IMPACT OF CHANGES IN LANDUSE ON ENVIRONMENT

Landuse analysis in Section 11.1 of Chapter 11 provides information about the trend of change in broad landuse categories e.g., declining trend of forest and net sown area, fluctuating trend of cultivable waste land and increasing trend of area not available for cultivation. Landuse analysis in Section 11.2 of Chapter 11 provides relatively more specific information by increasing the number of categories. However, both of these analyses provide only a crude conception about the areal interchange among different landuse categories. This categorical information provides, practically, no idea about environmental impact. Environmental impact is specific to both of the region and to the particular landuse. More clearly, a specific landuse in a particular biophysical and socio-economic setting will give rise to assemblages of environmental impact which are interconnected to each other. For
example, declining forest coverage is detrimental to physical environment and will give rise to a set of environmental impact. However, the set of impact is closely interrelated with the type of newly emerged landuse. Assemblages of impact of encroachment of agriculture on deforested land are different than that of encroachment of settlement or industrial unit on deforested land. Similarly the impact of deforestation on undulating land is not same as that of plain land. In this context, Section 11.3 of Chapter 11 provides relatively more specific information about region specific landuse change through field observations.

Before going into a detailed impact analysis, it is, therefore, relevant to provide a framework of nature of transformation of landuse in the study area (Table 12.1).

<table>
<thead>
<tr>
<th>Landuse category</th>
<th>Existing landuse</th>
<th>Previous landuse</th>
<th>Nature of change</th>
<th>Regional specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>Land under poppy seed cultivation</td>
<td>Either current fallow land or the land put to some rabi crops</td>
<td>Changes in cropping pattern</td>
<td>Distributed throughout the study area irrespective of the region’s bio-physical and socio-economic settings</td>
</tr>
<tr>
<td>Dam</td>
<td>Hinglow dam</td>
<td>Forest land, cultivated land and fallow land</td>
<td>From terrestrial to aquatic ecosystem</td>
<td>Geology: Chotanagpur gneissic complex&lt;br&gt;Land capability: poor</td>
</tr>
<tr>
<td></td>
<td>Bakreshwar dam</td>
<td></td>
<td></td>
<td>Geology: Chotanagpur gneissic complex&lt;br&gt;Land capability: moderately good (75.54%), good (14.92%) and very good (9.53%)</td>
</tr>
<tr>
<td>Mining</td>
<td>Mining (coal, fire clay)</td>
<td>Forest land, agricultural land and area not available for cultivation</td>
<td>Changes in air, water and land (surface and sub surface)</td>
<td>Geology: Gondwana super group with coal seam of Barakar and Raniganj formation (55%), Quaternary formation (38%), Chotanagpur gneissic complex (7%)&lt;br&gt;Land capability: very good</td>
</tr>
<tr>
<td></td>
<td>Moram quarrying</td>
<td>Cultivable waste land</td>
<td></td>
<td>Geology: Quaternary formation&lt;br&gt;Land capability: varies between poor to fair</td>
</tr>
</tbody>
</table>
Table 12.1: Transformation of landuse in the study area  (Contd...)

<table>
<thead>
<tr>
<th>Landuse category</th>
<th>Existing landuse</th>
<th>Previous landuse</th>
<th>Nature of change</th>
<th>Regional specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>Temporary and permanent brick kiln</td>
<td>Cultivable waste land, current fallow land</td>
<td>Changes in air, water and land</td>
<td>Sporadically distributed all over the study area with special consideration of relatively upland area</td>
</tr>
<tr>
<td>Thermal power plant</td>
<td>Fallow land</td>
<td></td>
<td></td>
<td>Geology: Chotanagpur gneissic complex (60%) and Quaternary formation (40%)</td>
</tr>
<tr>
<td>Coke factory</td>
<td>Fallow land</td>
<td></td>
<td></td>
<td>Land capability: varies between good to very good</td>
</tr>
</tbody>
</table>

Source: Compiled by the researcher

12.1 AGRICULTURE

12.1.1 Agro-ecological Situation

The Planning Commission, Govt. of India has divided the whole country into 15 agro-ecological regions. The state of West Bengal is further subdivided into 15 agro-climatic zones. According to the classification, the Birbhum district falls under three agro-ecological situations: a) AES-I (Gangetic Alluvial Zone), b) AES-II (Undulating Red and Lateritic Zone) and c) AES-III (Vindhya Alluvial Zone). The Southwest Birbhum District falls under AES-II Zone (Table 12.2).

Table 12.2: Agro-ecological situation of SWBD

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Agro-ecological Situations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil type</td>
<td>Sandy to sandy clay soil. 80% of cultivated area is under clay soil and slight acidity problem soil (pH 5.2-6.5).</td>
</tr>
<tr>
<td>Irrigation</td>
<td>20% area is under irrigation. Most of the area is irrigated from surface water and very little amount of area (5%) is irrigated from minor irrigation sources. Ground water is not easily available.</td>
</tr>
<tr>
<td>Important river</td>
<td>Hinglow, Bakreshwar, Sal, Ajay and Chandrabhaga</td>
</tr>
<tr>
<td>Flood/Drought prone</td>
<td>Moderate drought prone area</td>
</tr>
<tr>
<td>Available water area for fish cultivation</td>
<td>60% ponds are under this AES. Vast sweet water fish cultivation</td>
</tr>
<tr>
<td>Animal resources</td>
<td>Maximum percentage of goats and poultry population is available</td>
</tr>
<tr>
<td>Major Crops:</td>
<td></td>
</tr>
<tr>
<td>Paddy</td>
<td>Autumn, Winter and Summer rice</td>
</tr>
<tr>
<td>Oil-seeds</td>
<td>Mustard, groundnut, sesame in limited areas</td>
</tr>
<tr>
<td>Pulses</td>
<td>Khesari, black and green gram, kulthi</td>
</tr>
<tr>
<td>Vegetables</td>
<td>Seasonal vegetables round the year</td>
</tr>
<tr>
<td>Fruits</td>
<td>Mango, guava, citrus, banana, coconut</td>
</tr>
</tbody>
</table>

Source: Strategic Research and Extension Plan (SREP), Birbhum, 2009
Crops and cropping pattern

Cropping pattern of an area is the outcome of interaction between bio-climatic (climate, soil) and socio-economic factors. Cropping pattern of SWBD may be divided into three distinct seasons: pre-kharif (March to June), Kharif (June to October) and Rabi (October to March) (Table 12.3). However, the cropping system in the study area is mainly dominated by rainfed paddy cultivation during kharif season. Only 18% of the net sown area in the study area is under irrigation. The cropping intensity of the study area in 2008-09 is only 133% which is far below than the district average (169%). Since the last two decades a fluctuating trend in cropping intensity has been identified (Table 12.4). In such agro-ecological situation the cropping pattern of the study area has restructured with mono cultivation of opium poppy during winter season.

Table 12.3: Cropping pattern of SWBD

<table>
<thead>
<tr>
<th></th>
<th>Non-irrigated (82%)</th>
<th>Irrigated (18%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-kharif</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kharif</td>
<td>Fallow</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Short duration rice</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HYV paddy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vegetables</td>
<td></td>
</tr>
<tr>
<td>Rabi</td>
<td>Mustard</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gram</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Opium poppy</td>
<td></td>
</tr>
<tr>
<td>Pre-kharif</td>
<td>Aus paddy</td>
<td></td>
</tr>
<tr>
<td>Kharif</td>
<td>Jute</td>
<td></td>
</tr>
<tr>
<td>Rabi</td>
<td>Aman paddy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wheat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Boro paddy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Potato</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mustard</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vegetables</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Opium poppy</td>
<td></td>
</tr>
</tbody>
</table>

Source: Raw data obtained from District Statistical Handbook (2007), field observations and compiled by the researcher

Table 12.4: Cropping Intensity of SWBD

<table>
<thead>
<tr>
<th>Year</th>
<th>Net sown area (sq.km.)</th>
<th>Area sown more than once (sq.km.)</th>
<th>Gross cropped area (sq.km.)</th>
<th>Cropping intensity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993-94</td>
<td>600.49</td>
<td>168.92</td>
<td>769.41</td>
<td>128.13</td>
</tr>
<tr>
<td>1996-97</td>
<td>600.47</td>
<td>172.00</td>
<td>772.47</td>
<td>128.64</td>
</tr>
<tr>
<td>1997-98</td>
<td>690.39</td>
<td>172.00</td>
<td>862.39</td>
<td>124.91</td>
</tr>
<tr>
<td>1999-2000</td>
<td>559.70</td>
<td>172.00</td>
<td>731.70</td>
<td>130.73</td>
</tr>
<tr>
<td>2000-01</td>
<td>690.39</td>
<td>172.00</td>
<td>862.39</td>
<td>124.91</td>
</tr>
<tr>
<td>2002-03</td>
<td>694.20</td>
<td>95.20</td>
<td>789.40</td>
<td>113.71</td>
</tr>
<tr>
<td>2008-09</td>
<td>559.70</td>
<td>182.56</td>
<td>742.26</td>
<td>132.62</td>
</tr>
</tbody>
</table>

Source: Raw data obtained from District Statistical Handbooks (1993-2008), Birbhum and computed by the researcher

12.1.2 Opium Poppy Cultivation

The study area represents an agricultural economy. Economic growth of the study area is almost stagnant. Agricultural potential of the study area is very low. The greatest constraint of agriculture in the study area is the lack of adequate water during the crop cycle and the inefficient use of the available water. Therefore, in the existing bio-physical structure, cultivation of rabi crops during winter period require very high input cost. But as the productivity is very low, the ultimate return will be very low in relation to the input cost and thus making the agriculture unprofitable.
Moreover, in the existing socio-cultural setting combined with existing economic situation, the inhabitants of the study area do not have other options to acquire cash for survive with a minimum standard of living. Such bio-physical and socio-economic specificity of the study area force the inhabitants to opt for illegal opium poppy cultivation from where they can earn enough money with minimum effort (Photo 28).

Poppy seed is a cash crop which can tolerate well harsh conditions. It can tolerate a variety of soil and climatic conditions. It does not require much irrigation. Therefore, it can be said that, it can be cultivated in any areas where other crops are not suitable. In the hard granite-gneissic landscape having very low ground water potential and with severe lack of rainfall in most of the years, the drought-resistant opium poppy is the only profitable crop in the study area. Govt. has been taking several steps to stop opium poppy cultivation in SWBD. The police force along with the B.D.O. visit these poppy fields on surprise visit during the season and destroy some plantations. During her field survey in Chapla mouza of Khoyrasole block, the researcher observed the miserable conditions of the villagers. A working lady in the poppy field told the researcher that, ‘if you destroy one poppy field, we will grow in another field. The field will once again be full of poppies’. The villagers are with the view that, instead of destroying their crops, the Govt. should provide jobs for them. In 2011, the strict steps taken by the police are able to stop opium poppy cultivation in the study area. However, instead of acute anti-Govt. feeling and strong protest, the villagers are reluctant to give up the poppy cultivation which is most profitable to them. They are with the hope that, in the coming year they will again be able to cultivate the most profitable crop.

12.1.3 Impact on physical environment

a. Deterioration of aquatic ecosystem

Production of opium and heroin from the white milky latex of poppy pods require toxic chemicals. After drug production, the residual chemicals generate huge amount of dirty and toxic waste products. After mixing with flowing water, these substances pollute the surrounding water bodies and consequently become detrimental to the aquatic ecosystem.
12.1.4 Impact On Socio-Economic Environment:

a. Increase in net sown area

One of the most important positive consequences of opium poppy cultivation is that, it increases the amount of both net sown area and gross cropped area in the study area. As the good quality irrigated lands are given to opium poppy cultivation, the farmers have been converting some cultivable waste land to cultivated land for production of other rabi crops like potato, mustard etc. Moreover, due to lack of water resource, after rainfed paddy cultivation, most of the agricultural plots have been remained as current fallow land. However, the immediate and sure profit from opium poppy cultivation encourages the farmers to cultivate the land even during water scarcity period. As there is no Govt. record of opium poppy cultivation in the study area, it is not possible to quantitatively express the changed scenario. However, the researcher, during her field survey, observed the changed scenario.

b. Employment opportunity

Opium poppy cultivation is highly labour intensive. It requires a large number of labour to cut and remove the unwanted plants from the poppy fields in two or three times during the season. Moreover, poppy cultivation in the study area is mainly driven by opium production. To collect opium from poppy plants, it requires a large number of labour. There is a special technique to collect opium from poppy plants. The skin of the ripening pods of the poppy is scored by a sharp blade. This activity is done mainly in the afternoon. Special care should be taken so that rain, wind and dew cannot damage the extraction of latex from the poppy pods. Incisions are made three or four times at intervals of two or three days and each time the white latex are collected the following morning (Photo 29). For these activities a large number of labours are required who are paid at the rate of Rs. 120-150 per day. After the extraction of opium, the poppy pods are crushed and the poppy seeds are collected.

c. Profit-oriented occupation

Opium poppy cultivation is the most profitable economic activity in the study area. According to a villager of Sarsa mouza (122) of Khoyrasole block, ‘every parts of poppy plant are usable’. Opium poppies are cultivated in the study area mainly for the production of opium and heroin.
The villagers are also making additional money by drying the poppy heads and collecting the poppy seeds. The villagers are selling opium to the local people, to the people of Maldah and Murshidabad district of West Bengal and to the people of Delhi and Uttar Pradesh. The current market price (2012) of opium in the study area is Rs. 40000 per kg. Some of the villagers are making heroin from opium and are selling at the rate of Rs. 40-45 lakh per kg. Poppy seeds are selling at the rate of Rs. 250-300 per kg. to the local people. The sale of poppy seed is the only licit income generated from the opium poppy cultivation in the study area. Moreover, unlike other agricultural crops, marketing of opium poppy has an extra advantage of being collected at the farm gate by the traders or the wholesalers.

d.Decrease in *rabi* cultivation
Production of potato and mustard has decreased dramatically in the study area as the farmers are engaged in opium poppy cultivation during *rabi* season. The villagers are with the view that they can earn lakhs of rupees from poppy cultivation instead of rupees 8000-10000 per *bigha* from paddy or potato cultivation. Now, all the good quality irrigated lands are given to poppy cultivation. Such kind of activity has a detrimental impact on the local agricultural economy. It inhibits the region’s self sufficiency in agricultural production and, thus, impedes balanced socio-economic growth.

e.International crime
Apparently, it can be said that, opium poppy cultivation in the study area has reduced the rate of local crime in the study area. The rate of local miscreant activities (e.g. theft, robbery etc.) was much higher in the study area before the inception of opium poppy cultivation (2005). However, trafficking of opium and heroin has introduced international crime. Organised criminal group pose serious threat to the regional security. The illicit funds are distributed to the criminals and insurgent group. An inhabitant of Gangpur *mouza* of Khoyrasole block was caught red handed when he was smuggling 2 kg. heroin, amounting Rs. 90 lakh. He is now at Tihar jail.
Photo 28: A view of opium-poppy field in the interfluves areas of the river Ajay and Hinglow at Chapla *mouza* (168) of Khoyrasole block (2010, December).

Photo 29: The cut marks on poppy pods have been made for collecting white milky latex from which opium is produced.
f. Social disruption
The villagers who are engaged in opium and heroin production are often become addicted due to the passive exposure of the drug. Advanced addiction will reduce the working capacity of the workers. Thus, in the long run, the rural communities engaged in drug making will not be able to involve themselves in rebuilding and upgrading their domestic economies. Thus, such kind of practice will indirectly responsible for family breakdown of the study area in the coming future.

g. Change in rural livelihood
Opium poppy cultivation has drastically changed the rural livelihood pattern. They are cultivating the plant by illegal method and selling the output by illegal ways and earning huge amount of black money and become rich within short time. With the ready money they are now engaged in rebuilding their domestic livelihood pattern. They have been converting their mud house into brick-built house. They are not worried about the monetary problems in case of their daughter’s marriage. Two-wheelers are now easily available in many families of the study area which increases the mobility of the villagers.

However, there are also some evil effects of this ready money which adversely changed the rural livelihood pattern. Opium poppy cultivation is mainly concentrated in the families of illiterate poor farmers. The unexpected huge money just makes them blind. The apparently easy way to accumulate huge money makes their children reluctant to go to schools or colleges. Some of the college students, belonging to the families doing opium poppy cultivation, told the researcher that, they are just want to have the pass certificate in any way, so that by giving bribe they can get a permanent job. One of the college students told that, he will give Rs. 20 lakhs to ECL Company to get a permanent job. This is because of the fact that, money is not a matter of worry to them. Therefore, it can be said that, opium poppy cultivation not only quantitatively but also qualitatively deteriorates the educational scenario of the study area.

Table 12.5 summarises the environmental impact of opium poppy cultivation in the study area;
Table 12.5: Environmental impact of opium poppy cultivation

<table>
<thead>
<tr>
<th>Environment</th>
<th>Positive impact</th>
<th>Negative impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>Deterioration of aquatic ecosystem</td>
<td></td>
</tr>
<tr>
<td>Socio-economic</td>
<td>Increase in net sown area</td>
<td>Decrease in <em>rabi</em> cultivation</td>
</tr>
<tr>
<td></td>
<td>Employment opportunity</td>
<td>International crime</td>
</tr>
<tr>
<td></td>
<td>Profit-oriented occupation</td>
<td>Social disruption</td>
</tr>
<tr>
<td></td>
<td>Positive change in rural livelihood pattern</td>
<td>Negative change in rural livelihood pattern</td>
</tr>
</tbody>
</table>

12.2 DAM

There are two dams in the study area: Bakreshwar dam located at Dubraajpur block and Hinglow dam located at Khoyrasole block (Table 12.6).

Table 12.6: Salient features of Bakreshwar and Hinglow dams/reservoirs

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Bakreshwar dam/reservoir</th>
<th>Hinglow dam/reservoir</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>23°49'11&quot; N to 23°51'46&quot; N &amp; 87°23'22&quot; E to 87°25'37&quot; E</td>
<td>23°49'17&quot; N to 23°50'36&quot; N &amp; 87°11'27&quot; E to 87°12'53&quot; E</td>
</tr>
<tr>
<td>Geo-physical characteristics</td>
<td>Underlain by hard granite-gneissic landscape</td>
<td>Underlain by hard granite-gneissic landscape</td>
</tr>
<tr>
<td>Land capability</td>
<td>Varies between moderately good to good</td>
<td>Poor</td>
</tr>
<tr>
<td>River</td>
<td>Bakreshwar, a tributary of Mayurakshi river</td>
<td>Hinglow, a tributary of Ajay river</td>
</tr>
<tr>
<td>Purpose</td>
<td>Back up reservoir; supply water to BKTPP for a period of three months when water from Tilpara reservoir cannot be used</td>
<td>To supply irrigation water</td>
</tr>
<tr>
<td>Height</td>
<td>---</td>
<td>38 feet above the depth of foundation</td>
</tr>
<tr>
<td>Catchment area</td>
<td>987 sq. km.</td>
<td>305.62 sq.km.</td>
</tr>
<tr>
<td>Storage volume</td>
<td>2.29 million m³</td>
<td>1.24 million m³</td>
</tr>
<tr>
<td>Life time</td>
<td>50 years</td>
<td>---</td>
</tr>
<tr>
<td>Mouzas affected</td>
<td>About of 24 mouzas of Dubraajpur block</td>
<td>About 11 mouzas of Khoyrasole block</td>
</tr>
</tbody>
</table>

12.2.1 Impact On Physical Environment

a. Deforestation

Construction of Bakreshwar dam has severely affected the dense forest cover of the concerned area (Table 12.7 & Fig. 12.1, 12.2). Before the construction of the dam, the *mouzas* located in this part (*e.g.* J.L No. 52, 87,101,102,107) was under dense forest cover. According to the villagers, the forest was locally known as *bagkhalar jungle* which remained the habitat of several animal species like cat, dog, rabbit, fox, tiger *etc.* Construction of Bakreshwar dam and reservoir has caused destruction...
and submergence of the existing forest cover. This has disrupted the forest ecosystem. The animal species are totally disappeared. Construction of Hinglow dam and reservoir (Photo 30, 31), on the contrary, has affected very little amount (8.40 ha) of the local forest coverage, as the land was already deforested since 1972 onwards. However, construction of Hinglow dam and reservoir has caused submergence and loss of about 191.76 ha of agricultural land affecting 11 mouzas (e.g. J.L. No. 62, 63, 64, 65, 66, 68, 69, 70, 71, 78 and 79) of Khoyrasole block (Table 12.7 & Fig. 12.3, 12.4).

Table 12.7: Loss of forest due to Bakreshwar and Hinglow reservoirs

<table>
<thead>
<tr>
<th>Dam</th>
<th>J.L. No</th>
<th>Mouza</th>
<th>Submerged forest coverage (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakreshwar</td>
<td>52</td>
<td>Parulbona</td>
<td>5.02</td>
</tr>
<tr>
<td></td>
<td>53</td>
<td>Sahapur</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>87</td>
<td>Bhonra</td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td>88</td>
<td>Radhamadhabpur</td>
<td>2.27</td>
</tr>
<tr>
<td></td>
<td>89</td>
<td>Modapa</td>
<td>27.00</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>Bandhersol</td>
<td>6.02</td>
</tr>
<tr>
<td></td>
<td>101</td>
<td>Raghunathpur</td>
<td>36.56</td>
</tr>
<tr>
<td></td>
<td>102</td>
<td>Maniram</td>
<td>3.13</td>
</tr>
<tr>
<td></td>
<td>107</td>
<td>Milanchak</td>
<td>5.96</td>
</tr>
<tr>
<td>Hinglow</td>
<td>64</td>
<td>Madanpur</td>
<td>8.25</td>
</tr>
<tr>
<td></td>
<td>79</td>
<td>Islamkuri</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Source: Calculated from LULC map (1972 & 2009) by the researcher

b. Reduction Of Ground Water Recharge

Construction of dam on Bakreshwar and Hinglow rivers has inevitably stopped the flow of water in downstream area of the dam site. Prior to the construction of the dams, the rivers played a very important role in recharging the underground water. Drying up of downstream section of these river beds adversely affect the ground water situation in these regions.

Some of the mouzas of Khoyrasole and Dubrajpur block have previously been affected by fluoride contamination in ground water. Fluoride concentration in Teliadangal (183) mouza of Dubrajpur block and Rasa (107), Kendgare (120) and Lauberia (123) mouzas of Khoyrasole block has been much higher (ranges between 4.85-7.91 ppm) than the permissible (1.00 ppm). This problem is likely to increase with the reduction of the rate of ground water recharge.
Fig. 12.1

Fig. 12.2
Fig. 12.3

Fig. 12.4
Photo 30: This is a view of Hinglow dam on Hinglow river in Islamkuri mouza (79) of Khoyrasole block; it provides canal irrigation to some mouzas of Dubrajpur and Khoyrasole block.

Photo 31: This is a view of reservoir of Hinglow dam.
c. Fragmentation of aquatic ecosystem

Construction of dam on Bakreshwar and Hinglow rivers curb the natural flow pattern of the rivers. After the construction of dams the downstream portions of the rivers have transformed into non-perennial channels. Moreover, the turbidity conditions of the rivers have also changed. Many of the indigenous aquatic species become extinct, converting the reverine ecosystem into a fragmented and fragile one. Contrary to this, in the upstream portions, huge volumes of water of the reservoirs have become the storehouses of various species of aquatic flora and fauna. During winter season, the scenic beauty of the reservoirs is increased by the migrated birds coming from Siberia.

12.2.2 Impact on socio-economic environment:

a. Provide infrastructural facilities

Water supply from Bakreshwar reservoir enables the BKTPP to supply up to some 18% of power demand of West Bengal. Hinglow reservoir provides canal irrigation to 31 mouzas of Khoyrasole block and 41 mouzas of Dubrajpur block.

b. Submergence of agricultural land

During the field survey, the inhabitants of the Bataspur (65) and Islamkuri (79) mouzas of Khoyrasole block proposed that, due to construction of Hinglow dam, their mono-cropped and in some cases double-cropped agricultural land have submerged under Hinglow reservoir. According to Govt. record about 48.6 ha land of Bataspur mouza and about 41.50 ha land of Islamkuri mouza has submerged under water. They sold their agricultural land at the rate of Rs. 2000-3000 per bigha (1976).

However, the villagers of these two mouzas expressed their grievance by saying that, though they are the worst sufferer of the project, but they can not avail the benefit of the project. As these two mouzas are located in relatively upland areas they cannot avail the canal irrigation facility.

c. Problem of communication

Before the construction of Bakreshwar dam, the villagers of Metela mouza (58) can easily communicate with the Palasban (67) and Simlakuri (68) mouzas through the dry river bed of the Bakreshwar river. They
could easily bring their agricultural products through this short cut root. However, as these *mouzas* are located in the upstream portion, construction of Bakreshwar dam has converted the once dry river bed into perennial one. At present, the only means of transportation among these *mouzas* is the iron-made big potter (locally known as *nun*) through the Bakreshwar river. But *nun* is unable to transport the huge amount of agricultural products. Therefore, the villagers have to bring their agricultural products through Bakreshwar (42). For this they have to cover extra 18-20 km. distance by paying extra Rs.800 per car. This is uneconomical in terms of cost benefit ratio.

Similarly, before the construction of Hinglow dam, the inhabitants of Bataspur *mouza* (65) can easily communicate with Babuizore *mouza* (78). However, after the submergence of land, *nun* has become the only means of communication, the fair (up and down) of which is Rs. 2.50 per head.

d.Unhygienic living condition
Bataspur *mouza* (65) of Khoyrasole block was surrounded by Hinglow river in the West and a Kandar (tributary of Hinglow river) in the east. After the construction of Hinglow reservoir, the southern portion of the *mouza* has submerged under water. Therefore, at present the three sides (east, west and south) of the *mouza* are surrounded by water, which create unhygienic living conditions. Such kind of environment increases the performance of poisonous insects, mosquitoes and snakes which, in turn, cause several diseases.

e.Rehabilitation
Submergence of Gopalpur *mouza* (84) of Dubrajpur block due to construction of Bakreshwar dam has caused eviction of the total population of Gopalpur *mouza*. According to 2001 Census, total population of Gopalpur *mouza* was 346 of which 45% population belonged to S.T. category. About 31% of the total workers were cultivators and 45% were agricultural labourer. About 60% of the total population was illiterate. The above statistics reveal the fact that the poor illiterate villagers of Gopalpur *mouza* were mainly engaged in agricultural activities.
Submergence of Gopalpur mouza have evicted the people mainly in three directions i.e. in Metela mouza which is located in northwestern part of Gopalpur mouza, in Ranjanbazar area of Dubrajpur municipality which is located in southwestern part of Gopalpur mouza and in Tapaspur mouza which is located in southeastern part of Goaplpur mouza (Table 12.8).

**Table 12.8: Rehabilitation of project affected people**

<table>
<thead>
<tr>
<th>Source (evicted from)</th>
<th>Destination (settled in)</th>
<th>Name of blocks</th>
<th>No. of households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gopalpur</td>
<td>Metela</td>
<td>Dubrajpur</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Rangnibazar</td>
<td>Dubrajpur</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Dubrajpur cinema hall danga</td>
<td>Dubrajpur</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Binoynagar-Tappaspur colony</td>
<td>Dubrajpur</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Chinpai</td>
<td>Dubrajpur</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Hazratpur</td>
<td>Khoyrasole</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Field survey by the researcher*

* Field survey is based on interview of the project affected people. So the actual Govt. record may differ from this.

According to rehabilitation measure taken by the project authority, the villagers were given Rs. 6000-8000 per bigha for agricultural land and Rs. 2-3 lakhs per hoses for settlement area. Moreover, it was assured by the project authority that at least one member from each of the project affected family will be provided job facility either in the power plant or in other sectors as per their qualification. However, in reality the picture is quite different. Most of the people of Binoynagar colony have got job in power plant in AMC (Annual Maintenance Company) category. They are mainly engaged in posts like helper, sweeper, office boy etc. and get Rs. 8000-10000 per month. 11 persons who are now settled at Ranjanbazar area of Dubrajpur municipality have also got job in AMC category. Only one person has got job in WBPDCL in permanent post and enjoys all Govt. facilities. 8 persons having relatively high academic qualification (B.A. pass) have got job in primary school as they are the card holders of exempted category. However 75% of the land losers have not got any job security even after 12 years of completion of the project.

Table 12.9 summarises the environmental impact of dam in the study area:

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Table 12.9 Environmental impact of dam

<table>
<thead>
<tr>
<th>Environment</th>
<th>Positive impact</th>
<th>Negative impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>Deforestation</td>
<td>Reduction of ground water recharge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fragmentation of aquatic ecosystem</td>
</tr>
<tr>
<td>Socio-economic</td>
<td>Provide infrastructural facilities</td>
<td>Submergence of agricultural land</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Problem of communication</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unhygienic living conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Problem of rehabilitation</td>
</tr>
</tbody>
</table>

12.3 COAL MINING ACTIVITY

The southern part of the study area (Khoyrasole and Dubrajpur block) is underlain by coal seam of Raniganj and Barakar Formations of Gondwana Super Group. The productive Raniganj Coal field extends into the southern part of the study area.

All the existing illegal mines in the study area are scattered in the southwestern part of the study area. Mining activity in this part of the study area is practiced by the local inhabitants without any serious research. Most of these mines are manually operated mines, where each piece of coal is picked up by local people and loaded in jute bag to be transported by bi-cycle and bullock-cart. Such activities are illegal, unscientific and have been thriving endlessly. Relatively high labour cost and year round job security are forcing the local inhabitants to opt in more profitable mining activity. Moreover, high export price are providing impetus to large scale illegal mining which, in turn, are causing increased corruption and mafia activities. There is no effort to understand the impact and formulate adequate precautionary measures. This wasteful manner of mining operations not only cause immense loss to the national exchequer but disrupt the natural and social environment.

All the local inhabitants engaged in illegal mining activities only look at their individual area of concern. So, the scenario of bigger interest is deprived. However, the most valuable coal resources of the study area should not be frittered away on just small scale interest of the local inhabitants, rather it needs to be conserved for future generations.
Moreover, it needs to be harnessed more systematically, scientifically and legally by considering the ecological susceptibility and social stability.

Recently (since 2006) DVC-EMTA company, a Public-Private-Partnership, has been started to buy land from the local inhabitants for mining operation in both southwestern (Khoyrasole block) and southeastern (Dubrajpur block) parts of the study area.

The Central Govt. has given permission to DVC-EMTA Company to mine coal resources for ‘Khagra Jaidev Coal Project’. It will be an open cast coal mine and its life time is 37 years. The generated coal of this mine will be used only for Thermal Power Plant of Durgapur and Mejia of Burdwan and Bankura district respectively. For this purpose, 3353 acre of land is required. The required land will be acquired from Debipur (127), Joplai (128), Palasdanga (154), Jhirul (153), Loba (155), Barari (156), Khojkamalpur (157), Kota (158), Kamalpur (159) and Birbhadrapur (161) mouzas of Loba G.P. of Dubrajpur block. All these mouzas fall under very good land capability class (Table 12.10). The fertile alluvial tract of these mouzas is facilitated by relatively high surface (River Ajay and Hinglow) and subsurface water potential. As a consequence, the villagers express their grievance to sell their double/triple cropped land without adequate rehabilitation package.

Sri N.C. Mukherjee, Director, DVC-EMTA Company, elaborated the company’s future plan. After a long discussion and negotiation lasting about two years with the local people and panchayet level meeting, following rates have been settled: 10 lakh per acre for high class agricultural land (two and above crops per season), 8 lakh per acre for middle class agricultural land (one crop per season) and 4 lakh per acre for baluchar.
Table 12.10: Classification of land, acquired by DVC-EMTA Company (Dubrajpur block)

<table>
<thead>
<tr>
<th>J.L. No.</th>
<th>Name of mouzas</th>
<th>Total required land (acre)</th>
<th>Agricultural land (acre)</th>
<th>Non-agricultural land (acre)</th>
<th>Settlement area</th>
<th>Public utility land</th>
<th>Water bodies (acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>127</td>
<td>Debipur</td>
<td>16.93</td>
<td>16.93</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>128</td>
<td>Joplai</td>
<td>267.76</td>
<td>199.67</td>
<td>12.81</td>
<td>13.55</td>
<td>1.30</td>
<td>40.43</td>
</tr>
<tr>
<td>153</td>
<td>Jhirul</td>
<td>168.43</td>
<td>168.43</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>154</td>
<td>Palasdanga</td>
<td>701.88</td>
<td>377.38</td>
<td>279.84</td>
<td>11.09</td>
<td>0.15</td>
<td>33.42</td>
</tr>
<tr>
<td>155</td>
<td>Loba</td>
<td>770.97</td>
<td>566.33</td>
<td>120.08</td>
<td>10.88</td>
<td>0.52</td>
<td>73.16</td>
</tr>
<tr>
<td>156</td>
<td>Barari</td>
<td>652.12</td>
<td>368.73</td>
<td>240.60</td>
<td>6.43</td>
<td>1.92</td>
<td>34.44</td>
</tr>
<tr>
<td>157</td>
<td>Khoj kamaipur</td>
<td>210.51</td>
<td>179.46</td>
<td>0.00</td>
<td>3.46</td>
<td>0.12</td>
<td>27.47</td>
</tr>
<tr>
<td>158</td>
<td>Kota</td>
<td>455.05</td>
<td>359.61</td>
<td>64.00</td>
<td>6.29</td>
<td>0.00</td>
<td>25.15</td>
</tr>
<tr>
<td>159</td>
<td>Kamalpur</td>
<td>8.24</td>
<td>4.24</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>4.00</td>
</tr>
<tr>
<td>161</td>
<td>Birbhadrapur</td>
<td>101.34</td>
<td>97.06</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>4.28</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>3353.23</strong></td>
<td><strong>2337.84</strong></td>
<td><strong>717.33</strong></td>
<td><strong>51.7</strong></td>
<td><strong>4.01</strong></td>
<td><strong>242.35</strong></td>
</tr>
</tbody>
</table>

Source: Raw data obtained from DVC EMTA Coal Mines Limited, Birbhum and compiled by the researcher

The Director, DVC-EMTA, has also committed the following rehabilitation package:

i) They will provide a modern township having all amenities at the place of rehabilitation.

ii) Every family would have provided at least 550 sq.ft. of house and 5 decimal of land irrespective of their previous homestead land holding.

iii) The families would have been residing over a larger area of land and building, would be given valuation as per government rules, or same amount of homestead land.

iv) A market complex will be made for the employment of the land losers. Existing hawkers and small traders will get top priority.

v) Existing shopkeepers and traders will be provided one time grants of rupees thirty thousand to run their business.

vi) They will provide a modern and well equipped fifty bed hospital for the lives of the entire local people.

vii) For the sake of the good educational atmosphere they will provide a Secondary and a Higher Secondary School.

viii) They will build a bridge over the river Ajay for better communication between Burdwan and Birbhum district.

ix) They will return back 50% of land after eight years following/taking steps to be fit for agriculture.
However, the villagers are not satisfied with the compensation and rehabilitation package as provided by the DVC-EMTA Company. According to Felaram Mondal (farmer), the rate should be fixed by following the New Land Acquisition Act. He proposed that, according to New Land Acquisition Act, the price of the land should be four times more than the current market price. According to him, instead of Rs. 10 lakh, the villagers should get overall Rs. 72 lakh per acre.

DVC-EMTA Company has also extended its hand to the southwestern part (Khoyrasole block) of the study area. The company will develop an open cast coal mine in southwestern part of the study area. The generated coal of this mine will be used for Bakreshwar Thermal Power Plant of Dubrajpur block. For this purpose, the DVC-EMTA Company has been purchasing land from Barjor (113), Ahmadpur (56), Sahebpur (57), Bhadulia (58), Bastavpur (59) and Gangarampur (62) mouzas of Khoyrasole block since 2007 (Table 12.11). Unlike Dubrajpur block, these mouzas fall under fair to moderately poor land capability class. Agricultural lands of these mouzas are mono-cropped with rain fed paddy cultivation.

After a long discussion and negotiation with the local people and panchayet level meeting, following rates have been settled in 15th January, 2012: 6 lakh per acre for high class agricultural land (two crops per season), 5 lakh 50 thousand per acre for middle class agricultural land (one crop per season) and 4 lakh 50 thousand per acre for low class agricultural land and 5 lakh 50 thousand per acre for ponds.

### Table 12.11: Classification of land, acquired by DVC-EMTA Company (Khoyrasole block)

<table>
<thead>
<tr>
<th>J.L. No.</th>
<th>Name of mouzas</th>
<th>*Agricultural land (acre)</th>
<th>**Non-agricultural land (acre)</th>
<th>Forest (acre)</th>
<th>Orchard (acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>56</td>
<td>Ahmadpur</td>
<td>0.08</td>
<td>0.70</td>
<td>4.36</td>
<td>---</td>
</tr>
<tr>
<td>57</td>
<td>Sahebpur</td>
<td>13.99</td>
<td>2.79</td>
<td>14.00</td>
<td>6.97</td>
</tr>
<tr>
<td>58</td>
<td>Bhadulia</td>
<td>31.77</td>
<td>8.48</td>
<td>15.98</td>
<td>1.00</td>
</tr>
<tr>
<td>59</td>
<td>Bastavpur</td>
<td>---</td>
<td>0.04</td>
<td>158.14</td>
<td>---</td>
</tr>
<tr>
<td>62</td>
<td>Gangarampur</td>
<td>49.67</td>
<td>3.90</td>
<td>56.14</td>
<td>---</td>
</tr>
<tr>
<td>113</td>
<td>Barjore</td>
<td>125.09</td>
<td>28.80</td>
<td>4.90</td>
<td>---</td>
</tr>
<tr>
<td><strong>Total area</strong></td>
<td>220.60</td>
<td>44.71</td>
<td>253.52</td>
<td>7.97</td>
<td></td>
</tr>
</tbody>
</table>

* *Agricultural land includes dangal, baid, dow, jole; **Non-agricultural land includes hir, pukur par, sikasti bhumi, baluchar, rasta, nulla, viti

Source: Raw data obtained from B.L.R.O. Office, Khoyrasole and compiled by the researcher
However, both the existing illegal mining and the proposed legal mining activities have some environmental (physical and socio-economic) impacts.

12.3.1 Impact on Physical Environment:

a. Reshaping of topography
Open cast mining in the southwestern part of the study area has reshaped the existing topography. The land in this part of the study area falls under rolling land unit. In Bhadulia (58), Sagarbhanga (63) and Gangpur (61) mouzas of Khoyrasole block about 200 to 250 small rejected pits have been identified (Photo 32). The overburden is stripped away to recover the minerals by manual operations. The debris is dumped on the surrounding area resulting in disfigurement and degradation of landscape. The entire landscape in this part of the study area is converted from monotonous rolling land to land with small mounds and depressions. Thus, the natural landscape in this part of the study area is converted into anthropogenic landscape.

b. Soil degradation
In the manually operated illegal mines of Bhadulia (58) and Sagarbhanga (63) mouzas of Khoyrasole block, huge amount of top soil together with overburden is scrapped off to recover the underlying coal resources. Recently, in Sagarbhanga (63) and Gangpur (61) mouzas of Khoyrasole block and Palasdanga (154) mouza of Dubrajpur block, it has been observed that heavy powered JCB machines are using to scrap off the overburden (Photo 33, 34). The waste materials are scattered indiscriminately over the surrounding areas. These are susceptible to erosion by both air and water. Mixing up of these particles with the surrounding agricultural fields diminishes the fertility of the soil.

c. Sedimentation of the river bed
The stacking of overburden and building of spoil banks create problem of severe erosion which in turn increases the sediment load of the river bed. During monsoon the rain water carries the washed out material from the waste dumps to the adjoining low lying areas. This washed out material not only pollute the water bodies but also cause siltation of the reservoir of the Hinglow dam, the river bed and the canal.
d. Water scarcity
The vast open cast mine in the study area would deteriorate the water availability conditions in the already water scarce region. The opencast coal mines in the study area would necessitate to suck up the scarce water resources from the working pits. Pumping out of underground water and consequent lowering of water table will intensify the natural aridity in the study area. Moreover, plot no. 2630, 2627 and 2631 (pond and roads) of Palasdanga mouza (154) of Loba G.P. of Dubrajpur block have already been dug out by the DVC EMTA Company for open cast coal mine. The digging will ultimately cause drying up of the ponds which used to serve the domestic needs and irrigation to the surrounding areas.

Photo 32: Photo shows an excavated area of illegal coal mines in Gangpur mouza (61) of Khoyrasole block
Photo 33: Photo shows the parts of heavy powered machine of DVC EMTA Company at Sagarbhanga *mouza* (63) of Khoyrasole block

Photo 34: This is a view of JCB machine, already engaged in cutting the soil at Gangpur *mouza* (61) of Khoyrasole block
e. Diversion of natural flow of river
The ten mouzas of Loba G.P. are located in inter fluvial tract of river Hinglow and Ajay. The fertile lands of this inter fluvial tract are intensively cultivated by the villagers. Recently (November, 2011), the DVC-EMTA Company has made an earthen embankment on Hinglow river at Joplai (128) mouza by disrupting the natural flow of the river. Till now (17.12.2011), 150 m. long and 1 to 1.5 m. high earthen road has been constructed. According to Joydeep Majumdar (Secretary, Krishi Jami Raksha Committee), this earthen road has been made to transport the huge amount of soil generated during mining activity. Contrary to this, Mr. Nirmal kumar Sarkar (Vice President of Khagra Joydev Project) proposed that, this earthen road has been made to fulfill the demand of the villagers to make connection with Burdwan district.

However, whatever it may be the purpose of construction of this earthen road, it will give rise to a set of environmental problems. It will adversely affect the biodiversity of aquatic ecosystem. The river Hinglow, by nature, is a flood prone river which took a dangerous appearance during 1978 flood. In Islamkuri mouza (79) of Khoyrasole block, there is a dam on Hinglow river. Therefore, when excess water will be released from Hinglow dam, this earthen embankment will definitely cause a devastating flood. Spreading of flood water in surrounding land will cause deposition of sand which, in turn, will degrade the quality of land.

f. Acid drainage
In Bhadulia mouza (58) of Khoyrasole block a large number of rejected coal pits interspersed with several small mounds of spoil banks are observed. No efforts have been taken in this illegal mining site to remove the spoil bank or to reclaim the rejected pits. Waste rock piles, mine openings and pit walls are often the source of acid effluents. It occurs when sulfide bearing minerals (pyrite or pyrrhotite) are exposed to oxygen or water, producing sulfuric acid. Acid discharge impacts aquatic life when acidic water is discharged into nearby streams, canals and other surface water bodies.
g. Deforestation
Open pit mining in Bhadulia (58) and Gangpur (61) mouzas of Khoyrasole block involved the removal of native vegetation. Jawshar Ali Khan, an inhabitant of Gangpur mouza (61) told that, the mouza was developed based on local forest resources. Deforestation has been started since 1995 due to illegal mining of coal. Patches of degraded sal forest was observed up to 2011. Very recently (2012, April) due to the encroachment of DVC EMTA Company, it has been observed that the Gangpur mouza (61) has become totally devoid of forest cover.

12.3.2 Impact on Socio-Economic Environment
a. Fragmentation of agricultural field
Fragmentation of agricultural field causes serious problems in Loba G.P. of Dubrajpur block. The mouzas located in Loba G.P. of Dubrajpur block are characterised by very good land capability class. In these mouzas the percentage of net sown area ranges between 80% and 100% to total mouza area. Moreover, most of these mouzas are characterised by two to three crops in a year.

Out of 3353 acre land required for opencast colliery, DVC-EMTA Company till now (17.12.2012) has purchased 600 acre land in Loba G.P. of Dubrajpur block. This 600 acre land is not contiguous, rather the land is scattered. However, before acquiring the entire contiguous land, the Company has started to ditch the already occupied scattered land with the help of heavy powered machine (JCB WB 44B 6077). They have started to ditch the land since 7.11.2012. They are entering their already occupied land with vehicle and machine through the agricultural field of the other land owners which causes serious damage to the agricultural crops. Moreover, in some plots they have dug out the land about 5-6 metres. Depression in neighboring land creates the problem of drainage of water. Besides this, interspersed depressions also create the problem of bringing irrigation water.

b. Destabilization of roads
According to the rule, both the underground and opencast mining are proposed to be made at or extended to any point within 45 metres of any railway, public roads or buildings etc. In Loba (155) mouza the ditch, dug
out by the DVC-EMTA Company, is only 10-15 metres away from the nearby road. Moreover, in Palasdanga (154) mouza, they have already made ditches in plot no. 2630, 2627 and 2631 which represents a pond and roads respectively.

c. Deterioration of infrastructure
Large scale mining activity will aggravate the situation of the already existing poor infrastructure (road) of the study area. In the manually operated illegal mines in the southwestern part of the study area, the minerals are transported by bi-cycle, bullock cart and with a small number of trucks. However, once the large scale mining will start by the DVC-EMTA Company, huge numbers of truck need to be raced to and from the mines and the Bakreshwar Thermal Power Plant. The maximum legal load is 10 tons per truck; but in reality, no one follow the rule and in most cases the trucks are overloaded with 15 or 16 tons of coal. The constant heavy truck traffic will damage the narrow, low capacity road of the study area.

d. Increasing criminal activity
A large number of illiterate poor inhabitants of the study area are engaged in coal smuggling activities. At first, the smuggled coals are taken to the illegal dump yards by bi-cycle and bullock carts. From this dump yard the coals are being transported to Maldah and Murshidabad district of W.B. by trucks for brick kiln. The smuggled coals are also sold to the local people for their domestic need and to the local brick kiln in a relatively cheap rate. According to a coal smuggler, they used to earn between rupees 10000-12000 per month by extracting coal from illegal mines. They paid a lump sum amount to the local political parties and the police to ensure smooth running of their business. A resident of Sarsa mouza (122) of Khoyrasole block, involved in coal theft trade, told that, ‘after harvesting of rainfed paddy we don’t have any work. But we have to feed our families in the situation of high rising market price. This is for the theft of coal, we still alive. But we don’t know what will happen in the future.’
e. Health hazards
Coal mining activity involves the long exposure of the mine workers to the high-risk conditions. Inhalation of dust containing crystalline silica during drilling of wall and mining will cause black lung diseases. Noise-induced hearing loss is another problem of the coal workers resulting from long continued exposure to processing and mining equipment. Transportation of coal through bi-cycle poses a serious life risk to the local coal workers in the study area. They load as much amount that they cannot run the cycle; rather they walk through bare foot within the highly heated metalled road and draught the over loaded cycle. The situation becomes much strenuous during the months from March to June. They become too much exhaustive and there is every possibility of occurrence of heat stroke.

Table 12.12 summarises the environmental impact of coal mining activity in the study area:

<table>
<thead>
<tr>
<th>Environment</th>
<th>Positive impact</th>
<th>Negative impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>Reshaping of topography</td>
<td>Soil degradation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sedimentation of river bed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water scarcity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diversion of natural flow of river</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acid drainage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>deforestation</td>
</tr>
<tr>
<td>Socio-economic</td>
<td>Employment opportunity</td>
<td>Fragmentation of agricultural field</td>
</tr>
<tr>
<td></td>
<td>Profit oriented occupation</td>
<td>Destabilization of roads</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deterioration of infrastructure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increasing criminal activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Health hazard</td>
</tr>
</tbody>
</table>

12.4 BRICK KILN
One of the most important landuse practices, increasing the areal coverage at a rapid rate since the last 5 years, is the brick kiln (Table 12.13 & Fig. 12.5, 12.6). The existing brick making mechanism has typically caused significant air pollution and landuse problems.
Table 12.13: Distribution of brick kiln in the study area

<table>
<thead>
<tr>
<th>Years</th>
<th>Name of the blocks</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rajnagar</td>
<td>Khoyrasole</td>
</tr>
<tr>
<td></td>
<td>Bangla bhatta</td>
<td>Chimney bhatta</td>
</tr>
<tr>
<td>2007-08</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>2008-09</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>2009-10</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>2010-11</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>2011-12</td>
<td>30</td>
<td>5</td>
</tr>
</tbody>
</table>

* Data not available

Source: Raw data obtained from B.L.R.O. Office (Rajnagar, Khoyrasole and Dubrajpur and compiled by the researcher

Fig. 12.5

Temporal trend of changes in brick kiln (Rajnagar block)

Fig. 12.6

Temporal trend of changes in brick kiln (Khoyrasole block)

According to Govt. report, there are 220 bangla bhatta and 50 chimney bhatta are operating in the study area (2010-11). However, in reality the figure exceeds far more than the Govt. record. According to an employee of Khoyrasole B.L.R.O. Office, there are at least 10 bangla bhatta in each G.P. of Khoyrasole block. Therefore, there are at least 100 bangla
bhatta in 10 G.P.s of Khoyrasole block. Within limited study period, it is not possible to the researcher to visit all the 496 mouzas to collect actual information. However, to get an idea, a field survey has been conducted along the road extended from Gokrul mouza (121) of Dubrajpur block to Sarsa mouza (122) of Khoyrasole block (road length is 10 km.). The field survey reveals the fact that, there are 10 working brick kiln and 4 abandoned brick kiln along the 10 km. long road.

12.4.1 Driving forces behind brick kiln:
During the last 7 years (since 2005), the inhabitants of the study area are accumulating huge capital resources through opium poppy cultivation. Another source of raw capital in the study area is illegal coal mining activity. Increasing capital resource leads the villagers to upgrade their living standard. Most of the economically rich but educationally and socially poor villagers of the study area are now spending their extra money to convert their mud houses into brick built house. Therefore, increasing demand of brick for construction activity is one of the main driving forces for flourishing brick kiln activity in the study area.

During field survey it has been observed that the villagers are more vociferous about the less profitable agricultural activity. According to the villagers, from paddy cultivation they can earn Rs. 8000-10000 per bigha and from potato cultivation they can earn Rs. 4000 per bigha. On the contrary, from brick kiln they can earn as much rupees as 1-1.5 lakh from the same proportion of land.

Moreover, not only the ultimate return, but the input cost is also relatively low for brick kiln as compared to agricultural activity in the study area. The land owners allow the brick merchants to cut the soil from their relatively high land area either in free of cost or in a very limited price in the interest that their upland areas will be leveled down. The other principal raw material, the coal, is also abundant in the study area. Instead of Rs. 1200 per quintal, the brick kiln owners buy the local illegally mined coal resources only at the rate of Rs. 300 per quintal. Therefore, increasing scope of profit indulge the villagers to shift from agriculture to brick kiln activity.
Agricultural activity in the study area is totally dependent on rainfall. The study area is mono-cropped with rain fed paddy cultivation. During *rabi* season, the agricultural labourers become practically jobless. During November to March the agricultural labourers are shifted to brick kiln activity from where they can earn Rs. 140-350 per day. Therefore, employment opportunity during lean period of cultivation is responsible for flourishing brick kiln activity in the study area.

### 12.4.2 Types

There are two main types of brick kiln units in the study area: the *Bangle bhatta* (the conventional type) and the chimney *bhatta* (Table 12.14). *Bangle bhatta* is the most common type in the study area. Here the brick kiln owners lease a piece of land for a limited period. In some cases brick kilns are developed in personal land. These kilns are generally temporary in nature, usually not extending for more than few years. Here the land is the source of raw material (clay) for the bricks. Once the lease period is over the land is returned to its owner.

The chimney *bhatta*, on the other hand, is more formal industrial unit. These usually have gas-fired furnaces. Here the raw materials are collected from various sources to produce better quality bricks.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Types</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanency</td>
<td>1. Temporary</td>
<td>During winter season</td>
</tr>
<tr>
<td></td>
<td>2. Permanent</td>
<td>All round the year</td>
</tr>
<tr>
<td>Source of raw materias</td>
<td>1. In-situ</td>
<td>Raw material (soil) is derived from the same field where the kiln is located</td>
</tr>
<tr>
<td></td>
<td>2. Off-situ</td>
<td>Soils are collected from the surrounding fields</td>
</tr>
<tr>
<td>Mechanism of brick making</td>
<td>1. <em>Bnagla bhatta</em></td>
<td>Bricks are fired in clamps or scoves kilns. This is simply a pile of green bricks covered with a sealing layer of mud, with the fuel placed under the bricks. These are not permanent structures.</td>
</tr>
<tr>
<td></td>
<td>2. <em>Chimney bhatta</em></td>
<td>Here bricks are fired by using a chimney. These are permanent kilns.</td>
</tr>
</tbody>
</table>

Table 12.14: Types of brick kiln

Source: Field survey by the researcher
12.4.3 Mechanism

The brick kiln in the study area uses the most common, most primitive and most polluting technology. The firing in the brick kiln is intermittent *i.e.* bricks fired in batches either in clamp, or scotch. This technology is highly inefficient and labour intensive.

Operation begins with the digging of the earth. Clay is mixed with sand and water to make the paste. These are done by the local workers. Now, green bricks (unbaked) are prepared from the paste. Preparation of green bricks is mainly done by the workers who are immigrated from the neighbouring Jharkhand state along with their families. This process is followed by baking. Finally, the baked bricks are carried out from the kilns to be transported to the markets (Photo 35).

12.4.4 Impact on physical environment

a. Soil erosion

*Baid* lands (relatively upland area) are quarried in the study area for collecting the raw material (soil) for brick kiln. According to the villagers of the study area, quarrying of *baid* land convert their otherwise fallow land to suitable land for paddy cultivation. Thus, in case of temporary
brick kiln such kinds of measures are beneficial to some extent. However, in case of permanent brick kiln, such kinds of measures have some detrimental impact on most valuable soil resources. Instead of considering the individual person-specific and area-specific interest, if we consider the whole society and the whole landscape as a system, then the evil effect of such practice will come out. As quarrying of land is not continuous, rather it is concentrated in few places, so such kind of practice increases the undulating nature of the already undulating and rolling land. Thus, apart from the direct removal of huge amount of top soil for supplying the raw material of brick kiln, such kind of practice also accelerates the rate of natural soil erosion by increasing the undulation of the land.

b. Reduction of soil fertility
Removal of large amount of top soil from agricultural field is also responsible for reduction of soil fertility. Due to digging of earth so deep it leads to soil erosion and destruction of micro-organisms, because of which soil fertility is lost and nitrogen and carbon geo-chemical cycles are disrupted (Arms, 1990). To recover the soil fertility it requires huge amount of organic manure, minerals and chemical fertilisers. According to Imran Khan (inhabitant of Rajnagar mouza (38) of Rajnagar block), it will require at least two years to make the land suitable for agricultural purposes.

c. Water logging
In case of permanent brick kiln, digging of land year after year has created a clay pit or hollow areas. A large dimension clay pit is found in the Kukutia mouza (17) of Dubrajpur block. These pits accumulate rain water and ultimately become the breeding ground of mosquitoes and other insects which pose serious threat to the inhabitants of the surrounding mouzas.

d. Solid waste
Coal ash, over burnt, half burnt and broken bricks are the solid wastes generated in the brick kiln. These solid wastes are accumulated on or around the brick kiln. Low quality inputs, improper brick formation and unscientific firing mechanism through the traditional brick production
technology results in a huge amount of broken bricks. Most of the abandoned brick kilns of the study area have become the storehouse of these solid wastes and, thus, impede the agricultural activity on that affected land.

**12.4.5 Impact on socio-economic environment:**

a. Resource extraction and deterioration

In the study area, baking of green bricks is done by using the local fuel wood and coal resources. According to Imran Khan, a brick kiln owner of Rajnagar mouza (38), his kiln has the capacity to fire about 40000 bricks at a time which requires 6 tons of coal. Baking of 40000 raw bricks produces 20000 finished bricks. Therefore, for production of 20000 finished bricks, it requires 6 tons of valuable coal resources. The existing most primitive brick production technology of the study area is responsible for requirement of huge amount of fuel during firing. Moreover, the finished product of this technique is also relatively less durable as compared to the modern technique. Therefore, for producing relatively low quality, less durable brick, it consumes a great deal of valuable coal resources which otherwise would be used for a more efficient industrial work. Such kind of practice will leave less coal for future use.

b. Social exploitation

Efficient labours along with their families are immigrated from neighbouring Jamtara block of Jharkhand state for preparation of high quality green bricks from clay paste. However, the immigrated labours do not have their own houses; they have to live in the temporary houses made by the brick kiln owners in and around the brick kiln area with very miserable living standard. They cannot educate and socialise their children. The workers are engaged in continuous hazardous work in an unhygienic environment of the brick kiln. They cannot think about the high quality living standard within the ambient of coal sustained environment. Generation after generation, the continuing illiteracy increases the rate of child labour. Therefore, it can be said that, such kind of activities though provide financial support but is socially unsustainable.
c. Problem of irrigation
Digging of land has created a change in the landscape system of the study area. The continuity of the land is broken by ditches or furrows. The quarried land becomes a ditch while the neighbouring land remains elevated and hence difficult to irrigate (Singh, A.L. & Md. Sarafaz Asgar, 2003).

d. Health hazards
Various noxious gases (Cox, Sox, Nox etc.) are the byproducts of brick production. Inhaling rock dust and poisonous gases may cause serious health problems like respiratory diseases and eye diseases. Moreover, working in a bare foot without any protective clothing may cause severe skin diseases. Another important byproducts of brick kiln is dust. Dust is produced when soil is extracted and when the finished bricks are transported after the firing process. Inhaling rock dust can lead to a disease like silicosis, which affects lungs and breathing and, thus, lowering the productivity of the workers.

e. Employment opportunity
Brick production mechanism in the study area is highly inefficient and labour intensive. Man power is the basic requirement of the brick kiln. Apart from some large scale chimney bhatta, where JCB machine is used to cut the soil, in most of the brick kiln in the study area, from cutting the soil to preparation of green bricks to carry out the green and finished bricks i.e. all activities are done manually.

Lack of irrigation facility and relatively adverse agro-ecological situation make the study area mono-cropped with rain fed paddy cultivation. Therefore, about half of the years the agricultural labourers and the cultivators have no work. Non-availability of any other industrial unit and no other alternative source of income, force the villagers of the study area to absorb in the brick kiln from where they can earn their livelihood.

f. Profit-oriented occupation
The existing geo-physical and agro-ecological situation of the study area make brick kiln activity more profitable as compared to agricultural activity. The southern part of the study area bears the coal seam of
Ranigang and Barakar formations. Coals are extracted illegally from the Bhadulia (58) and Sagarbhanga (63) and Gangpur (61) mouzas of Khoyrasole block. Beside this, huge amount of coals are also imported by the villagers through buffalo cars from the neighbouring Desermal coal mines (Burdwan district). Therefore, availability of abundant coal resource, make it possible to supply coal to the local brick kiln at a very cheap rate (Rs. 300 per quintal). The existing undulating topography makes the farmers to allow the brick merchants to cut the soil of relatively high land either in free of cost or in a very limited price. The brick kiln owners only have to pay the labour payments.

Therefore, the input cost of brick kiln in the study area is much lower than the agricultural activity in the study area. Moreover, the output is much higher in brick kiln. Imran Khan of Rajnagar mouza (38) of Rajnagar block told that, from paddy cultivation they can earn as much rupees as 8000-10000 per bigha; whereas from brick kiln the amount rises up to Rs. 1 to 1.5 lakhs. Moreover, as agricultural goods are perishable, it requires extra cost to store agricultural products. However, bricks can be stored year after year without any storing cost. Taj Mahammad, inhabitant of Rasulpur mouza (131) of Dubrajpur block, told that ‘it is like a bank’. Therefore, as the input cost is lower and the output cost is higher, so brick kiln is much profit-oriented than that of agricultural activity in the study area.

Table 12.15 summarises the environmental impact of brick kiln in the study area:

<table>
<thead>
<tr>
<th>Environment</th>
<th>Positive impact</th>
<th>Negative impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>Soil erosion</td>
<td>Reduction of soil fertility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water logging</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Solid waste</td>
</tr>
<tr>
<td>Socio-economic</td>
<td>Employment opportunity</td>
<td>Resource extraction and deterioration</td>
</tr>
<tr>
<td></td>
<td>Profit oriented occupation</td>
<td>Social exploitation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Problem of irrigation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Health hazard</td>
</tr>
</tbody>
</table>
12.5 THE BAKRESHWAR THERMAL POWER PLANT

The Bakreshwar Thermal Power Plant is located at Chinpai mouza (90) of Dubrajpur block. The power plant is operated jointly by West Bengal Power Development Corporation Ltd. (WBPDCL), a Govt. of West Bengal Enterprise and Japan Bank of International Cooperation (JBIC). Table 12.16 represents the salient features of BKTPP.

### Table 12.16 Salient features of BKTPP

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Salient features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main plant</td>
<td>Chinpai mouza of Dubrajpur block</td>
</tr>
<tr>
<td>Township</td>
<td>Powabagan and Kachujor mouzas of Suri block</td>
</tr>
<tr>
<td>Dam (Nilnirgan)</td>
<td>Gopalpur, Madupa nad Metela mouzas of Dubrajpur block</td>
</tr>
<tr>
<td>Raw material</td>
<td>Coal is derived from domestic coal fields. Recently DVC-EMTA Company proposed to develop an open cast coal mine in Khoyrasole block. The output of this mine will be supplied to BKTPP. The raw water comes from Tilpara Reservoir, located 15 km. away from the power plant in Suri block of Birbhum district. The Bakreshwar reservoir has also been constructed (3 km. NW of power plant) as a back-up reservoir to supply water during summer season (three months) when water of Tilpara reservoir cannot be used.</td>
</tr>
<tr>
<td>Ash pond</td>
<td>Raipur and Panuria mouzas of Suri block</td>
</tr>
<tr>
<td>Pipeline</td>
<td>Hadla, Sangrampur</td>
</tr>
<tr>
<td>Cooperative</td>
<td>Jambuni</td>
</tr>
<tr>
<td>Capacity</td>
<td>210 MW</td>
</tr>
<tr>
<td>No. of units</td>
<td>5</td>
</tr>
<tr>
<td>Operated by</td>
<td>WBPDCL &amp; JBIC (20 years contract)</td>
</tr>
<tr>
<td>Operating since</td>
<td>1998</td>
</tr>
<tr>
<td>Pollution control equipments</td>
<td>Automated treatment plant, ash plant, effluent plant, electro-static precipitator, catalytic convertor, Fluidised Bed Combustion System (tall chimney are used)</td>
</tr>
<tr>
<td>Awards</td>
<td>The BKTPS has received a Meritorious Award for Low Oil Consumption and a Silver Shield for overall performance from Govt. of India in 2003; it has also received an Environmental Excellence Award in 2003, 2004 and 2005 from Govt. of West Bengal.</td>
</tr>
</tbody>
</table>

12.5.1 Impact on physical environment:

a. Air pollution

One of the two principal raw materials used in thermal power plants is coal. The combustible elements of the coal are converted into gaseous products (e.g. sulphur dioxide, oxides of nitrogen, carbon dioxide, carbon monoxide etc.) and particulate matters (such as fly ash, carbon particles, silica etc.). Tones of particulate matters are emitted every day which causes significant air pollution in surrounding areas.
b. Fly ash

Fly ash is one of the waste products of burning pulverized coal. Fly ash contains various hazardous substances. Various trace metals of fly ash (like Cu, Zn, Pb, Mn etc.) though present in small fractions, are of special interest due to their cumulative built up, long life and toxicity to man, plants and animals through air, water and soil.

The coal for power generation in BKTPP comes from Indonesia, Assam and Raniganj coal fields. The quantity of fly ash depends upon the ash content of the coal. The local poor quality coal produces 70-80% ash, whereas the Indonesian coal produces 50-60% ash. The impact of fly ash is distributed within 7 kms. radius from the power plant. According to A.K. Chatterjee, a resident of Metela mouza (58), a very thin layer (1-1.5mm) of fly ash has been spreading over the surrounding area. According to him, the hazardous impact of fly ash is realised from the low yield of coconut. Not only this, the size of coconut has also reduced and in some cases there is no water within the coconut. He proposed that, as the coconut tree is much higher than other agricultural crops, so the impact is first observed from coconut trees. He has a firm belief that, in the long run the hazardous influence of fly ash would definitely affect the other agricultural crops.

12.5.2 Impact on Socio-Economic Environment

a. Supply of energy

Availability of adequate energy will provide better provision of power to agricultural, industrial and domestic sectors. In 1992, the power demand of West Bengal was 12,833 GWh (4.2% of country’s power demand). In the first half of 1990, frequent power cut resulting from shortage of power, has caused serious obstacle for economic development. In this context, the BKTPPP was planned to develop by using the domestic coal fields to fulfill the purpose of alleviating WB’s power shortage.

Existing 5 units of BKTPS (210*5 capacity) are now able to ensure a more or less stable supply of electricity to contribute to the promotion of industries and the improvement of resident’s live of WB. In the early 1990s, Kolkata experienced severe power cuts totaling some 10 hours a day which at present has reduced to once or twice a week lasting for a
maximum of some 30 minutes. Since the commissioning of Unit 3 in March, 2001, the BKTPP has achieved a maximum output level (670 MW in 2002), which exceeds the design generating capacity. The BKTPP has been supplying up to some 18% of the power demand of WB.

b. Employment opportunity
BKTPP is a Govt. project. As per quality and quantity of the acquired land, the land losers are given compensation. They are also employed in different sectors of BKTPP according to their qualification. Some people (highly qualified) are engaged in permanent job in WBPDCL with high salary, medical facilities and other facilities as per Govt. rules. Some relatively less qualified people are engaged in AMC (Annual Maintenance Company). They are not directly under Govt. job, but are under private company. Besides this, Bakreshwar Thermal Power Co-operative Multipurpose Society Ltd. has been set up which supply local unskilled labour or helper to the thermal plant as per their requirement.

c. Reutilisation of solid waste
One of the most hazardous solid wastes generated from coal-fired thermal power plant is fly ash. Fly ash is used as a raw material for making cement, bricks and aggregates. Since 2003, the fly ash of BKTPP has been supplied to several external companies at a relatively cheap rate for making cement or brick. The utilisation rate of fly ash was 60% in 2005.

d. Infrastructural up gradation
Construction of BKTPP has radically changed the socio-cultural setting of the surrounding areas. Bakreshwar Township with park and hotel are established. Chief executive engineers of BKTPP, coming from out of district and state, are residing in the Bakreshwar Township. Thus, there has occurred cultural interchange between the local inhabitants and the immigrants. Besides this, a Gramin and Silpa Mela is organised every year (from 31st December to 6th January) by the power plant authority. In this festival, a high grade cultural programme is organised with stars coming from Kolkata and Mumbai. Moreover, BKTPP plays a pivotal role in developing a number of infrastructural facilities in the study area (Table 12.17).
Table 12.17: Infrastructural facilities of BKTPP

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Salient features</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
<td>Holy Mother English Medium Primary School (Nursery to class IV) BKTPP Prabir Sengupta High School (Bengali medium); financial assistance are provided for educating the poor households</td>
</tr>
<tr>
<td>Bank</td>
<td>Branch of United Bank of India</td>
</tr>
<tr>
<td>Post office</td>
<td>BKTPP Post office</td>
</tr>
<tr>
<td>Telephone exchange</td>
<td>BSNL Telephone exchange</td>
</tr>
<tr>
<td>Hotel</td>
<td>Motel Hindustan (with AC)</td>
</tr>
<tr>
<td>Police station</td>
<td>Sadaipur Police Station</td>
</tr>
<tr>
<td>Dam</td>
<td>Nilnirgan – picnic spot</td>
</tr>
<tr>
<td>communication</td>
<td>Chinpai and Kachujore railway stations are developed adjacent to the power station; Jambuni bus stand with State Bus stoppage</td>
</tr>
<tr>
<td>Hospital</td>
<td>Mainly for workers of Power Plant; however, the local people can also avail the facilities; provision of free health service are available at the clinic</td>
</tr>
<tr>
<td>Recreation</td>
<td>Construction of recreational facilities using the park and reservoir and sponsoring of sports meetings</td>
</tr>
<tr>
<td>Drinking water</td>
<td>Construction of drinking water supply facilities at the nearby villages</td>
</tr>
</tbody>
</table>

Table 12.18 summarises the environmental impact of BKTPP in the study area:

Table 12.18 Environmental impact of BKTPP

<table>
<thead>
<tr>
<th>Environment</th>
<th>Positive impact</th>
<th>Negative impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>Air pollution</td>
<td>Fly ash</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduction of visibility</td>
</tr>
<tr>
<td>Socio-economic</td>
<td>Energy supply</td>
<td>Employment opportunity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reutilization of solid waste</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Infrastructural up gradation</td>
</tr>
</tbody>
</table>

12.6 COKE FACTORY
A landuse practice, which is the outcome of illegal coal mining activity in the study area, is coke production. Coke is produced by the pyrolysis, i.e. heating in the absence of air of suitable grades of coal. In the formal coke making process, the bituminous coal is heated in a chimney at a high temperature in the absence of oxygen. Volatile compounds that are generated during heating of the coal are collected and processed to recover the combustible gases and other by products. The solid carbon, remaining in the chimney, is the coke. However, in the study area, apart from a few formal coke making factory, in most cases, coke making is done temporarily by the illiterate poor villagers through open heating of the illegally mined coal resources. The communities engaged in illicit way
of coke manufacturing were refused to interact with the researcher during her field survey. Such kind of activities results in sound environmental impact.

12.6.1 Impact on physical environment:

a. Air pollution

Coke making process in the study area produces huge amount of fugitive air emissions. Heating of coal emits particulate matter (PM), volatile organic compounds (VOC), polynuclear aromatic hydro carbons (PAHs), methane, ammonia, hydrogen sulfide, carbon monoxide, hydrogen cyanide and sulfur oxides.

In the study area, the villagers do not use any technology (oven or chimney) to produce coke. They just openly heat the local bituminous coal to produce coke. As there is no vapour recovery system, the rate of emission is much higher. For every ton of coke produced approximately 0.7 to 7.4 kg. of PM, 2.9 kg. of Sox, 1.4 kg. of NOx, 0.1 kg. of ammonia and 3 kg. of volatile organic compounds may be released into the atmosphere.

b. Micro-climatic change

One of the permanent coke factories of the study area is located in Puratan Nakrakonda mouza (128) of Khoyrasole block. The factory is named as M/S Joy Bharat Soft Coke and Briquette. The factory was established in 2001. Up to 2009, the chimney was used to produce coke. After that the factory remained closed for about one year (2010) for the personal problem of the owner. However, since the last two years (2011, 2012), the coke is produced in the factory without using the chimney. The open heating process releases huge temperature and a large amount of black smoke containing huge amount of fugitive air pollutants. Even in the day time (1 pm, 2012, January), when the researcher visited the factory, it was looking like evening time. The micro-climatic change in that particular land is evident from the surrounding planted vegetation communities. The coke factory is located in the highly undulating land which is not available for cultivation. This particular area has been planted with species like arjun, sonajhuri, sisu, eucalyptus etc. During field survey, it has been observed that, within 100 m. radius from the
factory, the once lush green vegetation is totally disappeared. Instead of the green foliage, only the skeletons of the forest are standing (Photo 12, 13 & 14).

c . Solid waste
Coke production mechanism generates huge amount of solid waste like coke breeze. The solid waste contains hazardous substances like benzene and PAHs. Disposal of these waste in the surrounding land adversely affect the soil, surface and sub surface water resources. After rain the surface runoff may percolate through these materials and carry the pollutants into the soil and underground water. Soil micro organisms are destroyed by these pollutants which, in turn, adversely affect the soil physical and chemical properties. In the long run, it will reduce the production of natural and cultivated plants and animals.

12.6.2 Impact on Socio-Economic Environment:

a. Employment opportunity
The impact of coke making in socio-economic environment is apparently positive. The negative impacts on physical environment are offset by significant positive outcome such as employment and consequent economic development. For example, The M/S Joy Bharat Soft Coke and Briquette factory provides employment for about 200 people of surrounding mouzas.

Table 12.19 summarises the environmental impact of coke factory in the study area.

Table 12.19: Environmental impact of coke factory

<table>
<thead>
<tr>
<th>Environment</th>
<th>Positive impact</th>
<th>Negative impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td></td>
<td>Air pollution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Micro-climatic change</td>
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<td></td>
<td></td>
<td>Solid waste</td>
</tr>
<tr>
<td>Socio-economic</td>
<td>Employment opportunity</td>
<td></td>
</tr>
</tbody>
</table>