The fourth section deals with the issues of the physical and the socio-economic environment of the study area. In Chapter 13, the nature of exploitation of the water resources, impact of anthropogenic interventions on the riverine system, river shifting vis-a-vis settlements and several issues of the socio-economic environment have been highlighted upon.
13

RIVERINE MORPHOLOGY AND SOCIO-ECONOMIC ENVIRONMENT: AN IMPACT ASSESSMENT

Contrary to the popular belief that nature always remains the same – a belief that has led to static theories of environmentalism and to their equally static rejections – nature changes profoundly whenever man, in response to simple or complex historical causes, profoundly changes his technical equipment, his social organization, and his world outlook. Man never stops affecting his natural environment. He constantly transforms it; and he actualizes new forces whenever his efforts carry him to a new level of operation. Whether a new level can be attained at all, or once attained, where it will lead, depends first on the institutional order and second on the
ultimate target of man’s activity: the physical, chemical, and biological world accessible to him. Institutional conditions being equal, it is the difference in the natural setting that suggests and permits – or precludes – the development of new forms of technology, subsistence, and social control (Wittfogel, 1959: 11).

The Southern Part of the Nadia District is essentially an agricultural country. The economy and social life of the people is intimately linked with its two main resources: land and water. The rivers and other surface water bodies such as bils, lakes and ponds all make a major contribution to the agriculture and general economy of the country by providing navigation, fish, water for irrigation and fresh alluvial sediments replenishing the soil. The general flatness of the terrain does not allow harnessing of the river flows for hydro-electric power generation. However the river systems also give rise to some of the problems faced by the country such as periodic floods which lead to destruction of human lives, livestock, property and crops and also the loss of land on the river banks by erosion. But these problems have been intensified by man himself due to his faulty and unsustainable practices. Groundwater is also an important resource of the study area. Over the past 20 years thousands of Hand, Shallow and Deep Tubewells have been sunk all over the country and are being extensively used for both domestic and agricultural purpose. Although the groundwater aquifer is substantial but the excessive rate of exploitation of the groundwater reserves has become a matter of concern in terms of lowering of groundwater level as well as arsenic contamination.

In this chapter, a comprehensive attempt has been made to focus on the various environmental issues (both physical and socio-economic) in the Southern Part of Nadia District (SPND) where the riverine regime and man are closely interrelated to one another. The impact of river on man and vice versa has been dealt upon in this chapter.
13.1 The Exploitation of Water

Water is part of our environment and in that respect everything we do by way of managing or exploiting water resources has an impact on the environment. Analysis of these impacts thus presents a considerable challenge. The water resources of the SPND, whether derived from the immediate climate or from inflow from outside the area’s political boundaries, provide enough opportunities for development. The area is endowed with a massive supply of readily accessed surface and groundwater. This coupled with a soil that is generally fertile and has a good structure, and with a climate that permits year round cultivation provides a potential for a highly productive agriculture. Water is also abundant for the needs of industry and domestic use. But the availability of water presents constraints and problems too. Floods and cyclones cause damage and the shifting nature of the Hooghly river both creates and destroys agricultural land. On top of this, the SPND has to cope with a very high population density which causes problems in ensuring a fair allocation of water resources.

As a first step in analyzing the consequences of water resource development it is necessary to categorise the major forms of exploitation undertaken and their purposes (Table 13.1).

Even such a simple categorization is difficult. There are numerous overlaps. At the simple level, water is abstracted from surface water bodies or underground reserves to provide irrigation to the agricultural fields for carrying out year round agriculture or for industry or domestic use. Water is also mined for its sand and silt used in construction process. Proliferation of brick industry in the entire study area is a clear evidence of such form of water exploitation. This represents a net loss to the natural water system and may also affect the natural rates of flow and in particular the downstream patterns of sedimentation.

The impoundment of water is a common form of manipulation undertaken so as to make the process of abstraction easier and more
convenient in space and time. However, water is also stored so as to use in situ for fisheries or for recreation or for flood control. Where impoundment is not undertaken the same set of purpose may be achieved by rechanneling the water, diverting it into other watercourses or along specially constructed canals or simply by the erection of controlled structures. Bridges to carry land traffic (like the Railway Bridge on the Churni near Majhdia, discussed later in the chapter) change the natural flow.

**Table 13.1: Nature of Exploitation of Water Resources in SPND**

<table>
<thead>
<tr>
<th>Exploitation</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstraction</td>
<td>Irrigation</td>
</tr>
<tr>
<td></td>
<td>Industry</td>
</tr>
<tr>
<td></td>
<td>Domestic use</td>
</tr>
<tr>
<td></td>
<td>Power generation</td>
</tr>
<tr>
<td></td>
<td>Construction</td>
</tr>
<tr>
<td>Mining (sand, sediments)</td>
<td>Industry</td>
</tr>
<tr>
<td></td>
<td>Irrigation</td>
</tr>
<tr>
<td></td>
<td>Flood Control</td>
</tr>
<tr>
<td></td>
<td>Recreation</td>
</tr>
<tr>
<td></td>
<td>Fisheries</td>
</tr>
<tr>
<td>Rechannelling and control</td>
<td>Irrigation</td>
</tr>
<tr>
<td></td>
<td>Flood control</td>
</tr>
<tr>
<td></td>
<td>Recreation</td>
</tr>
<tr>
<td></td>
<td>Transportation</td>
</tr>
<tr>
<td>Drainage</td>
<td>Fisheries</td>
</tr>
<tr>
<td></td>
<td>Harvesting</td>
</tr>
<tr>
<td></td>
<td>Aquatic Plant</td>
</tr>
</tbody>
</table>

Drainage can be thought of as special case of rechanneling, the purpose being to remove water from its natural situation to permit agriculture or housing and urban development to occur. The wetlands
of the area are subjected to such rechanneling. Thus the natural flows are affected exacerbating problems of downstream flooding.

Finally, natural water may be modified to a lesser or greater extent through the harvesting of its biological contents – fish spawns and various aquatic plants. This has little effect on the natural regime where simple harvesting techniques are used and the organisms are removed in amounts that do not affect their natural rate of replenishment. However, where harvesting involves complicated traps and overfishing occur organisms other than those being harvested are also affected. The environmental effects have been summarized in Table 13.2.

Table 13.2: The Environmental Effects of Water Exploitation in the SPND

<table>
<thead>
<tr>
<th>Condition</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowered water flows</td>
<td>Droughts, saline incursions, impeded abstraction and navigation</td>
</tr>
<tr>
<td>Raised water flows</td>
<td>Floods</td>
</tr>
<tr>
<td>Lowered sediment loads</td>
<td>Scouring, erosion</td>
</tr>
<tr>
<td>Raised sediment loads</td>
<td>Siltation</td>
</tr>
<tr>
<td>Pollution</td>
<td>Salinity, eutrophication, pesticide toxicity, heavy metals, organic pollutants, human diseases</td>
</tr>
<tr>
<td>Overexploitation</td>
<td>Overfishing</td>
</tr>
</tbody>
</table>

13.2 Impact of Anthropogenic Intervention in the Riverine System

Artificial works such as the construction of railways and roads, bridges and embankments, the silting up of marshes and the premature reclamation of lowlands for cultivation affect the natural drainage, bring about changes in annual floods and disturb the entire river system.
A deltaic river languishes or dies from the operation of the same forces which brought it into existence, but man’s artificial interference with drainage and river and his encroachment of the river’s territory bring about premature senility and death. A deltaic river periodically oscillates between its permanent channel and its off-takes into which it usually splits up. The life-history of a deltaic river constitutes, indeed, a continuous diversion of channels and formation of branches, such branches again dividing themselves into sub-water ways and similarly showing changes of their regime. The deterioration or death of some water-ways and improvement or emergence of others is thus essential feature of a deltaic landscape.

When due to the unfavourable position of its off-take as a result of the main or the deep channel of the parent river having oscillated on to the other side, a branch river is in moribund condition, it becomes relatively easier to bridge it with bridges of insufficient spans (Photos 24 & 25), build causeways (Photos 26 & 27) with embanked approaches and reclaim its margins for cultivation. Such artificial interferences cause a moribund river to dwindle all the more and finally to change to a chain of stagnant pools (Photo 28). The photographs 24 to 28 give a glimpse of the anthropogenic interventions in the riverine environment.

The rivers throughout their courses as well as the bils are subjected to different anthropogenic interventions as mentioned below.

a. **Untreated industrial effluents and sewage** from adjacent settled area are directly released into the rivers and bils. Effluents from the sugar mills of Bangladesh also contaminate the rivers of the area. Dumping of wastes in the rivers and bils is a common practice here. Photograph 29 shows the dumping of the idols and flowers in the Jamuna river in Haringhata after the Durga Puja.
Photo 24: Bamboo-bridge on the dry stretch of Ichamati River in Majhdia about 2 km south of Majhdia Railway Station

Photo 25: Road Bridge on the Kulia Bil in Kalyani P.S. about 5 km east of Kanchrapara Railway Station
Photo 26: Causeway on the dry stretch of Ichamati River in Majhdia about 2 km south of Majhdia Railway Station

Photo 27: Mud embankment on the Bhomra Bil dividing the water body in Jalkar Bhumra village of Haringhata about 40 km east of Kalyani Railway Station
Photo 28: Stagnant Pool on the dry stretch of Ichamati River in Majhdia about 2 km south of Majhdia Railway Station

Photo 29: Dumping of idols and flowers in the Jamuna River in Haringhata P.S. about 15 km east of Kalyani Railway Station
b. **Bamboo-made barrages** at several places on the rivers obstruct the normal flow of the water (Photo 30 & 31). Again such **methods of fishing** as *bitties, kumars, pallas, bars, doars, etc.* have contributed not a little to speed up the death of rivers after these had been languishing.

c. **Retting of jute** in the rivers and *bils* is another significant issue connected to the deterioration of the surface water bodies.

d. **Encroachment** along the river banks and *bils* by the illegal migrants especially from Bangladesh. Photograph 32 provides a glimpse of encroachment through construction of buildings along the Kulia *Bil* in Kalyani P.S.

e. Agriculture is practiced in an unscientific manner. Cultivation is not only restricted to the banks (Photo 33) of the dying rivers and *bils* but also extends to the beds of rivers and *bils* (Photo 34).

f. Soil is being cut at an alarming rate along the banks of the rivers for brick kilns. Photograph 35 shows the transport of soil from the banks of the Churni in mechanised boats to nearby brick kilns.

g. Faulty anthropogenic structures like bridges have been constructed on the rivers.
Photo 30: Bamboo barrage on the Ichamati River in Duttapulia village (JL No. 84) of Ranaghat P.S. about 40 km east of Ranaghat R.S.

Photo 31: Bamboo barrage on the Jamuna River in Haringhata P.S. about 15 km east of Kalyani R.S.
Photo 32: Encroachment through construction along the Kulia Bil in Kalyani P.S. about 2 km east of Kanchrapara R.S.

Photo 33: Cultivation and cutting of soil in Dakshin Haradham village (JL No 137) along the banks of the Churni River in Ranaghat P.S. about 5 km west of Payradanga R.S.
Photo 34: Cultivation of paddy on the bed of the Ichamati River in Majhdia about 2 km south of Majhdia Railway Station

Photo 35: Transfer of soil by mechanised boats to nearby brick kilns in Dakshin Haradham village (JL No 137) along the banks of the Churni River in Ranaghat P.S. about 5 km west of Payradanga R.S.
The cumulative impacts of the aforementioned anthropogenic interventions lead to the following impacts on the surface water bodies:

a. **Siltation** in the river bed and bils owing to the residues left after the retting of jute and dumping of wastes.

b. **Increased intensity of Floods** due to loss of depth of the surface water bodies due to excessive siltation.

c. **Soil Erosion and Bank destabilization** due to river bank cultivation and cutting of soil along the banks. Photograph 36 provides evidence of bank erosion alongside the Churni river.

d. Reclamation of the river banks and beds for agriculture effects an easy adjustment of the river in its new regime through the **reduction of the channel section**.

e. Unscientific agricultural practices have led to **agricultural erosion of soil as well as sub-soil nudation** (Photo 37). In order to obtain water free of cost, some farmers have lowered the levels of their fields in relation to the adjacent fields which get water leading to soil erosion and exposure of sub-soil.

f. Uncontrolled irrigation has caused stagnation of water in the agricultural fields leading to **soil salinisation and iron accumulation** in the soils (Photo 38).

g. **Raising of river bed** is a significant impact of the construction of railway bridge on the Churni river at Majdia (Fig. 13.1). The bridge is constructed at the place where the Mathabhanga river splits into the Churni and Ichamati. While the bed of the Ichamati river is 14 feet higher than that of the Mathabhanga, that of the Churni is lower than Mathabhanga by six inches. During the lean period the level of water in the Mathabhanga is higher than that of the Padma. As a result, no water enters the Ichamati during the dry season. One of the causes of silting of the river was the construction of guard wall for railway bridge (Photo 39) at Majdia.
Photo 36: Erosion in Dakshin Haradham village (JL No 137) along the banks of the Churni River in Ranaghat P.S. about 5 km west of Payradanga R.S.

Photo 37: Sub-soil nudation in Matikumra village (JL No. 108) in Ranaghat P.S. about 15 km east of Ranaghat R.S.
Photo 38: Iron concentration in soil in Matikumra village (JL No. 108) in Ranaghat P.S. about 15 km east of Ranaghat R.S.

Photo 39: Railway Guard Wall on the Churni River in Majhdia about 2 km south of Majhdia Railway Station
RAILWAY GUARD WALL AT MAJDIA OBSTRUCTING THE FLOW OF WATER INTO THE ICHAMATI RIVER

Fig. 13.1
h. Industrial pollution is another impact. The upper stretches of the Churni receive discharges of sugar mill effluents from the Darshana sugar mill factory (situated in Bangladesh) and ultimately reach the waters of the Hooghly and gets spread in the entire area during floods. Several unorganized small-scale industries located alongside the rivers and bils release their untreated effluents in them. The catchment area of the Churni river includes a medium populated (0.140 million) Ranaghat municipality on one bank and the opposite bank comprises village residential areas and unorganized small-scale industries, which release their untreated effluents (approximately 24,000 l/d) and sewage into the river.

h. Settlements have sprung up alongside the water bodies. Huge amount of sewage is thus regularly released into the water bodies causing sewage pollution.

i. Deterioration in water quality is bound to occur due to increasing levels of industrial and sewage pollution. The dissolved oxygen (DO) content in the river water is around 5 mg/l through most of the year (November–May). This DO sag indicates the continuous presence of substantial amount of dissolved organic load in the water. The average level of BOD is high due to occasional addition of degraded or partially degraded organic substances from the banks through erosion. The mean level of hardness is also high. The level of total nitrogen and total phosphorus is considerably high. The water is contaminated with bacteria possibly because of untreated sewage disposal to the rivers.

j. Weed infestation (Photo 40) and Eutrophication (Photo 41) in the water bodies have taken place due to high levels of organic matter, nitrogen and phosphorus content in the water.

k. Elimination of indigenous aquatic flora & fauna has taken place owing to pollution. 63.6% of fish species appeared to have been eliminated from the polluted Churni river since 1983. Out
of 44 fish types found in 1983, only 16 are found today in the Churni. *Labeo bata* (Hamilton), *Puntius sophore* (Hamilton-Buchanan), *Mystus bleekari* (Day), *Rita rita* (Hamilton), *Setipinna phasa* (Hamilton), *Mugil korsula* (Forsskal), *Xenentodon cancila* (Hamilton), have been completely eliminated from the river. The fishes of the river Churni have likely responded to ecosystem stress, resulting in the degradation of community structure. Decline in the number of fish species in turn affects the livelihood of fishermen.

The people living alongside the river treat it like an open drain dumping almost anything and everything (even dead bodies of animals as well as faecal matter) into the river. All these have led to the overall degradation of the riverine environment of the study area (Fig. 13.2).

**IMPACT OF ANTHROPOGENIC INTERVENTIONS IN THE SURFACE WATER BODIES**

- Discharge of Effluents, Sewage & Solid Wastes
- Obstruction by Bamboo barrages
- Jute Retting
- Construction of Guard Wall
- Unscientific agricultural practices
- Cutting of soil from river bank
- Encroachment along river bank

**Pollution**
- Deterioration of River Water Quality
  - Eutrophication & Weed Infestation
    - Elimination of aquatic biota

**Silting**
- Raising of River Bed
  - Soil Erosion & Bank Destabilization
    - Increased frequency of floods
  - Narrowing of River Channel
    - Degradation of Aquatic Environment

**Biodiversity loss**
Photo 40: Weed Infestation in the Churni River in Anulia village (JL No 153) in Ranaghat P.S. about 5 km west of Payradanga R.S.

Photo 41: Eutrophication in the Jamuna River in Haringhata P.S. about 15 km east of Kalyani R.S.
13.3 River Shifting, Settlements and Charṣ

13.3.1 River Shifting vis-a-vis Settlement: A detailed study of the villages of the Southern Part of Nadia District from 1971 to 2001 reveals certain characteristics on the basis of which they can be classified. Basically, most of the villages represented by J.L. numbers are settled for the entire period without interruption. It shows a continuous occupation of the village/settlement sites. Some are occupied continuously and some were never occupied. So, in the broad time spectrum 30 years, between the two extremes, i.e., continuous non-occupation and continuous occupation, six types have been identified (Tables 13.3, 13.4 and Fig. 13.3).

Table 13.3: Nature of Settlements in the SPND

<table>
<thead>
<tr>
<th>Type</th>
<th>Nature</th>
<th>No. of Villages</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Villages uninhabited throughout the period (1971 – 2001)</td>
<td>18</td>
</tr>
<tr>
<td>B</td>
<td>Settlements that were not in existence in 1971, but appeared in 1981 and continued in 1991 &amp; 2001</td>
<td>2</td>
</tr>
<tr>
<td>C</td>
<td>Settlements inhabited in 1971 but uninhabited thereafter</td>
<td>1</td>
</tr>
<tr>
<td>D</td>
<td>Settlements uninhabited in 1971 but inhabited in 1981 &amp; thereafter</td>
<td>4</td>
</tr>
<tr>
<td>F</td>
<td>Settlements that were in existence throughout the period</td>
<td>466</td>
</tr>
</tbody>
</table>

### Table 13.4: P.S. wise no. & types of Settlements in SPND

<table>
<thead>
<tr>
<th>P.S.</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Santipur</td>
<td>6</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>61</td>
<td>68</td>
</tr>
<tr>
<td>Ranaghat</td>
<td>4</td>
<td></td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>169</td>
<td>178</td>
</tr>
<tr>
<td>Chakdah</td>
<td>5</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>130</td>
<td>137</td>
</tr>
<tr>
<td>Kalyani</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>Haringhata</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>86</td>
<td>87</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>466</td>
<td>492</td>
</tr>
</tbody>
</table>


The uninhabited villages of the study area show one characteristic in common viz. the tendency of human beings to avoid the lowland areas and easily flooded areas. The Southern Part of Nadia District is a moribund delta area and here the history of the rivers show either strong stream migration or complete decay. The Hooghly river is still oscillating in their courses. The changes of direction and creation of spill channels cause depopulation. There are other rivers particularly like the Jamuna whose decay has also caused changes in the population distribution on its bank. The villages uninhabited throughout the period are either chars located alongside the Hooghly river or in low-lying bil areas. Bholadanga (JL No. 3), Nutanmath Bholadanga (JL No. 4), Champaklata (JL No. 79) in Santipur P.S., Char Gournagar (JL No. 190) in Ranaghat P.S., Raninagar Char (JL No. 191) in Chakdah P.S. and Char Raghunathpur (JL No. 193), Char Madhusudanpur (JL No. 195) in Kalyani P.S. are chars along the Hooghly river liable to annual flooding and Palashgachhi (JL No. 64), Char Simulia (JL No. 76) in Santipur P.S., Debipur Chak (JL No. 13), Jalkar Patuli (JL No. 30), Rajapur Chak (JL
No. 58) in Ranaghat P.S., Jutarpur (JL No. 111), Chak Gobindapur (JL No. 118), Chak Tengra (JL No. 149), Chak Chakudanga (JL No. 150) and Jalkar Mogra (JL No. 16) in Haringhata P.S. are located in low-lying *bils* susceptible to waterlogging.

Two settlements, Durgapur (JL No. 46) and Naosari Char (JL No. 192), of Chakdah P.S. were not in existence in 1971 but appeared in 1981 and continued in 1991 and 2001 owing to the depositional action of the Hooghly river. Chak Noapara (JL No. 193) in Ranaghat P.S. is a village which was inhabited in 1971 but uninhabited thereafter due to annual flooding and submergence by the waters of the Hooghly river. Chak Bholadanga (JL No. 2) in Santipur P.S., Uttar Bishnupur (JL No. 48), Badbagi (JL No. 93) in Ranaghat P.S. were uninhabited in 1971 but inhabited in 1981 and thereafter. Kathaura (JL No 16) of Ranaghat P.S. was uninhabited in 1971 and 1981 but inhabited thereafter.

Thus the settlement pattern developed along the highly meandering course of the Hooghly river and other water bodies offers an interesting study of the population and changes of river direction in the area.

Ox-bow lakes, marshes, spill channels *etc.* are a common sight in this region and have their bearing on the population distribution in the study area. If the courses of the rivers are traced it will be noticed how the changes in the course of the river have brought in changes in the settlement of the population in different decades. The Farakka Barrage Project has brought in a little change in the river system of the Bhagirathi-Hooghly but the impact on the Southern Part of Nadia District is still not evident.

Fig. 13.3
In the topographical sheet 79 A/7 which uses surveyed maps of 1917-18 and 1950-51, the distribution of population and settlement patterns shows considerable difference. The 1917-18 surveyed maps (Fig. 13.4) do not show population concentration near the ox-bow lakes and the spill channels because they were in the process of formation at that time, whereas the 1950-51 surveyed maps (Fig. 13.5) record dotted dense settlement along the ox-bow lakes. This is a consequence of the shifting course of the Hooghly in the Santipur P.S. To cite a particular instance, village Gangadharpur (JL No. 53), originally under the Santipur P.S. has shifted to the right of the Hooghly river with the eastward shift of the course of the river and by the time of Census of 1971 it had been transferred to the Balagarh P.S. of Hooghly district vide the notification no. 8346LREF of 1st June, 1961.

SETTLEMENT PATTERN IN 1917-18 ALONG THE HOOGHLY IN SANTIPUR

Fig. 13.4
In the past the alluvium deposited areas were selected by people for human habitation near the river. But gradually the constant fluctuations of the rivers affected population concentration. One can trace the abandoned settlements along the old course of the rivers.

Another important aspect of the population density and river dynamics is that of the seasonal river flooding and its consequences. For example, due to the heavy silt deposition in the river beds, the rivers flow above the surrounding region. So, during the rainy season it overflows the banks, fills up the inland depressions, marshes and river fields at different levels and thus replenishes the area by silt deposition. This is also a form of irrigation. The villages are situated at comparatively higher land levels and are thus protected from the direct impact of flooding. The fertile land areas close to the villages attract a
rural population which in due course of time reflects on the
distribution and density of population of the area concerned. As
the population grew, the pressure on the land also increased
and people started changing the landscape and utilising it
according to their convenience. As a result of this process, the
normal flow of the rivers has been affected.

The impact of the river shifting on some villages of the
Southern Part of the Nadia District has been pointed out in
Table 13.5.

Table 13.5: Impact of River Shifting on Villages of the SPND

<table>
<thead>
<tr>
<th>Police Station</th>
<th>Village (J.L. No.)</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Santipur</td>
<td>Gangadharpur (53)</td>
<td>With the eastward shift of the Hooghly the village has been transferred to Balagarh P.S. of Hooghly district</td>
</tr>
<tr>
<td>Santipur</td>
<td>Brittir Char (78)</td>
<td>The Hooghly has meandered widely submerging a part of this village</td>
</tr>
<tr>
<td>Ranaghat</td>
<td>Char Noapara (193)</td>
<td>Char sprung up from the river bed of Hooghly after changing course westwards</td>
</tr>
<tr>
<td>Chakdah</td>
<td>Durgapur (47)</td>
<td>This char is likely to be wiped off the map due to periodical shift of the Hooghly</td>
</tr>
<tr>
<td>Chakdah</td>
<td>Sri Krishnapur (189)</td>
<td>Surfaced from the changing course of the Bhagirathi river bed (Fig. 15.6)</td>
</tr>
<tr>
<td>Kalyani</td>
<td>Raghunathpur Char (193)</td>
<td>Westward diversion of the Hooghly</td>
</tr>
<tr>
<td>Haringhata</td>
<td>Chak Birahi (13)</td>
<td>Horse-shoe shaped spill channel</td>
</tr>
</tbody>
</table>

Source: Compiled by researcher from SOI Topographical Sheets (79 A/7, A/8, A/11, A/12, B/5, B/9) and Police Station Maps
Emergence of Srikrishnapur Char (JL No. 189) in Chakdah P.S. owing to the westward shifting of the Bhagirathi-Hooghly River
13.3.2 Evolution of *Chars* and related disputes

The Faridpur Settlement Report (p. 56) mentions, “The rivers fall rapidly and rise rapidly. The new land is often very extensive and the locality of its formation can never from year to year be anticipated. As soon as the river has receded the land is ripe for cultivation and, if any delay occurs in transplanting into the liquid mud which the river has left, there is great danger that the river will rise again too soon for the crop to be harvested. The situation is conditioned entirely by the rapidity with which agricultural operations must begin on the land covered by water. It is this rapidity which makes determination of rival claims untenable before the cultivators have fought for the land.” Thus the history of the *chars* of the lower delta is often such that turbulence and rioting must be linked with the conditions of local geography.

The river Hooghly forms the western boundary of the study area. Its deep stream is constantly changing its course, now swinging to the left and now to the right, cutting away the bank of one side and rebuilding it on the other and all the while forming islands in the middle of its bed. Successive floods and deposits of silt or sand add to these islands and thus raise the *chars* (river bed islands) permanently above flood level.

Old *chars* represent a typical landscape of their own. They are sometimes at a higher level than that of the surrounding lands and here villages are found consisting of little huts interspersed with palm trees and rice fields. Char Jirat (JL No. 27), Srikrishnapur Char (JL No. 189) in Chakdah P.S. (Fig. 13.6), Char Sripur (JL No. 188) of Ranaghat P.S. and Brittir Char (JL No. 78) of Santipur P.S. are examples of such *chars*.

Comparatively newer *chars* have different appearances than the old ones. There are numerous channels in these *chars* making the land unsuitable for cultivation, otherwise the *char* is
generally used for cultivation where trees are absent and a vast track of level land is available. When the *chars* are in the process of making, they grow luxuriant grass and this grass attracts people for grazing buffaloes and cows. The grass collects mud and sand during floods and increases the level of the land which in due course makes it convenient for human habitation. The attractiveness of a region to settlers often depends partly upon the quality of the soil.

Thus with the frequent change of the deep mid-stream of the river and with the consequent throwing up of *chars*, there has been some area adjustments between the districts of Hooghly and Nadia. Mangaldwip *Char* has evolved at the confluence of the Hooghly and Churni rivers. These *char* islands are a constant source of litigation. The islanders are often at a loss as to which side they should approach for settlement of disputes.

13.4 Issues related to the Socio-economic Environment

Human intervention has not only disturbed the physical environment but also affected the socio-economic environment created by him. The different issues related to the socio-economic environment are discussed in this section.

a. **Groundwater Depletion**: Intensive cultivation of two or more crops a year in the study area has shifted agriculture from its traditional dependence on rain water to an increasing dependence on irrigation, with a direct consequence that groundwater is pumped up in excess of the rate of recharging. With already lowered water tables, escalating groundwater withdrawal using electric pumps has further depleted aquifers, precipitating the water crisis in dry seasons. Photo 42 shows an electric water pump which has stopped functioning as the groundwater has been completely depleted.
b. **Arsenic Poisoning**: Arsenic is one of the most toxic metals derived from natural environment. It is a relatively common element that occurs in air, soil and all living tissues. Ground water is one of the most important sources of drinking water and the contamination of ground water with arsenic is one of the serious problems encountered in the study area. Soil contamination with arsenic occurs through the vehicle-contaminated groundwater being used for irrigation.

Arsenic contamination of plants occurs by irrigation with contaminated ground water. The input of arsenic to soil from various sources may prove detrimental to plant through its uptake to the toxic limit, thereby facilitating its entry into the food chain. There is also the possibility of biomagnification of the toxin as it travels up in the food web.

Continuous withdrawal of groundwater, combined with nitrogenous fertilizer residues leached from farms, interferes with complex geochemical processes to release arsenic from sedimentary pyrites and iron oxy-hydroxides into aquifers, leading to increasingly high levels of arsenic poisoning of groundwater in the area.

The groundwater of the entire study area contains arsenic (Table 13.6 and Figs. 13.7 & 13.8) above WHO guideline value of arsenic in drinking water (10 µg/L) and Indian Standard value (50 µg/L). More than 55% of the samples tested in all the blocks have reported arsenic levels above 10 µg/L.
Photo 42: An abandoned electric water pump due to the depletion of underground water in Ghatigachhi village (JL No. 164) in Ranaghat P.S. about 15 km east of Ranaghat R.S.

Fig. 13.7: Block-wise Distribution of total samples in different arsenic concentration (µg/L) ranges in the Southern Part of Nadia District
Table 13.6: Arsenic contamination status in the Southern Part of Nadia District

<table>
<thead>
<tr>
<th>Block</th>
<th>Total samples analysed</th>
<th>Distribution of total samples in different arsenic concentration (µg/L) ranges</th>
<th>% of Samples with As &gt;10µg/L</th>
<th>% of Samples with As &gt;50µg/L</th>
<th>Max. conc. mg/L (samples with As &gt;1000µg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt;4</td>
<td>4-10</td>
<td>11-50</td>
<td>51-100</td>
</tr>
<tr>
<td>Chakdah</td>
<td>2626</td>
<td>893</td>
<td>266</td>
<td>887</td>
<td>301</td>
</tr>
<tr>
<td>Haringhata</td>
<td>1157</td>
<td>384</td>
<td>97</td>
<td>438</td>
<td>140</td>
</tr>
<tr>
<td>Rana-ghat I</td>
<td>1310</td>
<td>511</td>
<td>76</td>
<td>691</td>
<td>20</td>
</tr>
<tr>
<td>Rana-ghat II</td>
<td>1401</td>
<td>476</td>
<td>114</td>
<td>656</td>
<td>91</td>
</tr>
<tr>
<td>Santipur</td>
<td>1133</td>
<td>300</td>
<td>150</td>
<td>543</td>
<td>95</td>
</tr>
</tbody>
</table>

Source: SOES, JU

C. **Build-up of resistant pests and super weeds:** Crop intensification and repeated use of toxic synthetic pesticides (16 extremely toxic, 44 highly toxic, 41 moderately toxic and 20 slightly toxic synthetic pesticides are used as against only 8 non-synthetic pesticides) in the study area have turned more than a dozen apparently innocuous insects into major rice pests (Photo 43). Several exotic floral species (Photos 44, 45 & 46) commonly referred to as super weeds like Wolfia sp., Fimbristylis sp. have invaded the agricultural fields in the study area jeopardizing the overall productivity.
Source: Raw data obtained from SOES (J.U.), processed and mapped by the researcher

Fig. 13.8
This invasion has proliferated after the floods in the year 2000 because large stretches of the study area got submerged and the seeds of these spread in the entire region.

d. **Biodiversity erosion**: Chemical elimination of pollinators (bee, moths, butterflies), predators (spiders, ladybirds, mantids) and parasitoids (ichneumonid wasps) of crop pests and nutrient enhancers (soil organisms) has caused serious economic losses, jeopardizing productivity and food security, and leading to broader social costs. Elimination of soil organisms has led to severe loss of soil fertility. As a consequence, agricultural lands in the study area face an enormous challenge to keep the current food production levels over the next 20 years.

e. **Human resource waste**: Child labour in the rural sector seems intricately linked with the expansion of industrial agriculture. The farmers who are in the middle group in farm asset scale and who are at the middle stage of agricultural modernization demand more child labour in cultivation. Due to insufficient farm asset holding, fragmented and small size, farmers cannot apply various inputs in required proportion timely. As a result, lower farm productivity and higher cost of production make it difficult for a farmer to earn a marginal profit for survival in cultivation in the face of strong crop market competition. In this situation, farmers reduce labour input cost by employing children against lower wages. Thus, modern technological packages applied sub-optimally can explain the higher demand for child labour in the capital-using stage of agricultural development. Furthermore, this increased demand for child labour motivates rural people to have a large family. This holds true for the present study area.

f. **Unregulated Settlement**: The presence of innumerable remnants of river courses in the study area vividly portrays the moribund condition. Such condition has most intensively developed as pockets in the study area. Such pockets are liable to inundation in the heavy cyclonic weather during the monsoons.
Photo 43: A Pest in the rice field of Paharpur village (J.L. No. 20) in Ranaghat P.S. about 15 km east of Ranaghat R.S.

Photo 44: Invasion of *Monocharnia hastata* in the rice field of Paharpur village (J.L. No. 20) in Ranaghat P.S. about 15 km east of Ranaghat R.S.
Photo 45: Invasion of *Wolffia* sp. in the rice field of Paharpur village (J.L. No. 20) in Ranaghat P.S. about 15 km east of Ranaghat R.S.

Photo 46: Invasion of *Fimbristylis* sp. in the rice field of Paharpur village (J.L. No. 20) in Ranaghat P.S. about 15 km east of Ranaghat R.S.
Built-in settlements with increasing density and without any regulation cause more loss of life and property.

g. **Illegal Migration**: Being located near the international border, the study area faces the problem of illegal migration from Bangladesh thus increasing pressure on the resources of the area and deteriorating the environmental health of the area.

The cumulative issues of the socio–economic environment and their related impacts are shown in Fig. 13.9.

**IMPACT ON THE SOCIO-ECONOMIC ENVIRONMENT**

Thus, it is evident from the above discussion that there is impact of the rivers and surface water bodies on man and at the same time the anthropogenic interventions have brought about a lot of harmful changes in both the physical and socio-economic environment.