PART II F1
CASE STUDY

DESAKOTA PHENOMENON OBSERVED IN SATKHIRA-KHULNA-JESSORE-DHAKA CORRIDOR IN THE SOUTHWESTERN BANGLADESH

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1. Understanding Desakota Phenomenon in Bangladesh

In recent decades, Bangladesh has been observing a few significant changes in its demographic, economic, social and environmental state of affairs. The country has been rather successful in South Asian standard towards reducing population growth rate from about 3.5 per cent in the 1970s to below 1.6 per cent by 2005. However, the population density is the highest in the world, and about 51 per cent of the current population is still below reproductive age, the latter having a potential to further population growth. The economy has been growing over 5.5 per cent per annum during the past two decades. The success has been dampened by the facts that (a) over 12 million people are unemployed, (b) over 52 per cent of the population still finds employment in subsistent crop agriculture, and (c) over 23 per cent of the population belongs to hard core poor category (below 1US$/day). The skewed income distribution contributed to the accumulation of wealth by the rich, often the urban elites, while the poor are becoming increasing poor. The latter has given rise wide-spread food impoverishment and malnutrition.

The environment in one hand is the cause of spreading poverty, while in the other it is a mere victim of overexploitation and degradation. The frequently occurring hydro-geophysical hazards and extreme weather events have been instrumental in reducing streams of ecosystem services for the poor, which in turn has shrunk livelihood opportunities of the poor. Subsistence based agriculture suffered the worst blow, which experienced proliferation of an input-dependent modern agriculture constantly pushing the already marginalized farmers who do not have the capacity to invest more for higher returns. Moreover, available information suggest that the returns from crop production have gradually been reducing. In a number of hazard prone regions crop agriculture suffered so much so that the lackluster farmers have continuously been out migrating to urban areas.

The rate of urbanization is rather high in recent years in Bangladesh. Dhaka city, the capital and prime centre for the country's economic activities, has been growing at a rate of about 8 per cent over the past fifteen years. Although the recent growth in ready made garment (RMG) industrial sub-sector attracted a large number of young women to find employment and to migrate into Dhaka city, the push from rural areas due to failed livelihoods has also contributed to such an apparent exodus. However, the escalating land price in urban areas inhibits such employment seekers to live within the city areas, which is why the low-income families prefer to stay within the urban fringes and peripheries. Despite the fact that urban service quality is rather unacceptable in such peripheral areas, a large majority of recent migrants find it

economically more suitable to accept such otherwise unacceptable living conditions. In this process, not only they can regularly commute to city centres and maintain healthy income streams, they also can keep close contacts with kins living in their respective ancestral villages. A combination of all these has given rise to Desakota Phenomenon in Bangladesh, especially along the Satkhira-Khulna-Jessore corridor, which has close ties with the urban fringes of Dhaka city.

2. Identification of the Study Area

The Satkhira-Khulna-Jessore triangle belongs to the Southwestern Region of Bangladesh (pls see Map in Figure-1). The three Districts also fall within the Ganges Dependent Area (GDA), within the catchment of the Gorai River – the major distributary of the Ganges River flowing to the south to discharge water in the Bay of Bengal. The northern reaches of the three Districts is generally sweetwater zone, belonging to the Jessore District. The other two Districts (i.e., Khulna and Satkhira) are aligned north to south, having the Sundarban mangrove forest located in the southern most reaches, the latter defining the boundary with the ocean. All three Districts constitute part of the Ganges Delta – the largest deltaic region on Earth, having extremely flat topography and located within 1~5 meters from the mean sea level.

In recent decades, the region has undergone severe forms of environmental degradation, which devastated livelihoods of primarily the farming communities, and lately of those involved in other livelihoods. The general occupation of the inhabitants of the region had been farming, mostly based of rainfed paddy cultivation. The rather sudden change in environmental conditions has forced farmers to forfeit the dry season cropping opportunities due to increase in salinity, especially along the southern boundaries of Khulna and Satkhira Districts. Moreover, along the northern parts of the study Area, a gradual process of river bed aggradation leading to water logging has been observed, which made it impossible to continue land-based agriculture. As a consequence, farmers find it difficult to maintain their livelihoods and out migrated to urban areas. Since the severe losses to livelihoods have triggered such a process of out migration to urban and semi-urban areas, the region in general, and the Satkhira-Khulna-Jessore corridor in particular offers a good case study site to assess Desakota phenomenon in Bangladesh.

3. Characteristics of the Study Area and Observed Changes

3.1 The Natural Setting

The Southwestern Region of Bangladesh has been subjected to a plethora of hydro-geo-morphological hazards which include poor drainage through its river systems, high rates of sedimentation on river beds, acute low flow conditions during the dry season, salinity ingress along the rivers, cyclonic storm surge, moisture stress in the dry season, rise in sea level, and to a lesser extent, flood (Halcrow-WARPO, 2001). The region is located in the coastal zone, and is significantly influenced by tidal effects. According to available statistics on Coastal Zone, majority of the land is within one meter from mean sea level, a significant proportion of which again falls below high-tide level (Islam, 2005).

The Gorai River has been the major distributary of the Ganges River, passing through the region, providing the majority of the dry season flow (DHV-WARPO, 2000). Main River systems of this region consist of the Gorai-Madhumati-Baleswar river system, the Gorai-Bhairab-Pusur river system, the Bhadra-Gengrail river system, the Hari-Teka-Mukteswari river

system, Sibsa river, the Kobadak-Betna-Kholpetua river system and the Mathabhanga-Ichamati-Kalindi river system. These river systems criss-cross the region through a complex network of smaller rivers and rivulets. Through a natural process of gradual east-ward migration of the Ganges River – the primary source of freshwater for all these river systems, many smaller rivers lost their drainage capacity over the past two centuries (Williams, 1919; Sarker, 2004).

The physical features of the study area have been dominated by surface water systems, the proximity of the sea in the south, the dynamic morphology that is greatly governed by sedimentation processes, and the human induced influence on the entire hydro-geophysical characteristics of the region. However, the latter has been the most dominant influence of all in recent decades, leading to profound subsequent implications on social and economic aspects of the inhabitants.

The region is endowed with surface water systems, as discussed earlier. The land is mostly floodplains of the major rivers. However, along the southern reaches of the area, there are inter-tidal floodplains that are generally inundated twice diurnally. In the floodplains, there are wetland areas. A few wetlands such as *beel* and *baor* wetlands have been formed naturally, proving ecosystem support to aquatic species. This in turn has provided for ecosystem services to humans, in the form of fish, weeds/reeds (as construction materials) etc. Simultaneously, a few other wetland systems such as ponds and constructed water bodies (locally known as *ghers*, i.e., captive wetlands) have been created by human beings to maximize ecosystem services further. Moreover, the encircled embankments (i.e., polders) have been created since early 1970s to safeguard agricultural activities from tidal/saline influence. Polders therefore have become a permanent feature on the land, which also have influenced sedimentation dynamics of the area.

The estuary not only provides an interface between seawater and freshwater, it also provides significant ecosystem services, often in the form of estuarine small-scale fisheries. The production of tiger prawn (*P. monodon*) in the ghers is largely supported by shrimp larvae, which are generally caught in the estuarine rivers and creeks. Sediments carried out by the major rivers have been deposited over millennia on the shallow continental shelf, which paved the path for land formation to the south. Meanwhile, tides carried seeds of a large variety of mangrove species to newly accreted lands and propagated the natural spread of mangrove forest at the southern reaches of both Satkhira and Khulna.

The Sundarbans, located in the Southern most reaches of the SW region, is the largest patch of productive mangrove forest ecosystem in the world. It provides various ecosystem services to approximately one million households living in the SW region and the South-central region. In addition to providing fish, timber, fuelwood, material for thatching roofs & walls of dwelling units, honey, and other valuable products, the forest often takes on the first blow of cyclonic storms rushing to the SW region, thereby reducing the extent of damages, as it has been observed in the cases of cyclones of 1986 and 2007. Furthermore, the forest is the natural habitat for a number of endemic species such as Bengal Tiger (*Panthra tigris*). Due to its richness in biodiversity and its great ecosystem service to millions of people, apart from its beaty, it has been regarded as an UNESCO Global Heritage Site since 1996.

3.2 Demographic Characteristics

The coastal zone support livelihoods of a large population. The population density is about 743 per square kilometer, as against the average national density of 839/km^2. However, there exists

a marked difference in population density among Districts: while Satkhira and Khulna has a density of 478 and 537/km^2, respectively, the same for Jessore appears to be quite high (i.e., 962/km^2). The per household population along the coastal zone is about 5.1, which is higher than the average for the country. A large fraction of the population belongs to two categories: children and old. About 41 per cent of coastal population belongs to age group of below 15 years. Therefore, the number of dependent population on every employable (income worthy) person is high (i.e., 0.9), compared to the national average (i.e., 0.83).

The population distribution in urban and rural areas in the three Districts provides interesting features. While only 22.8 per cent of coastal population resides in urban areas, in the case Study areas the urbanized population is higher 27.2 per cent, slightly higher than the national average of about 26 per cent. This simple feature demonstrates the fact that in the Case Study area, unlike other coastal areas more people are living in urban areas and corridors. Interestingly, urban population in Satkhira is rather paltry (only 7.2 per cent), while in Khulna it is remarkably higher (i.e., 53.3 per cent) than the national average. It may be inferred from this statistics that the population in the Case Study area has a general tendency towards living in urban areas in Khulna District, particularly in the corridor between Khulna Divisional metropolitan city and the Jessore District Town.

The other interesting observation reveals that, an increasing percentage of males (i.e, 53.7) are found compared to females among the urban population in both Khulna and Jessore. This suggests that there is not only a dominance of urban population in the corridor, there is also a male bias among the populace in the corridor.

3.3 Changes in Geo-physical and Ecosystem Features

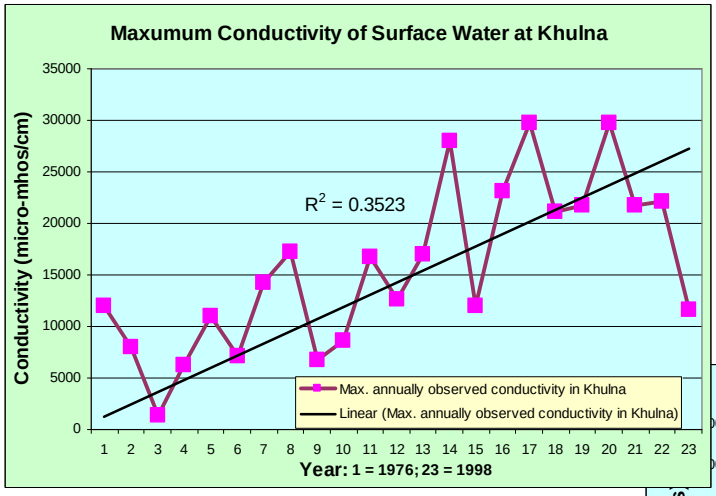
3.3.1 Climatological changes

Over the past few decades, the climate of the region has shown slight changes. A general warming has been observed in the surface average temperature, which is in the order of 0.5 ~ 0.6°C. Although there hasn't been a great deal of analysis on the climatological aspects of the region, the scanty available research reveals that the night time minimum temperature has been showing a rapid increase over the past five decades. Due to rise in temperature the winter has gradually been becoming milder and the autumn hotter. The region receives an average rainfall of about 1980 mm per annum, while about 78.3 per cent of is falls within the four months of monsoon. No significant change has been observed in terms of rainfall over the region, though on a national scale a bimodal shift in rainfall with a bias towards later parts of monsoon has been reported (Chowdhury, 2007).

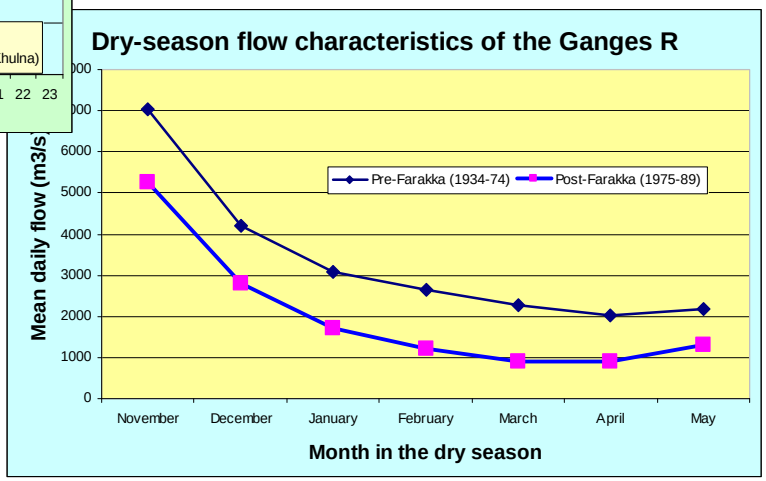
3.3.2 Changing hydro-geomorphological dynamics

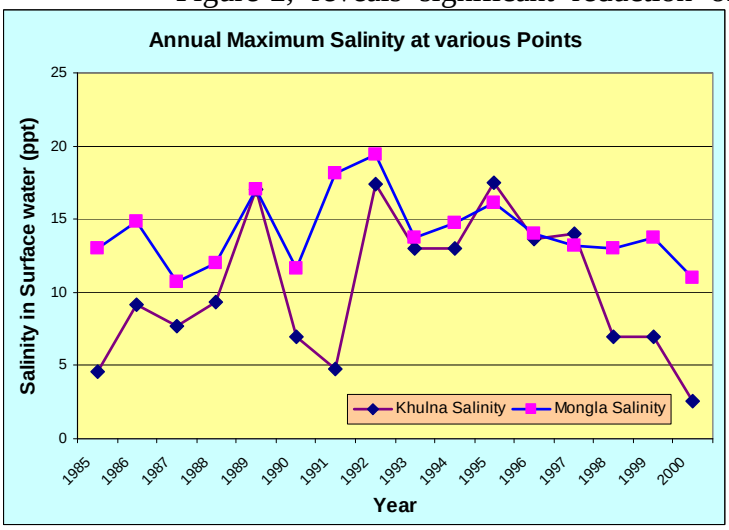
The empolderment of coastal reaches through the implementation of the Coastal Embankment Project has brought significant initial benefits to local population, by allowing them to cultivate lands without being adversely affected by saline tidal effects. Since late sixties and early 1970s, the crop production, mainly paddy, has increased significantly. However, the CEP also had a backlash, that has been demonstrated by enhanced sedimentation within the riverbeds, which eventually choked up the rivers (Sarker, 2004; Islam *et al.*, 2004). In absence of coastal embankments, sedimentation could have otherwise happened naturally in the entire floodplain, thereby rapid upliftment of riverbeds could have been avoided. The processes have been rather slow, however the results have been incremental and cascading. Not only the morphological processes have been altered severely with adverse effect in terms of narrowing down of width

of rivers and estuary, it also reduced the height differential between the crest height of embankment and the peak water level (mostly during neap tides in peak monsoon). Following a few iterations of such cascading effects, the drainage capacity of the affected rivers has been shrunk significantly.



However, the most drammatic hydrological effect has been observed in the region ever since the Ganges flows have been withdrawn by the upstream neighbour India by building and commissioning of the Farakka barrage in 1975 (Mirza, 2004; Halcrow-WARPO, 2001). A comparison of flow regime before and after the withdrawal of the Ganges flow, as shown in Figure-2, reveals significant reduction of dry season flow as a consequence of withdrawal of Ganges water.





The adverse impacts reached their height during the period between 1990 and 1996, when the Gorai river has been found completely disconnected from its tributary, the Ganges River (DHV-WARPO, 2000). During that rather extreme hydrological condition across the Ganges Dependent Areas (GDA), year-wise duration of closure of the Gorai River is shown in Figure-3.

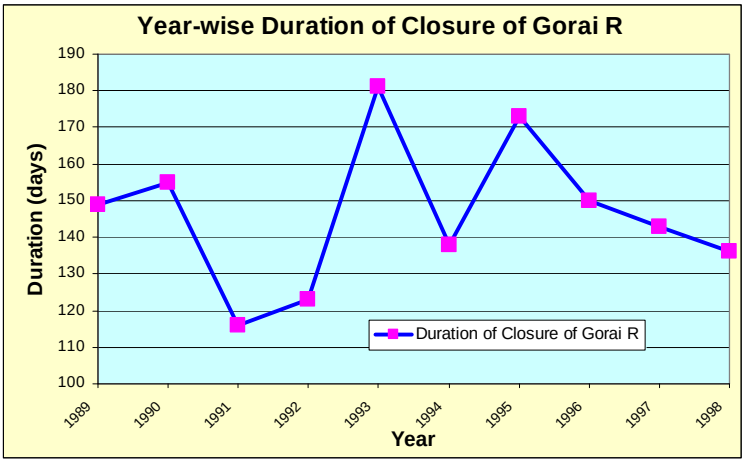
As a consequence of significant changes in flow regime along the Ganges River and its Distributaries in the GDA, the conductivity has been found to increase steadily, as schematically shown in Figure-4 for the Maximum conductivity measured at Khulna, the dominant urban centre in the entire GDA. Intriguingly, as a result of increasing conductivity in surface water systems along the southern reaches of the Ganges dependent rivers, salinity has began to penetrate inland. The increasing trend of salinity at two points, Khulna and Mongla are shown schematically in Figure-5.

The Gorai River, the major distributary of the Ganges R, has been the worst sufferer of hydrological changes caused by the withdrawal of the Ganges flows (Mirza, 2004). As indicated earlier, the Gorai flow has been completely ceased during the 1989-96 period. Heavy siltation at the Gorai offtake deteriorated the flow condition of the river. As a consequence, most of the smaller rivers in the region choked during every dry season, allowing salinity to penetrate inland towards north. Accordingly, the mixing zone between freshwater and brackish water has been shifted towards the north.

Other than the Gorai river, many other coastal rivers have experienced adverse hydro-morphological and environmental consequences due to flow withdrawal in the dry season compounded by salinity intrusion and morphological changes. Kobadak is a river where the rate of change has been dramatic following the closure of Gorai R. During the dry season, a combination of extreme low flow and increased salinity accelerated the processes of sedimentation in the riverbed, which eventually choked the river and drastically reduced its drainage capacity. This is how drainage congestion became a regular phenomenon in that river, resulting into overbank spillage during each peak monsoon. Consequently, the entire basin became water logged for a certain period of the year.

Water logging appears to be highly pronounced along the coastal rivers in the southwestern region, where the adjoining lands are mostly empoldered. Often it is found that the drainage infrastructure such as sluice gates also gets choked due to heavy sedimentation and eventually becomes inoperable. Ill-planning on the part of the custodian of the water structures, The Bangladesh Water Development Board (BWDB), especially towards wrong placement of such sluices has also contributed to the choking up of the infrastructure. Once spillage takes place over an existing embankment, water does not find ways to recede, inundates both agricultural lands and homesteads. Non-functioning of sluices often aggravates the situation and water logging within an embankment system becomes a perennial problem. The infamous water logging in Polder No. 24 of the BWDB had become a major concern in the 1990s (Rahman, 1995).

Currently, vast areas in Manirampur, Keshabpur, and Abhaynagar Thanas of Jessore District, Dumuria Thana of Khulna District, and Tala Thana of Satkhira District are generally water logged. In case of Manirampur and Keshabpur Thanas, over 85 per cent land has been remained water logged for over seven years. It has been observed that during the flood year 2007, Kobadak river had been flowing above danger level in Jhikargachcha for over 80 continuous days (FFWC, 2007). However, in the other flooded river basins towards the northern reaches, continuous inundation lasted upto 20 days in each of the two flood spells. The beel areas along the Kobadak River were all inundated between June and November in 2007.

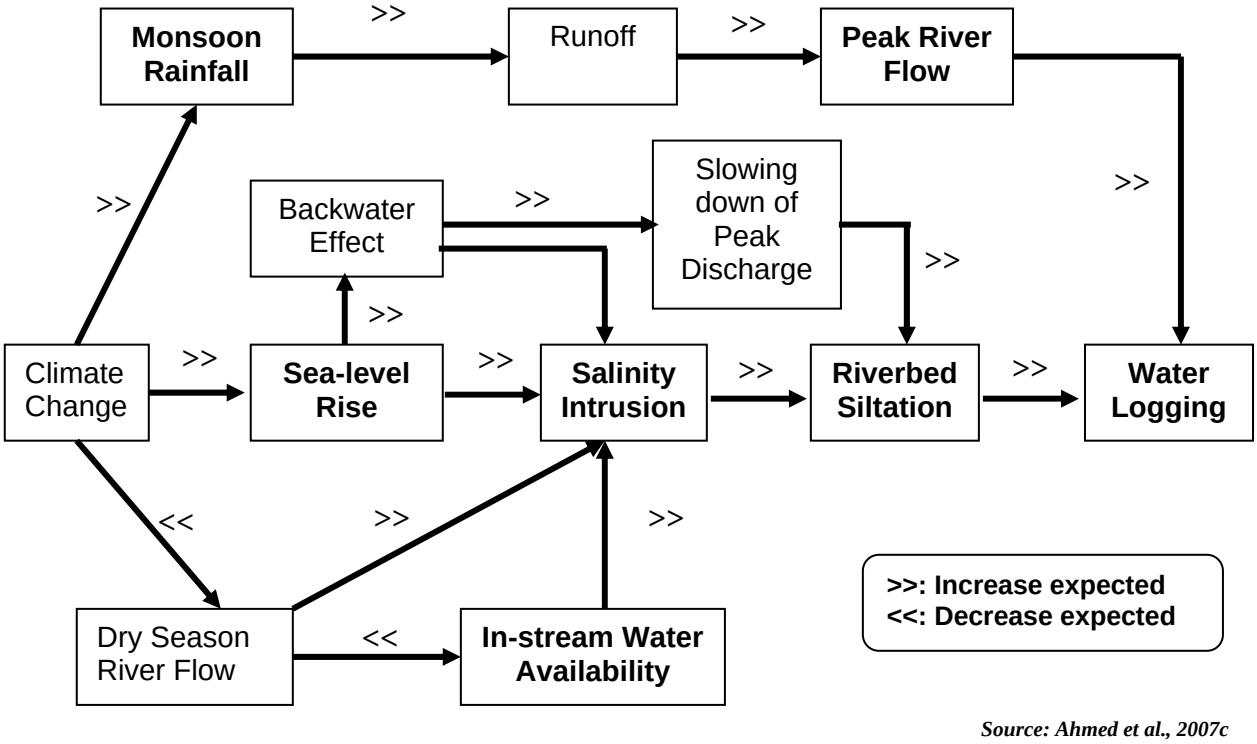


Under climate change induced increasing salinity along the coastal rivers, the above processes will be aggravated. This in turn will further complicate the current state of water logging. The process of increase in susceptibility to water logging due to climate change is schematically represented in Figure-6. It is inferred that water logging will be spread over a larger area, involving many more smaller river basins within the Ganges Dependent Area.

3.4 Economic and Social Features

The primary economic activity of the majority of the population in the study area is crop agriculture. Rice has been widely grown, however in recent years the coverage of paddy has shrunk gradually due to increasing water logging in Jessore and salinity in both Khulna and Satkhira Districts. With increasing salinity, a vast tract of paddy fields have been transformed into shrimp beds during the past quarter of century, especially in the wake of commissioning of the Farakka Dam. Although it allowed the government to fetch about 700 M$ worth of foreign currency through export of frozen fish (majority being *P. monodon*) annually, it has been criticized by many for driving away a large number of poor agriculture-based households to urban areas, while allowing urban elites to make profit from the lands suitable for shrimp production (Rahman, 2002; McLachlan, 2002).

Rice being the single dominant crop in the region, while in Jessore the cultivable lands are being used for many different productive purposes. For example, wheat and jute is grown in Jessore, which is not as visible in the other two Districts. In the saline affected areas of Khulna and Satkhira, farmers can utilize their lands for only one major rice crop during the (monsoon) *Aman* season. In those two Districts, dry-season (*Boro*) rice cannot be profitably grown due to constraints put by increasing salinity. Following the harvest of *Aman* rice, farmers quickly prepare their lands to plant crops of lesser economic return, such as spices (i.e., chilli) and early Rabi vegetables.



Source: Ahmed et al., 2007c

Figure-6: Schematic representation of various cause-effect relationships towards increasing Water Logging under Climate Change

In Jessore, people have been trying a number of alternative (cash) crops such as cut flower (viz. *Rajnigandhya* and Gladiola), spices, vegetables, tobacco, jute, and sugarcane. Jessore has also pioneered transforming their crop lands into ponds for the promotion of culture fisheries. While freshwater fish hatcheries have been thriving in Jessore, saline water shrimp hatcheries have

been established in both Satkhira and Khulna – most by taking advantage of increasing salinity. Intriguingly, industrial ventures, which have been requiring freshwater for various stages of processing, have all been shut down during the past two decades in Khulna District, the Divisional Head Quarters for the Southwestern region f the country. As a consequence of increasing salinization, no new investment in industrial sector could be seen in relevant sub-sectors which might require freshwater supply. Due either to lay off or closure, industrial workers lost their livelihoods and eventually have become destitute population in regional as well as national urban centres.

The national drive to increase agricultural production could not be steered properly in the study area due to various constraints, such as salinity and water logging. The coverage of irrigation has been rather dismal, especially in saline affected areas. While almost 80 per cent of the NCA in Jessore has been brought under irrigation, the same for Khulna and Satkhira has remained as low as 10.2 and 33.9 per cent, respectively.

Fishing in open water bodies as well as fish culture are major economic activities in the region. On an average, about 17 per cent of all open water fisheries in the coastal zone is contributed from the study area. In this category, Khulna alone contributes to 57.5 per cent, while Jessore contributes to about 30 per cent. However, pond culture is more pronounced in Jessore, accounting for 46.5 per cent of all pond culture fisheries. Jessore, however, does not contribute to shrimp production. In this regard, both Khulna and Satkhira contribute to over 20 per cent each of all shrimp production at national scale. The second sea port at Mongla, through struggling with heavy coarse siltation and non-performance of the port activities, is located in the study area.

The region can be considered as a backward region compared to its provision for physical infrastructure. This is again attributed to its continued vulnerability to water logging and salinity. Compared to national average ratio between population and hospital beds of about 4276, the same for Satkhira and Jessore appear to be 6959 and 7490, respectively. In sharp contrast, Khulna offers a much better facility as the ratio increases to 2877 – somewhat better than the national average.

Although 21 per cent of all rural households have been brought under electricity, the comparative pictures for Khulna and Satkhira are quite striking: some 10 and 15 per cent of rural households in the two Districts, respectively, have been brought under electricity coverage. Intriguingly, the road density in the three Districts isn't very bad compared to national average (i.e., 0.72km/km^2). Jessore has been enjoying 1.22, while Satkhira has been providing for 0.69 km/km^2 – both being highly competitive with respect to national average figure. While one would argue that this has been made possible with a notion to facilitate export of shrimp from Satkhira and fish fries from Jessore, it has certainly contributed to the pull factor towards urbanization.

Compared to the average Bangladeshi standards, the health care scene in the study area is quite competitive. However, there are regional differences in one or two important indicators of progress. For example, percentage of households using iodine salt in Satkhira is way far below than national standard (i.e, 39 as against 70). Salinity has put severe form of constraints in terms availability of safe drinking water. The number of effective (i.e., running/operable) tube wells per square kilometer for Khulna and Satkhira is about 4, compared to national availability of 7. Since the similar constraints are not visible in Jessore, the number of operational tube wells is 8/km^2, little higher than the national average. The above values just testify that rural

population in saline prone areas has to work hard to fetch non-saline water than the those in rest of the country.

4. Implications of Salinity and Water Logging on Local People

4.1 Effects of Salinity on People

Increasing salinity has decreased the overall performance of lands on crop production and contributed to food insecurity in the region (especially in Khulna and Satkhira). Majority of the farmers are forced to forfeit at least one cropping season, thereby accept huge economic losses. A significant proportion of farmers, however, do grow alternative crops with much lesser economic return. Such a coping mechanism does help maintain livelihoods, however it cannot provide a safety net against impoverishment. The low level of intake of important commercial product such as iodized salt testifies that poor households in saline prone areas cannot afford essential commodities.

The absence of saline-free safe drinking water appears to be a mirage for people in Satkhira and the southern parts of Khulna District. Not only the tube well density there is rather poor (about 50 per cent with respect to the country average), most of the tube wells draw saline water, since ground water aquifers (even confined aquifers) have been found to be saline affected! Moreover, many tube wells are sunk 300 feet below ground and a significant proportion of such tube wells draw water in highly reducing conditions. While tube wells across Bangladesh are known to have high concentrations of labile arsenic, in a few tube wells high concentrations of Nitrite have been reported, which may be attributed to rather unusual high incidence of blue baby syndrome in Satkhira. Women in pregnancy suffer from high blood pressure due to salinity in water. Cases of miscarriages and abortion are also common in the severely saline affected areas.

As Bangladeshi women are generally the homemakers, irrespective of economic class, sect and religious belief, they feel it necessary to provide saline-free drinking water for the household members. Since in some areas water sources in the neighborhood are all affected by high salinity, the women need to travel long distance on foot every day in search of drinking water (Ahmed *et al.*, 2007a). This is done by women irrespective of their physical condition. Women in their advance pregnancy and lactating mothers find it extremely difficult to carry on such duties (Ahmed *et al*., 2007b). Most of the people, especially the poor faces acute salinity problem in drinking water (RVCC, 2003).

Women and adolescent girls are usually required to collect drinking water from distant sources. This may take three to four hours a day. As a result, they do not have enough time or energy to carry out other household duties like cooking, bathing, washing clothes, taking care of elders, etc. In saline prone region, therefore, women have to curtail extra hours from their household works to combat with salinity problem. The consequent effects are difficulty in time management in their other household duties. For example, women become tired after the daily ordeal and cannot concentrate to the fullest towards their mental and physical health. In cases respective husbands use to complain for not serving food on time and women are also physically assaulted for this reason (Ahmed et al., 2007a).

When they go out to collect water, women and adolescent girls are sometimes harassed by men, even by adolescent boys. The womenfolk therefore feel uneasy and threatened while collecting water from distant sources. The skin of adolescent girls becomes rough and unattractive due to

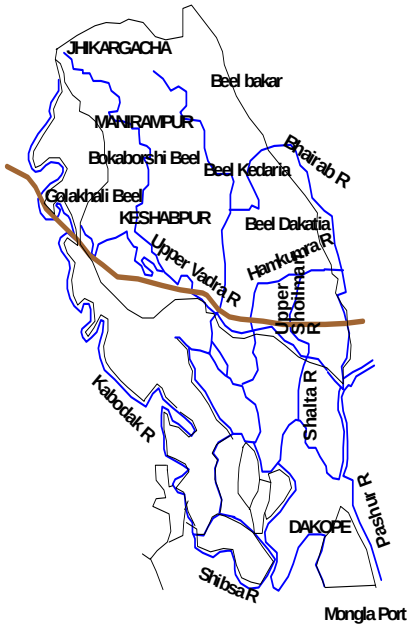


Figure-7: Water logged areas between Jessore and Khulna Districts

continued use of saline water. Men from outside the area do not show their interest in marrying these young girls (Ahmed *et al.*, 2007a).

Women also suffer from various diseases in the long run for accommodating extra hurdle of work in their day lives. Women and adolescent girls are affected by gynecological problems by using saline water during menstruation. Women, explaining their bitter experiences about menstrual hygiene management, reported that saline water creates pain during menstruation. The used clothes become hard after drying (due to the water salinity), which creates discomfort when next used. Further use of the same hard clothes can create genital injury, including bleeding, infection and other complications. Some women, who do not feel safe to keep their children alone at home, bring their children with them while traveling for drinking water. Obviously, it affects the health of the accompanying children as well. When a poor family cannot afford to collect water due to sickness or because it does not have any member in the family to do the job, they have to buy water from water vendors at Taka 10 per pitcher. It is very difficult for them to spend Taka 300 per month for drinking purposes as their monthly income is typically Taka 500 - Taka 1500. Therefore, sometimes they have no choice but to use saline water for drinking purposes (Ahmed *et al.*, 2007a).

There are evidences in southern Satkhira District that increasing salinity has been proved detrimental to common village homestead forestry (McLachlan, 2002). Due to lack of fruit bearing trees, young children do not find natural intake of vitamins and essential minerals. It becomes impossible for poor females to collect edible creepers/spinach from saline affected fields, again poor people's nutrition and health is affected. Due to non-availability of fodder (grazing lands are hard to come by in saline condition), cattle heads are declining fast in the areas, thereby inflicting upon adverse effects on livelihoods and economy of poor households.

4.2 Implications of Water Logging

Water logging, prolonged or seasonal, adversely affects land based productive system (RVCC, 2003; Islam *et al.*, 2004). However, the prolonged water logging in Manirampur and Keshabpur sub-Districts in Jessore have deprived the entire population, rich and poor alike, of crop production for about seven continuous years (Ahmed *et al.*, 2007c). Therefore, water logging can have devastating effects on people's livelihoods, mostly by increasing food insecurity and chronic malnutrition. The water logged areas between Jessore and Khulna are shown in Figure-7.

Women's usual efforts in rural areas to grow a few things as food supplement for the family can no longer be possible when they are virtually entrapped in water logging condition (Ahmed *et al.*, 2007c). Since lands are submerged, a great number of land-based activities – be it production of something, or be it performing religious activities – cannot be continued. Malnourishment is a common phenomenon in water logged areas. The disruption of land based productive system in turn aggravates women's malnutrition in affected areas due largely to gender-biased intra-household food distribution. Water logging compels women to stay in marooned conditions for several months a year. Collection of fuel and potable water become extremely hazardous. However, because of patriarchal nature of gender-specific roles as caregivers, women cannot avoid being exposed to hazardous living conditions. Women cannot send their children to schools during prolonged water logging.

Women are entrapped in water in water logging condition. The irony is, despite having water all around they have practically been devoid of an opportunity to get non-contaminated water for drinking purposes. The patriarchal nature of gender-based responsibility in a common Bangladeshi household dictates them to fetch safe drinking water on a regular basis and maintain household well being. Hence, women in a water logged area find it extremely difficult to accept the reality around them: using water for drinking purposes from the very same source where they are forced to defecate. Absence of safe sanitation services and supply of safe drinking water has been culminated into rather high rates of water-borne diseases, including skin diseases and reproductive health disorders. A large majority of the women reported that they had been suffering from vaginal infection (Ahmed *et al*., 2007c).

The food security of the affected people is found to be completely shattered because of non-availability of land-based productive system. For only those areas where inundation takes place for six to seven months, people can take advantage of the remainder of the calendar and try to produce crops. However, in most of the lands cereals cannot be grown due to miss-match in timings between land availability and cropping season. Males often leave their families back home in search of employment, leaving the responsibility to 'take care' of the family members on the shoulder of women. Food system for the poor, therefore, is found to be dependent on remittance from male members, or by purchasing food items from nearby markets. Female-headed households are common in water logging affected areas. In absence of land based productive system and incidence of acute poverty, women often are forced to go for anti-social works just to feed their child and their family as a desperate effort (Ahmed *et al*., 2007c).

Purchasing food items requires sustained flow of income, the latter being extremely hard to come by for the lower-middle class and poor families (i.e., having income less than US$2 and US$1 per capita per day, respectively). For the day labours, no appreciable employment is generated in the area. People, man and women of virtually all age, religion and sect use hand-hold push-nets to catch small fish, mostly shrimp fries. People try to catch fish almost every day, fully knowing that absence in 'work' for a day might translate into the following day's hunger.

In Jessore-Satkhira region, mud-built walls are common for the poor households in rural areas. Most of such houses have been destroyed due to prolonged water logging. Houses which had been built by using woody biomass and/or corrugated tin (i.e., iron sheets) are found to be dilapidated due to prolonged exposure to humid conditions.

In rural Bangladesh, the sense of helplessness for any adult/adolescent woman gives rise to insecurity, in both physical and mental terms. In a society where the coming out of house for a female is regarded as a 'bad conduct' and otherwise an 'invitation to harassment', it is only

obvious that in water logging condition males often take advantage of women's helplessness. Female-headed households suffer the most, while young single mother (herself often being an adolescent) with one or two toddlers in a shanty household is the most common victim of sexual as well as psycho-physical harassments. The patriarchal society, as expected, generally does not ensure justice, often due to not having enough eye-witness of an incidence. In a 'water world', the lack of adequate surveillance often leaves ample room for males to take advantage on women, while the inevitable lack of access of poor women to legal assistance makes it impossible to curb social vices and bring forth justice.

Mothers in the affected area live in a state of mental trauma in anticipation of sudden drowning of a child. Many households faced sudden slipping of a restless toddler in waist-deep water on the inundated courtyard, especially during the first two years of water logging. Every mother feels bad regarding the fact that they cannot ensure healthy and safe environment in the processes of upbringing their young children. One of their major agonies is not being able to send children in schools: not only it appears costly to send a child in school by hiring a boat, often the schools are inundated too and therefore remain closed.

5. Evidence of Desakota Phenomenon in Satkhira-Khulna-Jessore Corridor

The current demographic characteristics clearly suggest that, due to hopeless environmental conditions such as salinity ingress and prolonged water logging, people lost their livelihoods and consequently out-migrated to either urban areas in the close vicinity (along the said corridor) or in the urban periphery of Dhaka Metropolitan City – the latter being the major destination for rural out-migrants. The unusually high urban population in Khulna District clearly indicates that the urban centres of Khulna has been the prime Desakota destination for the people in the region who have lost their livelihoods due to failure towards securing adequate ecosystem services. The male bias in urban population in both Khulna and Jessore clearly suggest that males have indeed left behind their respective spouses in the hopeless 'water world'.

It is intriguing to examine the major characteristics of urban development within the said Desakota corridor. A new urban township called Noapara, located almost halfway between Khulna and Jessore, had emerged as a municipality even before it was recognized as a Thana (i.e., sub-District). Its growth rate have been unprecedented in Bangladesh context of urbanization, which clearly have given the right impetus (i.e., the pull factor in urbanization) for destitute people in the region to migrate in and find an employment. In a bid to cater to the need of the regional growth pattern, a number of new industries such as cement manufacturing units, small-scale fertilizer manufacturing units etc. have been established. These newly emerged industrial units flourished by providing employment to primarily those who had already lost their livelihoods, who was looking for easy employment in urban peripheries and who were willing to take on any form of labour.

However, out-migrants from Satkhira primarily took a longer route to reach ever expanding Dhaka – the capital city. A large majority of the ready-made garment manufacturing units have become operational during the 1980s and 1990s, providing jobs to over 2 million workers in the thriving sector. Moreover, the mushrooming sky-scrapers provided daily unskilled/semi-skilled jobs in building construction sector in and around Dhaka, again offering temporary form of employment to about another million people. In addition to job seeking people from other parts of geo-physically vulnerable regions of the country, people from the Desakota region found perfect pull and subsequent opportunity to secure employment. Meanwhile road

communication have become easier and accessible, much to the delight of these new migrants. They not only had began to enjoy income opportunities in urban centres, while remaining in urban fringes and peripheries they still could maintain close ties with their ancestral villages and kins. The result has been astonishing: Dhaka grew at a rate of about 8 per cent per annum during the past two decades, a rate of growth unprecedented in urban history. In five years time between 2003 and 2008, Dhaka has become the newest Megacity and eventually grown into the 11^{th} most populous city on earth.

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Annex 1: Desakota Criteria and Relationship to Poverty and Ecosystem Services

Desakota Criteria	**Satkhira-Khulna-Jessore**	
	Poverty	**Water ecosystem service**
1. Transport Connectivity, local and potentially international	Enhanced road transport facility being capitalized by the poor to access non-local livelihood opportunities. Cell phone coverage has increased significantly. (+ve)	Non-local marketing opportunities of water intensive crops like apples leading to a strain on groundwater resources. (-ve)
2. Expanded local labour market and wage labour	Rate of expansion of local labor market outpaced by rate of increase in poverty due to loss of livelihoods. (-ve)	Increasing exploitation of water ecosystem services (shrimp fry catching). (-ve)
3. Active information exchange	Media coverage is increasing. Information flow increased. Cell technology making it easier to ensure higher prices. (+ve)	
4. Mixed household economies	Considerably diverse household economies between agriculture, service, labor and manufacturing jobs locally and nationally. (+ve)	Expansion on service and industrial sectors have negative feedback on water ecosystem services. (-ve)
5. Decline in local collective action and institutions	Weakening of local collective voice. Poor local participation in governance process. (-ve)	No strong local voice for conservation of aquatic ecosystem. (-ve)
6. Increased use of modern production and processing technology	Poor cannot afford services from modern production and processing technologies. Marginalization in terms of service quality. (-ve)	
7. Informal institutions and the informal market are locally predominant.	Poor still enjoy access to locally available informal markets. (+ve)	Weak informal institutions are not so capable to check/curb degradation of aquatic environment. (-ve)
8. Tensions between formal, informal institutions especially over land and resource rights.	Tension is mounting with increased ecosystem service demands from the poor and degrading quality of services. (-ve)	Access to common properties regime has been restricted. (-ve)
9. Fluid local economy can absorb shocks		