduction, while the growth in labour income, in turn, was mostly driven by increases in farm income.

A greater contribution of rural non-farm income and overseas remittances to poverty reduction has been a widely acceptable proposition to many of us in Bangladesh. With the dominance of farm income in the reduction of national poverty as claimed, a greater prevalence of extreme poverty in rural areas deserves further scrutiny. From the policymaking perspective, it is important to understand the factors driving these seemingly paradoxical outcomes. This article tests whether the broad conclusions in the World Bank Poverty Report (2013) about the drivers of poverty reduction in rural Bangladesh are right.

The main objective of this article is to estimate the contribution of total income from each sector to the rural income. It allows us to see if the poor, who are concentrated in the lower-income quintiles, gain most from farm or non-farm sources of income growth. Also, within the farm or non-farm income, what are the relative contributions of its different sources. However, we do not decompose rural income with the objective of matching the reductions in poverty into specific components of income here. Another purpose of this article is to analyse the dynamics of rural income for the 20-years period spanning from 1991–1992 to 2010 using 1991–1992, 1995, 2000, 2005 and 2010 HIES surveys of BBS.

The second section of this article discusses the relevant literature on poverty figures and decomposition methods. The third section analyses the decomposition of per capita real income of rural households across sectors and across quintiles where the subsections analyse: the decomposition of overall per capita rural income into sectors, the growth of overall per capita real income across quintiles, the decomposition of per capita rural income at quintile level, the shift in occupations over time in different quintiles and the changes in the non-farm sources of income of the agricultural group. The fourth section analyses the relative efficiency, real wages, and unskilled labour demand shortly. The fifth section compares the income figures with other studies and discusses the limitations with the sixth section providing the summary.

Related Literature

According to Inchauste, Olivieri, Saavedra, and Winkler (2012), the contributions to moderate poverty reduction on account of labour markets amount to 61 per cent in Bangladesh. Within this, the increase in the returns to endowments or characteristics explains most of the observed poverty reduction. Increases in real wages and higher productivity were shown as the main contributors to poverty reduction in this case. Several potential reasons have been cited in that study that could explain the dominance of labour incomes in explaining reductions in poverty in Bangladesh, Peru and Thailand. As shown, there were changes in the occupational structure, with workers moving away from farm and daily work and toward salaried employment, which are likely to be economic activities with higher productivity.

Jolliffe et al. (2013) provide figures which indicate change in the ratio of the rural working-age population to the total population. Despite it does not mean that there has been a decline in the ratio of rural to total national working-age population in each period and thus a corresponding increase in the ratio of urban to the national working-age population in each period. Since changes in rural real wages depend on both demand and supply of rural labour, we cannot argue that the migration has been an important part in raising real wages in rural areas; not even when we accept that there has been a consistent migration of rural working-age population to the urban areas. This is very important for our analysis of rural poverty reduction.

There are different strands of methodologies to deal with the macro decomposition of poverty reduction. Datt and Ravallion (1992) method, one of the most widely used methods, splits changes in poverty into distribution-neutral growth, a redistributive effect and a residual. Kolenikov and Shorrocks (2005) decompose changes in poverty into growth, distribution and structural effects, while Ravallion and Huppi (1991) offer a way of decomposing changes in poverty over time into intrasectoral effects, a component due to population shifts and an interaction term between sectoral changes and population shifts. The tables constructed here are in line with the spirit of these macro decomposition methods. There are problems with the way poverty decomposition is planned to be executed here. Since the constructed tables will deal with summary statistics only, the insights obtained from them will need to be further investigated if deemed necessary.

Breakdown of Rural Income Growth into Sectors and Quintiles

The total rural income from the agricultural sector is composed not only of the income of those households whose major occupation is agriculture (i.e., largest source of income is from agriculture) but also of those whose major occupation is not agriculture but a smaller share of their income is derived from agriculture. To derive the total rural income from agriculture we need to add income derived from agriculture not only of those whose major occupation is agriculture, but also income derived from agriculture of those whose major source of income is outside agriculture.

To better understand the sector dynamics of rural poverty reduction, we classify the rural households as follows:

1. Agriculture: Farming and agricultural wages and salary
   a. Farming
   b. Agricultural wages and salary
2. Non-agricultural income:
   a. Non-agricultural wage
   b. Non-agricultural salary
   c. Non-farm enterprise
3. Remittances and transfers:
   a. Foreign remittances
   b. Transfers (+ domestic remittances)
4. Other income:
   a. Rent from land
   b. Return to other assets
   c. Others

Even though subsector (1b) includes wages and salaries, it presents almost entirely wages. In the case of HIES 1991–1992 and 1995–1996 survey, salary was not shown separately. In HIES 2000, salary was in the questionnaire separately but there was no household observation in this category. However, very few households (only 41) were observed in HIES 2005 and 2010. Thus, we kept wages and salary together to make per capita income from this category comparable across years.

Decomposition of Overall per Capita Rural Income into Sectors

The contribution of each of the sectors (as defined above) to the total real income of all the rural households have been calculated and presented in Table 1a. The first column of Table 1a presents the broad sector categories, the second column shows the breakdown of per capita real income of rural households into sectors where income includes all income (i.e., income from both major and other occupations). The third column shows the contribution of each sector to the total per capita real income of all rural households, and the fourth column shows the proportion of rural households in a sector.

Table 1a. Breakdown of per Capita Rural Income (Annual) into Sectors (Base Year—1991–1992)

	1991–1992			2010		
Income From	**Per Capita (PC) Income**	**%**	**% of Households (HH)**	**PC Income**	**%**	**% of HH**
1. Agriculture: farming and agricultural Wages & Salary	**3558**	**53**	**58**	**3014**	**34**	**38**
1a. Farming	2698	40	37	2270	26	22
1b. Wages & Salary	860	13	21	744	8	16

(Table 1 Continued)

(Table 1 Continued)

Income From	1991–1992 Per Capita (PC) Income	%	% of Households (HH)	2010 PC Income	%	% of HH
2. Nonagricultural income	**1564**	**23**	**25**	**3054**	**35**	**41**
3. Remittances and Transfers	**755**	**11**	**10**	**1775**	**20**	**12**
4. Other Income	**876**	**13**	**6**	**3024**	**11**	**9**
Total (1+2+3+4)	6753	100	100	8840	100	100

Source: Authors' own construction from data.

Comparing Column 6 with Column 3 of Table 1, we obtain that the contribution of agriculture to per capita real income of rural households went down from 53 per cent in 1991–1992 to 34 per cent in 2010, a decrease of 35.3 per cent, whereas the proportion of households in agriculture went down from 58 per cent in 1991–1992 to 38 per cent in 2010, a decrease of 33.7 per cent. A relatively larger fall in agricultural contribution is evident here. However, breakdown of the changes in two periods—1991–2000 and 2000–2010—gives us a better understanding of it. Agricultural contribution declined 51.4 per cent against the 37.8 per cent fall in the proportion of households in agriculture over 1991–2000 showing a relatively larger fall in agricultural contribution during that period. To the contrary, a 33.1 per cent increase in agricultural contribution against a 4.9 per cent increase in the proportion of households in agriculture shows a large relative increase in agricultural contribution over 2000–2010.

For non-agriculture, the contribution went up by 49.2 per cent against the 63.3 per cent increase in the proportion of households in non-agriculture over 1991–2010. However, a 101 per cent increase in non-agricultural contribution against an 84 per cent rise in the proportion of households in non-agriculture shows a relatively greater increase in non-agricultural contribution during 1991–2000. To the contrary, a 25.8 per cent decrease in non-agricultural contribution against a 10.9 per cent decrease in the proportion of households in non-agriculture shows a large relative decrease in non-agricultural contribution over 2000–2010. We need to be able to explain the driving forces behind that huge changes in rural household income.

The fluctuation of these contributions over the 20-years period is presented in Chart 1. Chart 1 shows that the contribution of agriculture dropped from 1991 to 2000 and increased thereafter. To the contrary, contribution of non-agriculture started increasing from 1991 to 2000 and fell thereafter. Contributions from both the sectors converged to nearly the same level in 2010. Therefore, the claim of the study by Jolliffe et al. (2013) is found valid for the period of 2000–2010 in terms of income growth. But non-agriculture dominated agriculture in 2010 in terms of its contribution in per capita real income of rural households. However, it is the growth of non-agricultural income which has made the major contribution to the income of rural households during the periods of 1991–2000. Contribution of remittances and transfers increased steadily over the 20-years period.

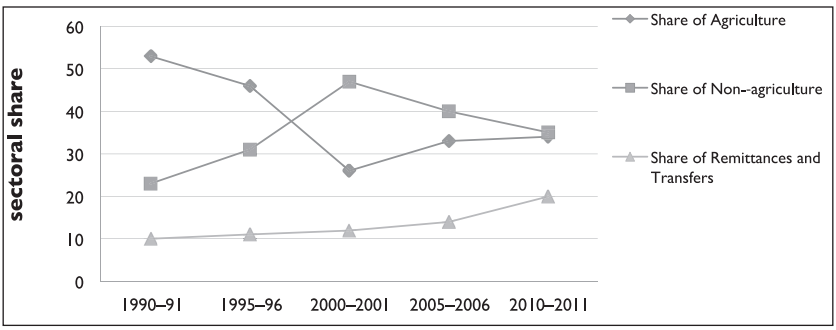

Chart 1. Trend of Income Shares of Different Sectors as a per cent of Rural per Capita Income

Source: Authors' own construction from data.

Table 1b. Change in per Capita Real Income of Rural Households

Category/Sub-category	1991–2000	2000–2010	1991–2010
Overall	**12.3**	**16.6**	**31.0**
Income from agriculture	**–45.4**	**55.2**	**–15.3**
Farming	–50.0	68.4	–15.9
Wages and salaries	–31.9	25.2	–13.5
Income from non-agriculture	**125.6**	**13.5**	**95.3**

Source: Authors' own construction from data.

As shown in Table 1b, the overall per capita real income of rural households increased 12.3 per cent over 1991–2000, with a 45.4 per cent decrease in agricultural income and a 125.6 per cent increase in non-agricultural income, and increased 16.6 per cent over 2000–2010, with a 55.2 per cent increase in agricultural income and a 13.5 per cent decrease in non-agricultural income. However, there is a 31 per cent increase in overall per capita real income of rural households over 1991–2010 when the real per capita income from agriculture went down from Tk. 3,558 in 1991–1992 to Tk. 3,014 in 2010, a decrease of 15.3 per cent, and real per capita income from non-agriculture went up from Tk. 1,564 in 1991–1992 to Tk. 3,054 in 2010, an increase of 95.3 per cent.

In the case of agriculture, the sectoral decline in per capita real income that occurred during 1991–2000 more than offset the gains that took place during 2000–2010 leaving the decline at 15.3 per cent for the entire period of 1991–2010. This lead us to conclude that agriculture experienced a shock during 1991–2000 what was partially recovered in 2000–2010. There was a decrease in per capita real income from farming by 50 per cent over 1991–2000, whereas the increase was 68.4 per cent over 2000–2010 leaving a 15.9 per cent decline over the entire period of 1991–2010. A similar conclusion follows for wages and salaries component of per capita real income. Thus, concluding a strong role of agriculture

in poverty alleviation of rural households is not plausible. The experience of an upswing in income growth of agriculture during 2000–2010 is just a recovery after the absorption of an earlier shock in agriculture during 1991–2000.

When we consider the changes in per capita real income from wages then we see a 13.5 per cent drop in it despite the fact that there had been a substantial increase in agricultural real wage with a slight decline during 1995–2000 (Taslim & Taslim, 2008). It might be the fact that there was a drop in the number of working days in a year during that period. This is obvious from the sharp decline of per capita real income from farming indicating a lower demand for labour in agriculture than previous comparable period. The change in relative real earnings between agriculture and non-agriculture—might be one of main the driving forces of the dominance of non-agriculture in real per capita income of rural households in 2010—also reflected an increase in the share of non-agricultural households from 25 per cent in 1991 to 41 per cent in 2010 along with a decrease in agriculture's share from 58 per cent in 1991 to 38 per cent in 2010. The shares of remittances and transfers and other income increased slightly from 10 to 7 per cent in 1991 to 12 and 9 per cent in 2010, respectively.

The scenario we have got from the discussion so far is based on the average per capita real income of all the rural households. The question is how this changes when our focus is only on the lowest quintile (in terms of income) of the rural households. To better understand the link of rural poverty reduction with sector dynamics we need to examine the corresponding changes at different quintiles, especially at the bottom two quintiles where the poor are mainly concentrated.

Growth of Overall per Capita Real Income Across Quintiles

We expect a strong growth in per capita real income for rural households in bottom quintiles to match the poverty reduction as claimed. Of course, this growth has to come from agriculture and non-agriculture both. But the sharp decline in real per capita income from agriculture and a small increase in real per capita from non-agriculture do not explain such reality. Before we explain this inconsistency, it may be helpful to present the growth of per capita real income between the years for each quintile and the overall rural income together. Table 2 presents both overall and quintile level per capita real income and their growth over different periods.

Table 2. Growth of per Capita Real Income in Each of the Quintiles

Quintile	1991–2000	2000–2010	1991–2010
Q1	–25.5	17.6	–12.3
Q2	–9.7	8.9	–1.7
Q3	–4.9	11.7	6.2
Q4	4.2	14.2	18.9
Q5	42.4	18.5	68.7
Total	12.3	16.6	30.9

Source: Authors' own construction from data.

As shown in Table 2, growth of per capita real income at Quintile 1 was –25.5 per cent for 1991–2000 and 17.6 per cent for 2000–2010, while it was –12.3 per cent for the entire 1991–2010. The corresponding figures for the entire 1991–2010 are –1.7, 6.2, 18.9 and 68.7 per cent for Quintiles 2, 3, 4 and 5, respectively. This huge negative growth in overall per capita real income at the lowest quintile does not go along the huge poverty reduction what we experienced according to many studies, and also maybe that is why the poverty reduction in rural households is slow (World Bank Poverty Report, 2013). The conclusion here is that quintile-wise decomposition suggests that substantial income enhancement was realised at upper quintiles leaving a relatively smaller effect on poverty reduction.

Decomposition of per Capita Rural Income at Quintile Level

Here we decompose per capita real income into sectors at quintile level. Table 3 presents the breakdown of per capita real income of rural households for Quintile 1 into sectors obtained for the five surveys being used for this analysis. The average per capita real income of Quintile 1 households is Tk. 2,820 which is just 42 per cent of the overall average Tk. 6,753. There was a decrease in per capita income from all sectors with the highest fall of 35.3 per cent for farming over 1991–2010.

Non-agricultural income for Quintile 1 households also experienced a 19.3 decrease during that period. However, there were gains for many sectors except wages and other income categories, with the highest gain of 109.3 per cent from remittances and transfers during 2000–2010. Despite only non-agriculture and remittances and transfers showed positive change for the entire period, 1991–2010, with the highest gain of 51.9 per cent from the latter category. Therefore, a greater contribution of remittances to poverty reduction gets credence which has been a widely acceptable proposition to many of us in Bangladesh. Also, the role of rural non-farm income in poverty reduction is evident even though at a smaller magnitude than remittances.

Table 3. Breakdown of per Capita Real Income into Sectors Along with Change Over Time/Quintile 1

Income From:	1991	1995	2000	2005	2010	1991–2000	2000–2010	1991–2010
1. Agriculture: Farming and agricultural wages and salary	1,563	1,204	1,085	1,116	1,156	–30.6	6.5	–26.0
a. Farming	671	558	434	481	632	–35.3	45.7	–5.8
b. Wage and salary	892	646	651	635	524	–27.0	–19.6	–41.3
2. Non-agricultural income	707	529	570	616	767	–19.3	34.6	8.6

(Table 3 Continued)

(Table 3 Continued)

Income From:	1991	1995	2000	2005	2010	1991–2000	2000–2010	1991–2010
3. Remittances and transfers	235	110	171	185	357	–27.4	109.3	51.9
4. Other income	316	276	276	254	193	–12.5	–30.2	–38.9
Total (1 + 2 + 3 + 4)	2,820	2,119	2,102	2,170	2,473	–25.5	17.6	–12.3
N	768	1,008	1,245	1,280	1,567			

Source: Authors' own construction from data.

Above all, 13.5 per cent decrease in per capita real income from agricultural wages for all rural households and 41.3 per cent decrease in that for Quintile 1 rural households contradict the finding that increases in real wages were one of the main contributors to poverty reduction. As a result, the contribution of agricultural wages in per capita real income at Quintile 1 households decreased from 32 per cent in 1991–1992 to 21 per cent in 2010 against the corresponding figures for farming as 24 per cent in 1991–1991 to 26 per cent in 2010 (shown in Table A2). Total earnings from agricultural wage depend not only on the wage rate but also on the number of days worked. The combined effect does not support it as the driving force for poverty reduction.

However, the dependence on agriculture is slightly lowered in the case of Quintile 2 rural households (Table A3 in the Appendix). For this set of households, contribution of agriculture came down from 57 per cent in 1991 to 44 per cent in 2010 whereas contribution of non-agriculture came up from 23 per cent in 1991 to 36 per cent in 2010, which shows an increasingly greater dependence on non-agriculture than Quintile 1 households. If we look into subsectors of agriculture, we find contribution of farming to decrease from 35 per cent in 1991 to 23 per cent in 2010. However, contribution of wages and salary remains almost the same. Unlike Quintile 1, we find no sharp change in the incomes of farming and that of wages and salary over 2005–2010. Similar trend is obvious for other quintiles even though the dependence on agriculture and farming is more pronounced. Another striking change to cite is the increasing dependence of top quintile households on remittances and transfers. Contribution of remittances and transfers increased from 13 per cent in 1991 to 28 per cent in 2010 (Tables A4–AA6 in the Appendix).

Shift in Occupations Over Time in Different Quintiles

We need to look into if there is a significant change in the proportions of households in different income groups across quintiles over that period to better understand occupation-based poverty dynamics. Table 4 presents the change in occupational proportions in different survey years over the 1991–2010 periods for different quintiles. It is interesting to see agriculture is always embracing almost 50 per

cent of the agricultural households at the lowest quintile. Proportion of Quintile 1 rural households remained in agriculture fluctuated from as high as 62 per cent in 1995–1996 to as low as 47 per cent in 2010.

As we move up, the income ladder the proportion of rural households, agriculture being main profession, declines fast. It came down from 61, 62, 54 and 54 per cent in 1991–1992 to 44, 39, 34 and 28 per cent in 2010, for Quintiles 2, 3, 4 and 5, respectively. To the contrary, as we move up the income ladder the proportion of rural households, non-agriculture being main profession, rises fast. It came up from 26, 22, 26 and 24 per cent in 1991–1992 to 42, 47, 46 and 37 per cent in 2010, for Quintiles 2, 3, 4 and 5, respectively. The least switching of income occupation is observed for the lowest quintile.

Changes in the Non-farm Sources of Income of the Agricultural Group

We have special interest in the poverty and income of the agricultural occupation group. The standard hypothesis is that non-farm sources of income of the agricultural group have increased over time. This has contributed to the income increase in agricultural group as well as decline in their poverty rate. We could not prove that poverty rate in agricultural group had declined substantially over time. Still, we intend to test here if non-farm sources of income of the agricultural group had increased over time. If not, then we cannot reject the standard hypothesis regarding the surge in non-farm sources of income of the agricultural group behind the poverty reduction in agricultural group.

We have prepared Tables 5–8 which show only two occupational categories—(a) agriculture (as defined above) and (b) non-agriculture (the rest of occupations). Table 5 presents the shares of non-agricultural income in agricultural group across the years. Column 'Ratio' of Table 5 shows the ratio of non-agricultural income in agricultural group to the total income of agricultural group except for the bottom row. For the bottom row of Table 5, Ratio shows the ratio of non-agricultural income from major source of non-agriculture to the total income of non-agricultural group which includes both non-agricultural and agricultural incomes. If this ratio takes the value of 1.0, it will indicate zero income from agricultural sources for non-agricultural households.

The share of non-agricultural income in the total income of agricultural households increased from 17 per cent in 1991 to 19 per cent in 1995 to 20 per cent in 2000. Thereafter it declined to 19 per cent in 2005 and then it declined to 15 per cent in 2010. This implies no surge in non-agricultural income in agricultural households denying the indirect benefit of latter from the former. No obvious link between this ratio and the poverty rates across years does exist. A similar pattern is observed for subsectors of agriculture and non-agricultural households. The share of non-agricultural income in total agricultural income of each quintile over the years showed an increase initially and a decline thereafter. Again no deterministic relationship between the share of non-agricultural income in total agricultural income and the poverty rates across years was found.

Table 4. Proportion Households in Each Occupational Categories Across Quintiles

		1991–1992	1995–1996	2000	2005	2010		1991–1992	1995–1996	2000	2005	2010
Occupational category	Q1						Q4					
1. Agriculture		0.59	0.62	0.53	0.56	0.47		0.54	0.49	0.28	0.38	0.34
a. Farming		0.21	0.24	0.22	0.22	0.23		0.42	0.36	0.22	0.25	0.23
b. Wage and salary		0.38	0.38	0.32	0.34	0.24		0.11	0.13	0.06	0.12	0.11
2. Non-agriculture		0.27	0.28	0.28	0.30	0.33		0.26	0.39	0.55	0.47	0.46
	Q2						Q5					
		0.61	0.57	0.46	0.51	0.44		0.54	0.42	0.18	0.28	0.28
		0.34	0.28	0.18	0.24	0.19		0.46	0.36	0.17	0.24	0.25
		0.27	0.28	0.28	0.27	0.25		0.08	0.06	0.01	0.04	0.03
		0.26	0.33	0.42	0.41	0.42		0.24	0.37	0.57	0.45	0.37
	Q3											
		0.62	0.54	0.37	0.44	0.39						
		0.42	0.34	0.21	0.24	0.20						
		0.19	0.20	0.16	0.20	0.20						
		0.22	0.35	0.49	0.44	0.47						

Source: Authors' own construction from data.

Table 5. Ratio of Non-agricultural Income in Agricultural and Non-agricultural Group

	1991		1995		2000		2005		2010	
Major Occupation	**Ratio**	**Poverty Rate**	**Ratio**	**Poverty Rate**	**Ratio**	**Poverty Rate**	**Ratio**	**Poverty Rate**	**Ratio**	**Poverty Rate**
Agriculture	0.17	0.54	0.19	0.63	0.20	0.58	0.19	0.54	0.15	0.56
Farming	0.19	0.43	0.22	0.51	0.22	0.43	0.21	0.43	0.14	0.46
Wages & Salary	0.16	0.74	0.16	0.80	0.17	0.77	0.16	0.66	0.16	0.69
Nonagriculture	0.85	0.53	0.85	0.53	0.92	0.36	0.90	0.39	0.89	0.44

Source: Authors' own construction from data.

Table 6. Per Cent of Rural Households Required for 1 per Cent of Rural Income Gain

Category	1991	1995	2000	2005	2010
Agriculture	1.09	1.15	1.42	1.30	1.12
Non-agriculture	1.09	1.10	0.98	1.03	1.17
Contribution/non-agriculture–agriculture	0.17	0.19	0.20	0.19	0.15
Contribution/agriculture–non-agriculture	0.15	0.15	0.08	0.10	0.11

Source: Authors' own construction from data.

Relative Efficiency, Real Wages and Unskilled Labour Demand

Dynamics of Relative Efficiency of Agriculture and Non-agriculture

As already argued in several subsections above, agriculture grew slowly whereas non-agriculture grew fast during 1991–2000. To the contrary, agriculture grew fast whereas non-agriculture grew slowly during 2000–2010. We can link this growth with efficiency in these sectors. If we put proportion of rural households in agricultural group next to contribution of agriculture to total rural per capita income, then we get interesting results.

When the contribution of agriculture was 53 per cent in 1991–1992, the proportion of rural households in agriculture was 58 per cent (Table 1). For making 1 per cent contribution to rural household income, agriculture required 1.094 per cent of rural households in agricultural group. Contribution of agriculture went down from 53 per cent in 1991–1992 to 34 per cent in 2010 with agriculture requiring 38 per cent of the rural households (Table 1). For making 1 per cent contribution to rural per capita income in 2010, agriculture required 1.118 per cent of rural households in agriculture which is 0.023 percentage points or 2.1 per cent more than in 1991.

Table 6 presents the per cent of households required for making 1 per cent contribution to overall rural per capita income by different sectors. Table 6 also presents the share of non-agricultural income in the total income of agricultural households and also the share of agricultural income in the total income of non-agricultural households. The share of non-agricultural income in the total income of agricultural households did not fluctuate much from its 20 years average of 18 per cent. Similarly, the share of agricultural income in the total income of non-agricultural households did not fluctuate much from its 20 years average of 12 per cent.

Everything else remains the same, part of the higher growth in agricultural group over 2000–2010 may be explained by the relative efficiency enhancement in the agricultural sector. Efficiency was the lowest in 2000 which is agriculture requiring 1.42 per cent of rural households in making 1 per cent contribution to

rural per capita income. Thereafter, efficiency enhanced gradually requiring 1.12 per cent of rural households in making 1 per cent contribution to rural per capita income in 2010. It is clear from Table 6 that agricultural efficiency decreased over 1991–2000 and it increased thereafter. It appeared from the discussion on quintile-wise decomposition that the efficiency enhancement was realised more at upper quintiles leaving a relatively smaller effect on poverty reduction.

Real Wages and Unskilled Labour Demand on Poverty Reduction

Separate efficiency estimates for farming and wages and salary are presented in Table 7. For making 1 per cent contribution to rural household income, farming required 0.93 per cent of rural households in 1991 than requiring 0.85 per cent of rural households in 2010 which went up to 1.11 per cent in 2000. For making 1 per cent contribution to rural household income, wages and salary required 1.62 per cent of rural households in 1991 than requiring 2.0 per cent of rural households in 2010 which went up to 2.13 per cent in 2000. This implies a fall in its relative efficiency over time.

Since the contribution of agriculture came down from 53 per cent in 1991–1992 to 34 per cent in 2010 with the rest increased from 47 in 1991–1992 to 66 per cent in 2010, the relative efficiency of agricultural wage earners was expected to rise at the margin because of 36 per cent contraction of agriculture. It did not happen due to the 40 per cent expansion of the rest of the rural sectors. It might have pulled better-skilled labour from agriculture leaving mostly unskilled there. The fall in the relative efficiency of labour can at the same time validate the proposition that rural poverty reduction was partly driven by increases in the demand for unskilled workers in rural households.

Comparison of Income Figures with Other Studies and Limitations

To make sure that we have done our calculations properly, we have compared our income figures with what are reported in the studies undertaken by Khan (2008, 2014) and Hossain (2004), and BBS (Table 8). Our per capita income figures at current prices are not very different from the corresponding figures from others. Our income figures are slightly (about 5%) higher than others.

Table 7. Per Cent of Rural Households Required for 1 per Cent of Rural Income Gain

Category	1991	1995	2000	2005	2010
Farming	0.93	0.94	1.11	1.09	0.85
Wage and salary	1.62	1.75	2.13	1.90	2.00

Source: Authors' own construction from data.

Table 8. Per Capita Income for Rural Households

	1991–92	1995–96	2000	2005	2010
Current Price					
BBS (Ref: Khan 2008)	6972	8361	11136	14952	25560
Khan (2014)	6864	7773	10621	14257	24101
Khan (2008)	6744	7583	10464	13720	
Ours	6753	7762	11956	15077	26789
Constant Price (1992/92 = 100)					
BBS (Ref: Khan 2008)	6972	6743	7138	7551	8435
Khan (2014)	6864	6269	6737	6953	7953
Khan (2008)	6744	6115	6708	6929	
Ours	6753	6260	7584	7353	8840
Consumer Price Index (CPI)Deflator for rural	1	1.24	1.56	1.98	3.03

Source: Authors' own construction from data.

The problem with this occupation-based analysis on non-panel data is that we cannot focus on the shifting of occupations over time. We just follow the major source of income of a household to classifying them. We cannot capture occupational shifting in this process. Share of non-agricultural income in agriculture is much less increased may be due to the fact that many of such agricultural households are counted as non-agricultural households because of their higher-income share from non-agriculture. Otherwise, the significant increase in total non-agricultural income is expected to be reflected either in per capita income growth of non-agriculture or a greater share of non-agricultural income in agriculture or both. This may be one of the main reasons why we see a decline in the proportion of households in agriculture during 1991–2000 along with an increase in the proportion of non-agricultural households during the same period. The reverse happened during the 2000–2010 periods with an increase in the proportion of households in agriculture along with a decrease in the proportion of non-agricultural households. This makes occupation-based analysis difficult when it is done not based on the same cohort of households.

Summary

The growth of agricultural income has made the major contribution to the income of rural households during 2000–2010 but it is the growth of non-agricultural income which has made the major contribution to the income of rural households during the periods of 1991–2000. However, dominance lies with non-agriculture if we consider the entire 1991–2010 period. It is worth noting that the dominance of agriculture is still there for Quintile 1 rural households, farming still being the

dominant sub-category. Above all, 13 per cent decrease in per capita real income from agricultural wages for all rural households and 41 per cent decrease in that for Quintile 1 rural households contradict the finding that increases in real wages were one of the main contributors to poverty reduction.

Quintile 1 figures make it clear that rural households at the bottom are still heavily dependent on agriculture despite their increasing dependence on non-agriculture. As we move up the income ladder, the proportion of rural households, agriculture being the main profession, declines fast. The share of non-agricultural income in the total income of agricultural households fluctuated between 20 per cent in 2000 and 15 per cent in 2010 implying no surge in non-agricultural income in agricultural households denying the indirect benefit of latter from the former. It appears from the quintile-wise decomposition that the efficiency enhancement was realised more at upper quintiles leaving a relatively smaller effect on poverty reduction.

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Appendix

Table A1. Breakdown of per Capita Annual Income of Rural Household into Sectors (Real, Base Year—1991–1992)

	1991–92		1995–96		2000		2005		2010	
Income From:	**PCI**	**As %**	**PCI**	**As %**	**PCI**	**As %**	**PCI**	**As %**	**PCI**	**As %**
1. Agriculture: farming and agricultural Wages & Salary	**3558**	**53**	**2862**	**46**	**1942**	**26**	**2396**	**33**	**3014**	**34**
a. Farming	2698	**40**	2103	**34**	1348	**18**	1653	**22**	2270	**26**
b. Wages & Salary	860	**13**	759	**12**	594	**8**	743	**10**	744	**8**
2. Nonagricultural income	**1564**	**23**	**1932**	**31**	**3528**	**47**	**2936**	**40**	**3054**	**35**
a. Non-agricultural Wage	676	**10**	1003	**16**	634	**8**	732	**10**	840	**9**
b. Non-agricultural Salary		**0**	0	**0**	1310	**17**	1078	**15**	1008	**11**
c. Non-farm Enterprise	888	**13**	930	**15**	1584	**21**	1125	**15**	1206	**14**
3. Remittances and Transfers	**755**	**11**	**655**	**10**	**919**	**12**	**1016**	**14**	**1775**	**20**
a. Foreign Remittances	755	**11**	655	**10**	546	**7**	641	**9**	1311	**15**
b. Tranfers (+ domestic remittances)		**0**	0	**0**	373	**5**	375	**5**	463	**5**
4. Other Income	**876**	**13**	**811**	**13**	**1194**	**16**	**1005**	**14**	**998**	**11**
a. Rent from Land	61	**1**	73	**1**	214	**3**	241	**3**	228	**3**
b. Return to Other Assets		**0**	0	**0**	290	**4**	53	**1**	98	**1**
c. Others	815	**12**	738	**12**	690	**9**	710	**10**	672	**8**
Total (1+2+3+4)	**6753**	**100**	**6260**	**100**	**7584**	**100**	**7353**	**100**	**8840**	**100**

Source: Authors' own construction from data.

Table A2. Breakdown of per Capita Annual Income into Sectors (1991–1992 Prices): Quintile 1

	1991		1995		2000		2005		2010	
Income From:	**PCI**	**As %**	**PCI**		**PCI**		**PCI**		**PCI**	
1. Agriculture: Farming and agricultural wages and salary	**1,563**	**0.55**	**1,204**	**0.57**	**1,085**	**0.52**	**1,116**	**0.51**	**1,156**	**0.47**
a. Farming	671	0.24	558	0.26	434	0.21	481	0.22	632	0.26
b. Wage and salary	892	0.32	646	0.31	651	0.31	635	0.29	524	0.21
2. Non-agricultural income	**707**	**0.25**	**529**	**0.25**	**570**	**0.27**	**616**	**0.28**	**767**	**0.31**
a. Non-agricultural wage	351	0.12	335	0.16	108	0.05	364	0.17	404	0.16
b. Non-agricultural salary		0.00	0	0.00	234	0.11	70	0.03	141	0.06
c. Non-farm enterprise	356	0.13	194	0.09	229	0.11	182	0.08	222	0.09
3. Remittances and transfers	**235**	**0.08**	**110**	**0.05**	**171**	**0.08**	**185**	**0.09**	**357**	**0.14**
a. Foreign remittances	235	0.08	110	0.05	11	0.01	18	0.01	160	0.06
b. Transfers (+ domestic remittances)		0.00	0	0.00	159	0.08	166	0.08	197	0.08
4. Other income	**316**	**0.11**	**276**	**0.13**	**276**	**0.13**	**254**	**0.12**	**193**	**0.08**
a. Rent from land	6	0.00	5	0.00	47	0.02	48	0.02	57	0.02
b. Return to other assets		0.00	0	0.00	21	0.01	5	0.00	8	0.00
c. Others	310	0.11	271	0.13	208	0.10	201	0.09	128	0.05
Total (1 + 2 + 3 + 4)	**2,820**		**2,119**		**2,102**		**2,170**		**2,473**	
N	**768**		**1,008**		**1,245**		**1,280**		**1,567**	

Source: Authors' own construction from data.

Table A3. Breakdown of per Capita Annual Income into Sectors (Current Prices): Quintile 2

	1991		1995		2000		2005		2010	
Income From:	**PCI**		**PCI**		**PCI**		**PCI**		**PCI**	
1. Agriculture: Farming and agricultural wage and salary	**2,491**	**0.57**	**2,590**	**0.53**	**2,632**	**0.43**	**3,557**	**0.46**	**5,673**	**0.44**
a. Farming	1,512	0.35	1,515	0.31	1,204	0.20	1,868	0.24	2,959	0.23
b. Wage and salary	979	0.22	1,075	0.22	1,428	0.23	1,689	0.22	2,714	0.21
2. Non-agricultural income	**1,015**	**0.23**	**1,417**	**0.29**	**2,306**	**0.37**	**2,777**	**0.36**	**4,742**	**0.36**
a. Non-agricultural wage	419	0.10	781	0.16	510	0.08	1,529	0.20	2,419	0.19
b. Non-agricultural salary		0.00		0.00	909	0.15	419	0.05	892	0.07
c. Non-farm enterprise	597	0.14	636	0.13	888	0.14	830	0.11	1,430	0.11
3. Remittances and transfers	**417**	**0.10**	**238**	**0.05**	**455**	**0.07**	**501**	**0.07**	**1,368**	**0.11**
a. Foreign remittances	417	0.10	238	0.05	108	0.02	92	0.01	716	0.05
b. (+ domestic remittances)		0.00		0.00	347	0.06	410	0.05	653	0.05
4. Other income	**449**	**0.10**	**645**	**0.13**	**764**	**0.12**	**861**	**0.11**	**1,239**	**0.10**
a. Rent from land	15	0.00	21	0.00	110	0.02	176	0.02	281	0.02
b. Return to other assets		0.00		0.00	51	0.01	29	0.00	28	0.00
c. Others	434	0.10	624	0.13	604	0.10	656	0.09	931	0.07
Total (1 + 2 + 3 + 4)	**4,373**		**4,890**		**6,158**		**7,696**		**1,3023**	
N	**768**		**1,008**		**1,262**		**1,279**		**1,566**	

Source: Authors' own construction from data.

Table A4. Breakdown of per Capita Annual Income into Sectors (Current Prices): Quintile 3

	1991		1995		2000		2005		2010	
Income From:	**PCI**	**As %**	**PCI**	**As %**	**PCI**	**As %**	**PCI**	**As %**	**PCI**	**As %**
1. Agriculture: Farming and agricultural wages and salary	**3,282**	**0.57**	**3,188**	**0.51**	**2,932**	**0.34**	**4,499**	**0.42**	**7,507**	**0.40**
a. Farming	2,361	0.41	2,146	0.34	1,718	0.20	2,708	0.25	4,448	0.24
b. Wage and salary	921	0.16	1,042	0.17	1,215	0.14	1,790	0.17	3,059	0.16
2. Non-agricultural income	**1,214**	**0.21**	**1,970**	**0.31**	**3,732**	**0.44**	**4,175**	**0.39**	**7,293**	**0.39**
a. Non-agricultural wage	424	0.07	1,024	0.16	849	0.10	1,770	0.16	3,210	0.17
b. Non-agricultural salary		0.00		0.00	1,364	0.16	999	0.09	1,689	0.09
c. Non-farm enterprise	790	0.14	946	0.15	1,519	0.18	1,406	0.13	2,394	0.13
3. Remittances and transfers	**590**	**0.10**	**353**	**0.06**	**780**	**0.09**	**955**	**0.09**	**1,849**	**0.10**
a. Foreign remittances	590	0.10	353	0.06	271	0.03	340	0.03	822	0.04
b. Transfers (+ domestic remittances)		0.00		0.00	509	0.06	616	0.06	1027	0.06
4. Other income	**680**	**0.12**	**800**	**0.13**	**1,107**	**0.13**	**1,176**	**0.11**	**1,906**	**0.10**
a. Rent from land	31	0.01	49	0.01	171	0.02	202	0.02	340	0.02
b. Return to other assets		0.00		0.00	104	0.01	44	0.00	82	0.00
c. Others	649	0.11	751	0.12	833	0.10	930	0.09	1,484	0.08
Total (1 + 2 + 3 + 4)	**5,766**		**6,310**		**8,552**		**10,806**		**18,555**	
N	**768**		**1,008**		**1,262**		**1,279**		**1,566**	

Source: Authors' own construction from data.

Table A5. Breakdown of per Capita Annual Income into Sectors (Current Prices): Quintile 4

	1991		1995		2000		2005		2010	
Income From:	**PCI**	**As %**	**PCI**	**As %**	**PCI**	**As %**	**PCI**	**As %**	**PCI**	**As %**
1. Agriculture: Farming and agricultural wages and salary	**3,857**	**0.51**	**3,890**	**0.46**	**3,348**	**0.27**	**5,597**	**0.36**	**9,666**	**0.35**
a. Farming	3,143	0.41	2,977	0.35	2,623	0.21	3,937	0.25	7,083	0.25
b. Wage and salary	714	0.09	913	0.11	725	0.06	1,660	0.11	2,583	0.09
2. Non-agricultural income	**1,774**	**0.23**	**2,870**	**0.34**	**5,927**	**0.48**	**6,523**	**0.41**	**10,818**	**0.39**
a. Non-agricultural wage	700	0.09	1,388	0.16	1,514	0.12	2,072	0.13	3,496	0.13
b. Non-agricultural salary		.		.	1,964	0.16	2,171	0.14	3,494	0.13
c. Non-farm enterprise	1,074	0.14	1,482	0.18	2,449	0.20	2,280	0.14	3,828	0.14
3. Remittances and transfers	**872**	**0.11**	**583**	**0.07**	**1,366**	**0.11**	**1,673**	**0.11**	**4,005**	**0.14**
a. Foreign remittances	872	0.11	583	0.07	706	0.06	791	0.05	2,644	0.09
b. Transfers (+ domestic remittances)		.		.	659	0.05	882	0.06	1,361	0.05
4. Other income	**1,098**	**0.14**	**1,068**	**0.13**	**1,711**	**0.14**	**1,945**	**0.12**	**2,902**	**0.10**
a. Rent from land	53	0.01	68	0.01	358	0.03	463	0.03	628	0.02
b. Return to other assets		.		.	233	0.02	132	0.01	181	0.01
c. Others	1,045	0.14	1,000	0.12	1,120	0.09	1,351	0.09	2,093	0.07
Total (1 + 2 + 3 + 4)	**7,601**		**8,410**		**12,352**		**15,739**		**27,392**	
N	768		1,008		1262		1,279		1,566	

Source: Authors' own construction from data.

Table A6. Breakdown of per Capita Annual Income into Sectors (Current Prices): Quintile 5

	1991		1995		2000		2005		2010	
Income From:	**PCI**	**As %**	**PCI**	**As %**	**PCI**	**As %**	**PCI**	**As %**	**PCI**	**As %**
1. Agriculture: Farming and agricultural wages and salary	**6,596**	**0.50**	**6,223**	**0.39**	**4,688**	**0.16**	**8,704**	**0.24**	**19,320**	**0.29**
a. Farming	5,802	0.44	5,541	0.35	4,385	0.15	7,480	0.20	17,986	0.27
b. Wage and salary	794	0.06	681	0.04	302	0.01	1,224	0.03	1,335	0.02
2. Non-agricultural income	**3,109**	**0.24**	**4,912**	**0.31**	**14,893**	**0.51**	**15,409**	**0.42**	**21,093**	**0.31**
a. Non-agricultural wage	1,487	0.11	2,509	0.16	1,949	0.07	1,418	0.04	2,376	0.04
b. Non-agricultural salary		0.00		0.00	5,700	0.19	7,330	0.20	8,768	0.13
c. Non-farm enterprise	1,623	0.12	2,402	0.15	7,244	0.25	6,661	0.18	9,950	0.15
3. Remittances and transfers	**1,661**	**0.13**	**2,717**	**0.17**	**4,362**	**0.15**	**6,923**	**0.19**	**18,588**	**0.28**
a. Foreign remittances	1,661	0.13	2,717	0.17	3,193	0.11	5,312	0.14	15,205	0.23
b. Transfers (+ domestic remittances)		0.00		0.00	1,168	0.04	1,611	0.04	3,383	0.05
4. Other income	**1,837**	**0.14**	**2,090**	**0.13**	**5,378**	**0.18**	**5,820**	**0.16**	**8,489**	**0.13**
a. Rent from land	200	0.02	305	0.02	975	0.03	1,537	0.04	2,033	0.03
b. Return to other assets		0.00		0.00	1,856	0.06	332	0.01	1,163	0.02
c. Others	1,637	0.12	1,786	0.11	2,547	0.09	3,950	0.11	5,293	0.08
Total (stata)	**13,203**		**15,941**		**29,321**		**36,856**		**67,491**	
	768		1,008		1,262		1,279		1,566	

Source: Authors' own construction from data.

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