



# Waterlogging, crop damage and adaptation interventions in the coastal region of Bangladesh: A perception analysis of local people

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## ABSTRACT

Waterlogging is a persistent problem resulting in damage to crops and therefore livelihood of the coastal people in the southwestern region of Bangladesh. It is important to better understand the perception of local people on this problem to formulate appropriate policy interventions. This research aimed at analyzing the perception of local people on waterlogging, its impact on crop production and related adaptation interventions in Khulna district. Concurrent mixed methods of research were employed and a total of 200 households were interviewed. The findings revealed that lack of silt removal or dredging in canals, reduction of water flow in canals and encroachment of canals were the main causes of waterlogging. Major demographic, social and economic characteristics of the surveyed households rarely affected crop production. It was also observed that delayed cropping reduced waterlogging-induced crop damage in coastal areas. Although local people spontaneously participated in traditional adaptation methods, they hardly realized their own contributions towards the practices. About one-third of the local people were not aware of institutional initiatives addressing waterlogging. They proposed structural solutions such as re-excavation of canals to reduce waterlogging. Furthermore, majority of the people living inside the polder (a low-lying tract of land enclosed by a built construction that forms an artificial hydrological unit) perceived that institutions and management were vitally important. The post-facto nature of adaptation interventions in the region might lead to unusual losses and damages, which could be minimized through a good mix of technology and management.

## 1. Introduction

### 1.1. Polder management and waterlogging in Bangladesh

Waterlogging is an acute problem in the southwestern region of Bangladesh, especially Jessore, Khulna and Satkhira districts, causing severe damage to people's livelihoods and often creating social unrest (Rahman, 1995; Lázár et al., 2015; Bernier et al.,

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2016). Waterlogging in this part of the country had its genesis when the upstream river Mathabhanga got separated from the river Ganges, known as the river Padma in Bangladesh. This separation caused reduced upstream flow, which eventually contributed to siltation in the rivers flowing to the Bay of Bengal. The process has multiple impacts including elevation of riverbeds. Construction of polders (a low-lying tract of land enclosed by a built construction that forms an artificial hydrological unit) in the 1960s and 1970s restricted water flow into the settlement areas and consequently restricted sedimentation within polders, which have no connection with outside water sources other than through manually operated devices. The special nature of soil in the coastal areas is causing subsidence at the rate of 6 mm year<sup>-1</sup> (Brammer, 2013). In addition, the level of sedimentation in riverbeds outside the polders is increasing the gap between the levels of ground surfaces in and outside the polders. The difference in elevation of land surfaces is the main reason for differential water level, which is ultimately causing waterlogging.

Referred to as a persistently nagging problem, waterlogging reduces the carrying capacity of rivers and ultimately leads to flooding (Kibria, 2011). Waterlogging has been a chronic crisis in Bangladesh since 1980. The causes of waterlogging include, among others, insufficient drainage, deficiency in embankment management, siltation of rivers and reduced upstream river flow due to the Farakka Barrage (UNDP, 2011; Kolás, 2013). This problem has surfaced during the last two decades mainly due to reduced dry season flow, which further aggravates sediment deposition on riverbeds, and heavy rainfall during the monsoon (Rahman and Rahman, 2011). Rahman and Rahman (2011) have also identified other causes of waterlogging including the construction of infrastructure such as bridges, culverts, sluice gates and unauthorized encroachment of rivers.

Waterlogging has affected millions of people, especially poor and marginal (landless) farmers as well as sharecroppers (an agricultural system where a landowner allows a tenant to use his/her land in return for a predetermined share of crops produced on respective portion of land). Waterlogging has drastically reduced agricultural productivity across the region (Awal, 2014) and it has adversely affected homestead vegetation. Although water is present everywhere, scarcity of clean drinking water, along with the absence of other basic necessities of life causes diseases, malnutrition and environmental degradation in the region. The southwest coastal region is barely 1 m above mean sea level. Roughly one-fifth of cultivated areas of Khulna are permanently cropped, while the rest are provisionally utilized. *Boro* or winter rice production is dominant in the region followed by *aman* or wet season rice.

Three districts at the southwestern part of Bangladesh namely, Jessore, Khulna and Satkhira, are highly vulnerable to waterlogging. In Jessore and Satkhira, the waterlogged area sharply increased from 12,687 ha in 2003 to 22,389 ha in 2008 indicating an average annual increase of more than 12%. As a result, the number of people affected by waterlogging also rose from 115,200 in 2003 to 865,789 in 2008 (more than a six fold increase). This indicates the severity of the problem, which needs to be addressed immediately. Waterlogging is a serious problem in Beel Dakatia in Jessore district, where almost 100% of the land is unsuitable for crop production, causing socioeconomic and environmental disaster (Iqbal et al., 2009). In addition to affecting nearly one million people, waterlogging has caused large-scale damage to the national economy, especially crop damage and loss of employment, resulting in increased poverty in the area (Rahman, 1995; Ahmed et al., 1998).

It has been argued that the Coastal Embankment Project, which began in the early 1960s, and the Farakka Barrage, commissioned in 1975, together impacted geo-morphological characteristics of southwest coastal Bangladesh, with an accelerated process of sediment accumulation along the riverbed and banks making sluice gates virtually inoperative in some cases (DHV-WARPO, 2000; Sarker, 2004). The primary goal of the construction of the Farakka Barrage was to divert an adequate amount of water through long feeder canals for the preservation and maintenance of the Kolkata Port of India. However, its operation created problems for Bangladesh by reducing upstream flows, especially during the dry seasons, which is required for the flushing of rivers that discharge into the Bay of Bengal.

The southwest coastal region of Bangladesh experiences various types of natural disasters. Although polders were constructed to overcome threats posed by flood-driven tidal surges, in many cases inappropriate construction has altered the landscape, causing changes in the geophysical setting and the hydrological cycle in the southwestern coastal region of Bangladesh. Adri and Islam (2012) mentioned that inappropriate construction of polders contributed enormously to the environmental havoc caused by waterlogging. Crop production, especially rice (*Oryza sativa* L.), is also affected by waterlogging.

Although the primary goals of polder construction during early 1960s were to decrease flood risk and salinity intrusion for increasing agricultural productivity, polders started to adversely affect people's livelihoods after the 1980s. Anecdotal evidence suggests that coastal polders are the first large scale human interventions in the coastal areas of Bangladesh. Prior to the construction of polders, high tides brought in salt water and inundated agricultural land. This resulted in low agricultural production and poor livelihood opportunities. To protect agricultural land from frequent tidal flooding, the Coastal Embankment Project was implemented under a master plan by the Bangladesh Water Development Board (BWDB). A series of polders to enclose low-lying coastal areas were built. It has been reported that inefficient polder management, at least partly, creates a waterlogging problem, contributing to crop loss and damage (Ali et al., 2008).

### 1.2. Need for perception assessment

The study of perception is well known and widely practiced in business, psychology, medicine and other social sciences. In climate change and disaster-related research, perception has also been studied. Being a dynamic field of research, risk perception, as Bird (2009) argued, is a vital tool for analyzing mitigation and adaptation strategies. High levels of risk perception are an important factor when building sustainable resilience and increasing adaptive capacity (Mercado, 2016). Understanding the perception of people and community in resource management and conservation is required to devise the policy process and implement management actions (Hopkins et al., 2016). Tesfahunegn et al. (2016) reported that farmers' perception plays a key role in appropriate adaptation and mitigation strategies for land use and agricultural practice, such as crop rotation, early planting and crop diversification. Hence, perception analysis of local people

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