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Fly Ash and its Impact on Land: A Case Study of Kolaghat Thermal Power Plant, Purba Medinipur, West Bengal

Dr Arindam Dasgupta
Suman Paul

The Kolaghat Thermal Power Plant (KTPP) is situated on the right bank of the Rupnarayan river in the district of Purba Medinipur, West Bengal. This power project was established during the sixth plan period (1980-85) with only one 210 MW unit. It was in 1985 when the West Bengal Power Development Corporation Limited took charge and subsequently added another five 210MW units in two stages. The KTPP covers about 900 acres of land out of which 871.89 acres lie in the Panskura-II block and the rest in the Sahid Matangini block, Tamluk. Although the plant has a number of benefits, the lack of treatment of the fly ash generated from this plant has been detrimental to the productivity and quality of the main commercial crops of the surrounding area and is also responsible for some changes in the landuse pattern. The present paper is an attempt to investigate all these in detail with a case study.

The Kolaghat Thermal Power Plant (KTPP) (22°10' N and 88°00' E) is situated on the right bank of the Rupnarayan river in the district of Purba Medinipur, West Bengal (Map 1). It is located 80 km south west of Kolkata and 50 km north-west of Haldia, one of the major industrial regions of South Bengal. The KTPP has a total installed capacity of 1260 MW with six units, generating about 7500-8000 metric tones of fly ash every day by cosuming a total of 18000 tones of coal (*Source:* KTPP Office, 2009). It has been learnt from the plant authority that for its usual disposal of fly ash one acre of land is required for each megawatt of electricity produced in the whole life of the plant, which is about 30 years (*Source:* KTPP Office, 2009). So the KTPP requires 1250 acres of land for the disposal of fly ash generated in its whole life span. Presently the plant has only 325 acres of land located 4-5 km away from it. Five ash ponds are now operating on it. The fly ash which is coming out of the chimneys generally subsides in the surrounding areas generally 3 – 4 km away. The effect of fly ash on agriculture and social conditions of the local people can be explained through a flow diagram (Fig 1).

The present paper explores the impact of fly ash on the land in terms of change in land use pattern and degradation of land. Village Borodangi which is situated in the Kolaghat block has been chosen for the study. The survey reveals that considerable amount of land have been affected due to the fly ash emitted by KTPP.

Profile of the Study Area

The village Borodangi is located about 4 km away from Kolaghat Railway station and 4 km (air distance) north of Kolaghat Thermal Power Station. The village is connected through bus route with Kolaghat, the nearest town. A number of trekkers are also running from Jhashar to Kolaghat which touches the village (Map 2). The village's economy has been mainly based on agriculture where a

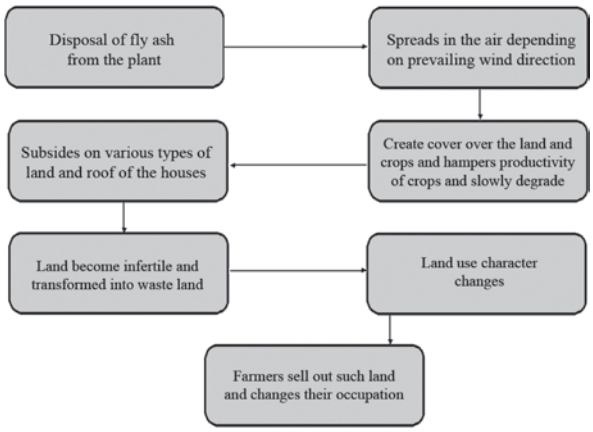
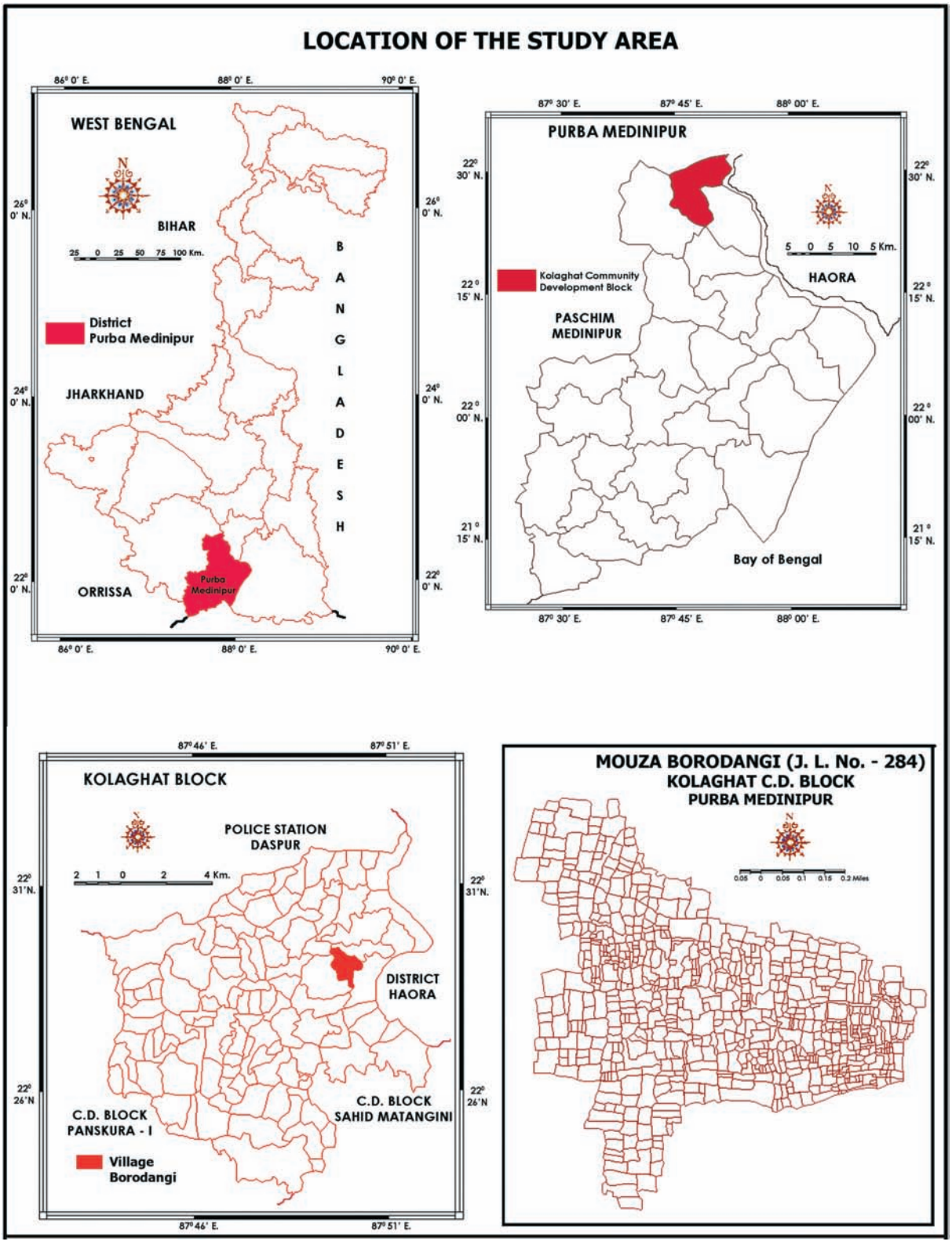
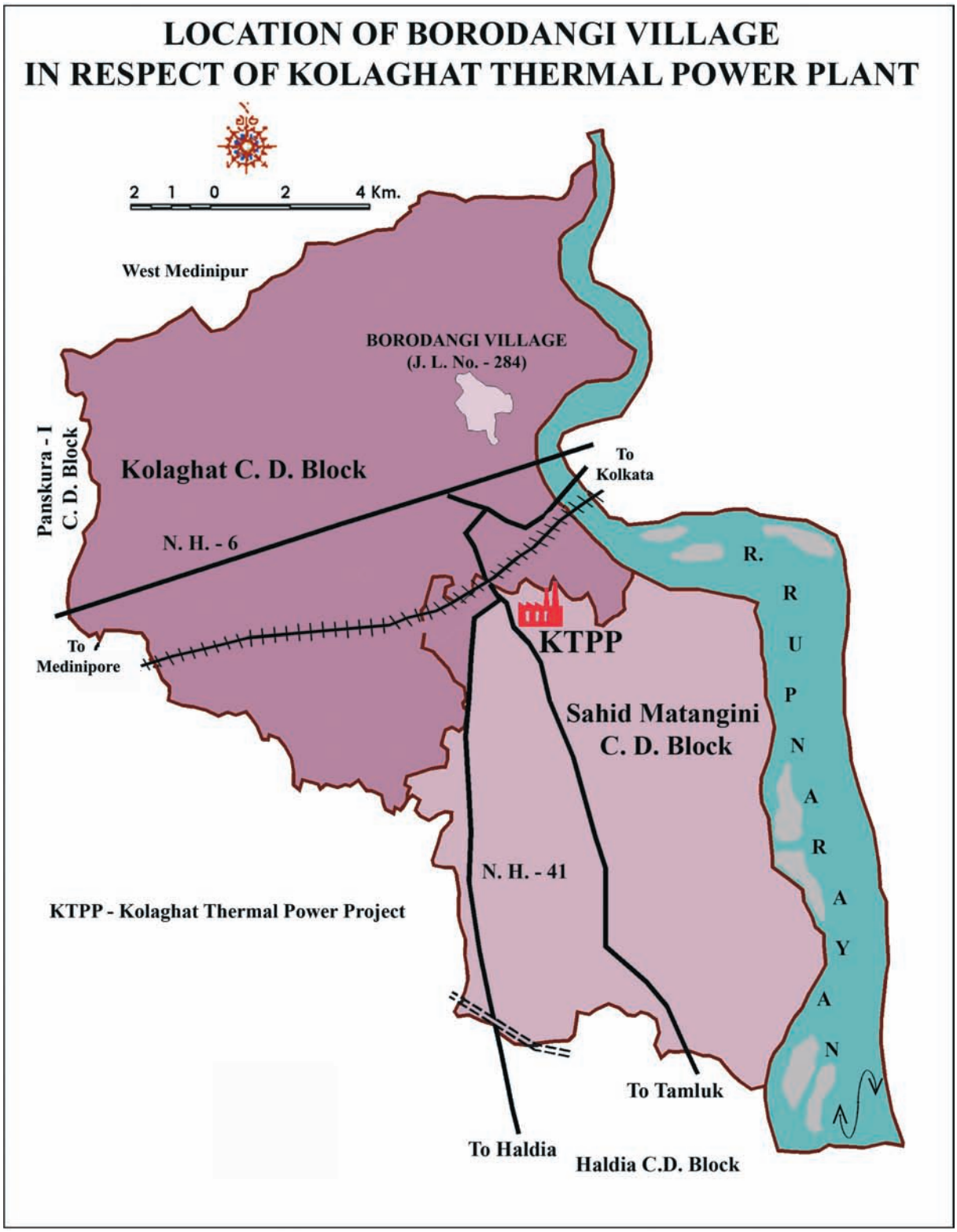


Fig 1.



Map 1.

substantial share of population is engaged in this activity. Some are land owning farmers, some are share croppers and some are daily wage labourers. People engaged in the business sector, industrial sector, and service sector are comparatively few. The educational level of population is medium due to



Map 2.

lack of infrastructure. The nearest school in this village is "Abhinas Chandra Primary School" and the higher educational centre is at Kolaghat which is quite far from the village. The nearest health centre in this village is "Bidhyasagar Datobyo Chikitsha Kendra" where the villagers are given free

medical treatment; the nearest hospital is Tamluk Sadar Hospital, about 16 km away where people get better medical facilities. The transport and communication are very poor as the village roads are largely unmetalled.

Objectives of the Study

The major objectives of the study are:

- To examine the salient characteristics of land use pattern of the study area.
- To assess the impact of fly ash on the production of major commercial crops and the cropping pattern.
- To identify the change in land use pattern and nature of land degradation in the study area due to fly ash.
- To recommend some measures in order to minimize the effect of fly ash on the land.

Data Base

The primary data has been collected from two sources— (a) Field Survey and (b) Kolaghat Block Office. Data related with land holding details along with mouza map were collected from Block Office. The production data of tuberose has been collected from Purba Medinipur Flower Traders' Association, Kolaghat. The data related to the cropping pattern, crop production and type of irrigation facilities available were collected from the field by questionnaire survey and as well as from the Block Development office. The data on different types of fly ash and their utilization have been collected from Kolaghat Thermal Power Plant Authority and Pond Marketing Agency.

Methodology

The methodology has been carried out in three steps—

Pre-field

In this stage the whole study has been planned and some literature concerned with the topic of the study has been collected and reviewed. The District Gazetteer, Medinipur has also been consulted in order to have an idea about the area.

Field Survey

Questionnaire survey was conducted among agricultural households in order to get an idea about the nature of cropping pattern, crop production, major use of land, nature of irrigation and its problems, input used, problems of fly ash and its probable fall out on the landuse and crop production, change in cropping pattern and any change in land use etc. This information has also been collected from Block Agricultural office. Landuse map of the village has also been collected from block office which is the old one and acted as the base map for the current study.

Post-field

The collected data on cropping pattern, landuse characteristics, crop production have been arranged in proper tables and represented by suitable diagrams and maps.

Findings

Land use characteristics of the Study Area

The selected area belongs to the Borodangi Mouza (JL No. 284). The area of the total mouza is 118.4 hectares (292.45acres).

Agricultural Profile of the Study Area

The study area has an agricultural economy. It is suitable for paddy and flower cultivation. Besides, vegetable cultivation is also found in private land but commercial vegetable cultivation on large scale is not practised.

Composition of the Type of the Respondents

The village has 200 households out of which 33 households i.e., 16% are engaged in agricultural activities and it has been found that among these

Table 1: **Composition of the type of the Respondents**

Agricultural Household		Share Coppers		Farmers	
Total	**Percentage**	**Total**	**Percentage of the total agricultural Household**	**Total**	**Percentage of the total agricultural Household**
33	100	17	51.52	16	48.48

Source: Field Survey, 2010.

33 households 51.52% belong to share croppers and the rest 48.48% to the farmers. Therefore, the distribution of the sample households is almost equal.

Land Holding Distribution of the Households

The land holding distribution shows (Fig. 2) that, more than 50% of the surveyed households have on an average land holding size between 0.5-2.0 bigha of land. The percentage of big land holders having on an average of (3.5-6.5 bigha) is 11%. The land owning class having land between (0.0-0.5 bigha) is 18% and the remaining class (2.0-3.5 bigha) have the contribution of 21%. The land holding distribution with reference to different land classes in respect to frequency density has been shown in Fig 2.

Table 2: **Landholding Distribution in Agricultural Households**

Class Limit (bigha)	Frequency	%	Class-width	Frequency Density
0.0-0.5	6	18	0.5	12
0.5-2.0	18	55	1.5	12
2.0-3.5	7	21	1.5	4.667
3.5-6.5	2	6	3.0	0.667
Total Households	33	100	–	–

Source: Field Survey, 2010.

Existing Land Use of the Study Area

The landuse map of Borodangi village (Map 3b) shows, that the agricultural land and the forest land occupied distinguished area. The settlement area is present in the forest zone. The beauty of the settlement area is that a small pond is attached with every settlement. Sometimes the pond is used by the villagers as a source of drinking water. There are number of tube wells in the village that cater to need of the villagers. The pattern of settlement is compact. The strip of land around the pond is used by the villagers as pathway of their daily use. It is unmetalled. One primary school, one health centre, one burning ghat and one play-ground are situated in the adjacent area. Every household has its own storage for harvested crops. Within the stretch of agricultural land, there are pockets of current fallow. These are left unused for some years for natural restoration of fertility. Previously these were used to cultivate the flowers – tuberose, marigold, dopati but due to the fly ash the flower cultivation is no more a profit making business now. It is followed by hibiscus and jasmine as interculture. The production of flower has declined because the fly ash covers the sensitive part i.e. bud of the flower which reduces production of flower from a particular bud. Most of the land is used for paddy which is the principal crop of the village. Turmeric is cultivated between the rows of paddy as an intensive cultivation where every bit of land is utilized. Some portion of agricultural land is also used as production of organic manure which is very useful to the farmer.

Cropping Pattern

Paddy is cultivated in 48.45 bigha of land which accounts for almost 92% of the total cultivated land whereas vegetables are raised on 3 bigha land which covers only 6% of the cultivated land. The most important commercial crop of the region i.e., flower cultivation takes place in 2% of the total cultivated land. In most of the part of the agricultural land paddy is cultivated twice a year. Aman paddy is grown in khariff season whereas boro paddy is grown just before the summer. The paddy cultivation dominates and hence the cropping pattern of the study area is a monoculture one (Fig 3.).

Table 3: **Cropping Pattern in the Study Area**

Total cultivated land (bigha)	Share of various Crops		
52.95	**Crops**	**Amount (bigha)**	**%**
	Paddy	48.45	92
	Vegetables	3	6
	Flowers	1.50	2

Source: Field Survey, 2010

Agricultural Landuse

Agriculture is characterized by double cropping (83.25% of land). The amount of mono crop and

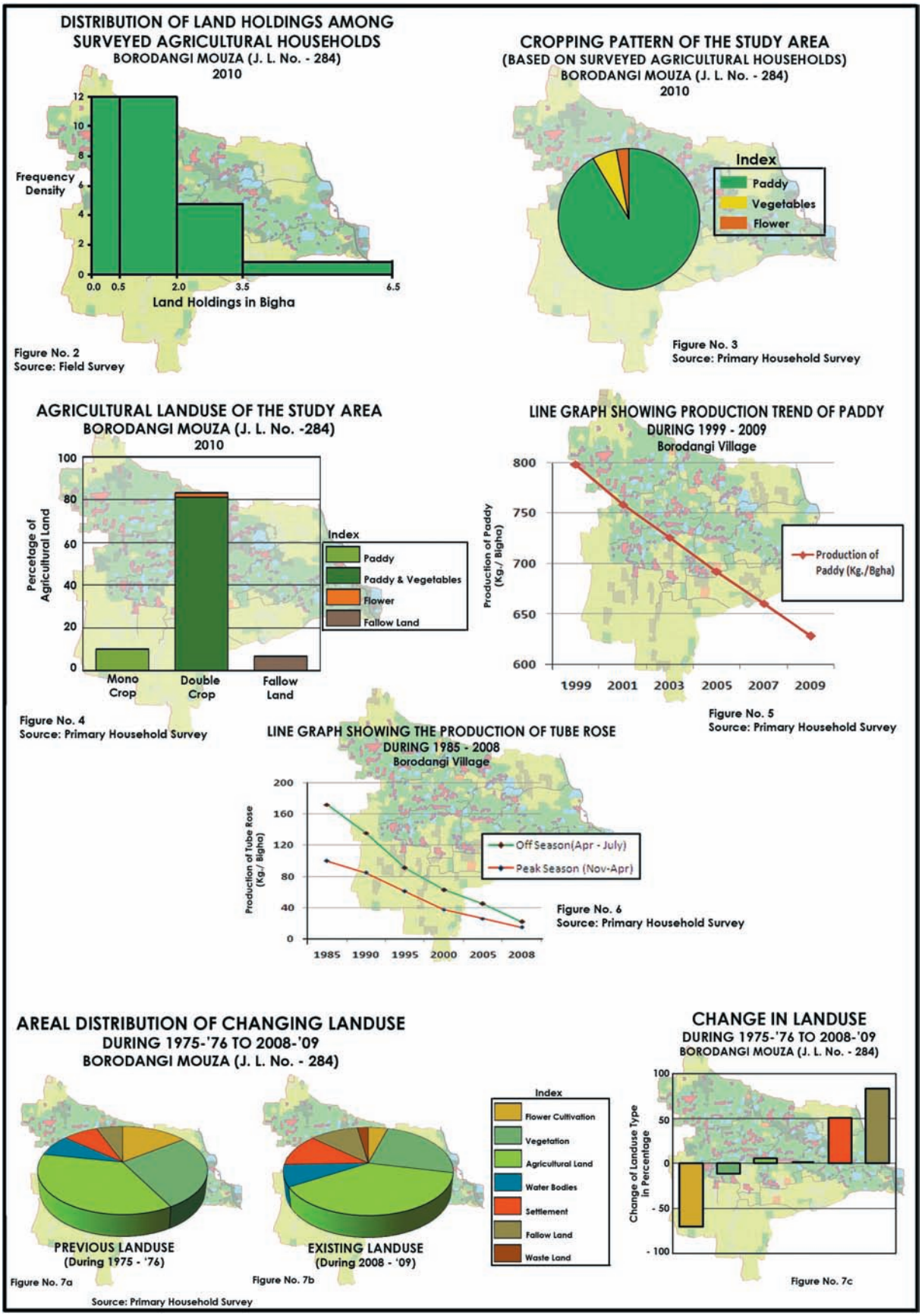

DISTRIBUTION OF LAND HOLDINGS AMONG SURVEYED AGRICULTURAL HOUSEHOLDS
BORODANGI MOUZA (J. L. No. - 284)
2010
Frequency Density
Land Holdings in Bigha
0.0 0.5 2.0 3.5 6.5
Figure No. 2
Source: Field Survey
CROPPING PATTERN OF THE STUDY AREA
(BASED ON SURVEYED AGRICULTURAL HOUSEHOLDS)
BORODANGI MOUZA (J. L. No. - 284)
2010
Index
Paddy
Vegetables
Flower
Figure No. 3
Source: Primary Household Survey
AGRICULTURAL LANDUSE OF THE STUDY AREA
BORODANGI MOUZA (J. L. No. -284)
2010
Percetage of Agricultural Land
Index
Paddy
Paddy & Vegetables
Flower
Fallow Land
Mono Crop
Double Crop
Fallow Land
Figure No. 4
Source: Primary Household Survey
LINE GRAPH SHOWING PRODUCTION TREND OF PADDY
DURING 1999 - 2009
Borodangi Village
Production of Paddy (Kg./ Bigha)
Production of Paddy (Kg./Bgha)
1999 2001 2003 2005 2007 2009
Figure No. 5
Source: Primary Household Survey
LINE GRAPH SHOWING THE PRODUCTION OF TUBE ROSE
DURING 1985 - 2008
Borodangi Village
Production of Tube Rose (Kg./ Bigha)
Off Season(Apr - July)
Peak Season (Nov-Apr)
1985 1990 1995 2000 2005 2008
Figure No. 6
Source: Primary Household Survey
AREAL DISTRIBUTION OF CHANGING LANDUSE
DURING 1975-'76 TO 2008-'09
BORODANGI MOUZA (J. L. No. - 284)
PREVIOUS LANDUSE
(During 1975 - '76)
EXISTING LANDUSE
(During 2008 - '09)
Index
Flower Cultivation
Vegetation
Agricultural Land
Water Bodies
Settlement
Fallow Land
Waste Land
Figure No. 7a
Figure No. 7b
Source: Primary Household Survey
CHANGE IN LANDUSE
DURING 1975-'76 TO 2008-'09
BORODANGI MOUZA (J. L. No. - 284)
Change of Landuse Type in Percentage
Figure No. 7c

Fig 2-7

fallow land are very much less which cover only 10.05% and 6.7% respectively (Fig 4.).

Table 4: **Spatial Pattern of Agricultural Land Use**

Total cultivated land (52.95 bigha) 100%		
Mono crop (bigha)	**Double Cropping Land (bigha)**	**Fallow land (bigha)**
5.32 (10.05%)	44.1 (83.25%)	3.55 (6.7%)

Source: Field Survey, 2010

Trend of Production of Paddy and Tuberose

It has already been mentioned that Aman and Boro paddy are the major subsistence crops here. During the field survey, it has been found that the average production of both type of paddy is declining. Table 5 shows that the average production of paddy has dropped from 798.48 kg/bigha in 1999 to 628.33kg./bigha in 2009 i.e. near about 27% production fall for last ten years (Fig 5.). An effort has been taken to identify the reasons for such drop. A questionnaire survey was done among the farmers who are engaged in paddy cultivation for last forty years and according to them the intensive use of the fertilizers in the field is slowly reducing the soil fertility which has resulted in the decline in the yield of paddy. Some of them are also of the opinion that the fly ash has also to some extent hindered the production. The layer of the fly ash sometimes blocks the air circulation in the soil and paddy saplings cannot have sufficient amount of nutrients and food and as a result the growth is thwarted. Some amount of land is kept fallow/ unused for many years. Gradually, with the passage of time, when the soil retains its fertility, the land is again utilized for further agricultural practices.

Table 5: **Production Trend of Paddy**

Year	Average Production (kg/bigha)	Year	Average Production (kg/bigha)
1999	798.48	**2005**	692.42
2001	758.78	**2007**	660.60
2003	726.12	**2009**	628.33

Source: Field Survey, 2010.

The production of tuberose has also declined to a large extent. The farmers said that the tuberose grows well but its capacity to produce flower has reduced (Table 6). Tuberose peak season starts from November and ends in April and again it starts giving flower in the month of June and it continues up to October. The peak season production has declined from 100kg/acre/day in 1985 to only 15 kg/acre/day in 2008. This suggests that there has been more than 60% decline in peak time production in last twenty years. In non peak season the production has declined from 72kg/acre/day in 1985 to only 7kg/acre/day in 2008. The peak and non-peak time production trend has been shown in the diagram (Fig 6.). Ash problem is maximum during summer months (March-June) due to the flow of southerly wind which carries considerable amount of dust towards north. It has been found that the production also started declining at a faster rate as summer approaches.

Declining Nature of Production

The declining rate of production of paddy for every two years has been assessed. In 1999 the yield of

Table 6: **Production Trend of Tube Rose (commercial crop) in Peak and Off Season**

Year	*Peak season production (kg/acre/day) (Nov – April)*	*Off season production (kg/acre/day) (April – July)*	*Year*	*Peak season production (kg/acre/day) (Nov – April)*	*Off season production (kg/acre/day) (April – July)*
1985	100	72	**2000**	37.5	25.6
1990	85	51	**2005**	26	19.2
1995	61	30	**2008**	15	7.10

Source: Field Survey, 2010 and Block Agricultural Office

paddy was 728.48 kg/bigha. It dropped by about 5% during 1991-2001. The rate of decline reduces to a small extent in 2001-03. In the next two years 2003-05, the rate of decline was more or less same and during 2007-09 it was again close to 1999-2001 rate.

The fall in production of tuberose has been more during 2005-08. On an average the production decline is significant for tuberose.

Table 7: **Rate of Decline in Production of Paddy and Tuberose**

Year	Rate of Decline of Paddy (%)	Year	Rate of Decline of Tuberose (%)
1999–2001	-4.97	**1985–'90**	-20.93
2001–2003	-4.30	**1990–'95**	-33.09
2003–2005	-4.64	**1995–'00**	-30.66
2005–2007	-4.59	**2000–'05**	-28.37
2007–2009	-4.80	**2005–'08**	-51.11

Source: Based on Table 5 and Table 6.

A questionnaire survey was done among the farmers in order to know the reasons behind the loss of soil fertility. According to the respondents, the fertility of land has decreased mainly due to intensive use of chemical fertilizer (47.92%) followed by fly ash problem (63.64%). Poor application of agricultural technologies (2.08%) has been regarded as a factor which has much less impact on soil fertility**.**

Table – 8: **Response for declining fertility of land.**

Reasons	Frequency	%
Due to high Intensity of cropping	3	6.25
Due to intensive use of fertilizer	23	47.92
Due to fly ash problem	21	43.75
Poor application of Agricultural Technologies	1	2.08

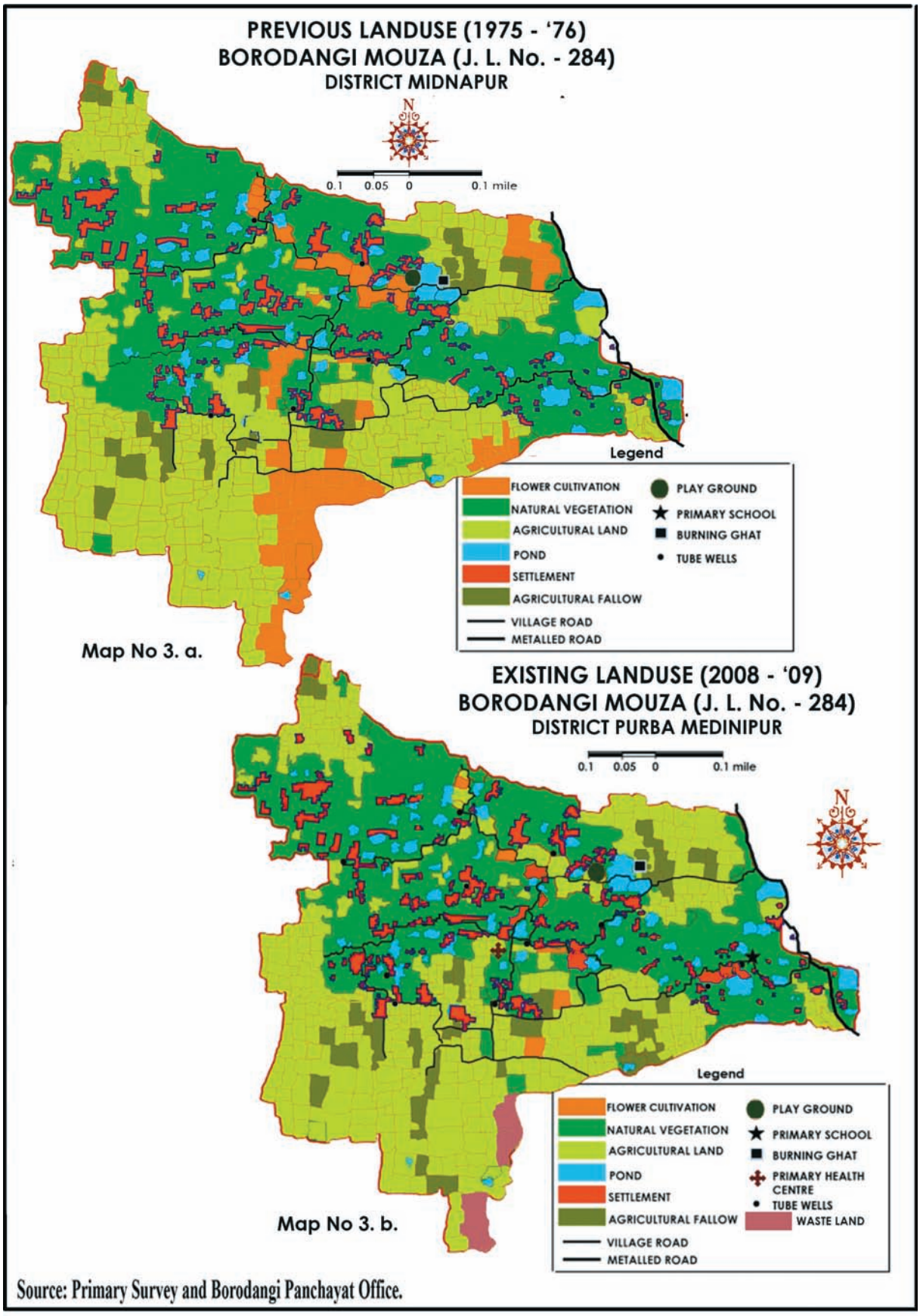
Source: Interaction with field respondents.

Changes in Landuse and its impact

Borodangi village has been facing a severe problem due to "fly-ash" originating from the "Kolaghat Thermal Power Station" that has an adverse impact on agricultural production, especially the production of flower like tuberose which is the major commercial crop of the study area. These have induced a change in land use character (Fig 7a – 7c.). There is an appreciable change in flower cultivation where there is almost 70% decline in area compared to the 1975-76 situations. It clearly indicates the level of impact of fly ash on the flower cultivation. The vegetation cover has also reduced to 10% with the growth of settlements. A certain percentage of land under flower cultivation is now devoted to paddy cultivation. By this, the agricultural land has increased approximately by 5% during a period of more than 30 years.

Thus it is evident that there is considerable growth of settlements and fallow land. The growth in fallow land may be due to decline in flower cultivation. Some of this land becomes waste land as it could not be used for any productive activities. A good number of farmers were engaged in flower cultivation as this was a profitable occupation and they were assured of their market demand for different flowers in different seasons. As the problem of fly ash started to adversely affect the production of the flowers particularly tuberose, the farmers were then compelled to shift to other flower initially but in course of time it has been found that the cultivation was not so profitable as in the case of tuberose or rose. As a result many small farmers have sold their lands to big land owners and changed their occupation from farming to jobs in the unorganised sector. It has been found that out of 17 share cropper households at least 10 households have changed their occupation to daily labourers. At least seven farmer families in this village are now in difficult situation and they are also planning to sell their lands on which they used to produce various types of flowers. There is also land degradation found in some portion of the agricultural field where the fly ash deposit gradually encroaching into agricultural land and thereby making it less productive.

The map on previous and present land use (Map 3a & 3b) show the changes in flower cultivation, land under other agricultural uses, vegetation cover, settlement, fallow land and creation


PREVIOUS LANDUSE (1975 - '76)
BORODANGI MOUZA (J. L. No. - 284)
DISTRICT MIDNAPUR
N
0.1 0.05 0 0.1 mile
Legend
FLOWER CULTIVATION
NATURAL VEGETATION
AGRICULTURAL LAND
POND
SETTLEMENT
AGRICULTURAL FALLOW
VILLAGE ROAD
METALLED ROAD
PLAY GROUND
PRIMARY SCHOOL
BURNING GHAT
TUBE WELLS
Map No 3. a.
EXISTING LANDUSE (2008 - '09)
BORODANGI MOUZA (J. L. No. - 284)
DISTRICT PURBA MEDINIPUR
0.1 0.05 0 0.1 mile
N
Legend
FLOWER CULTIVATION
NATURAL VEGETATION
AGRICULTURAL LAND
POND
SETTLEMENT
AGRICULTURAL FALLOW
VILLAGE ROAD
METALLED ROAD
PLAY GROUND
PRIMARY SCHOOL
BURNING GHAT
PRIMARY HEALTH CENTRE
TUBE WELLS
WASTE LAND
Map No 3. b.
Source: Primary Survey and Borodangi Panchayat Office.

Map 3a & b.

Table 9: **Change in Land Use in Borodangi Mouza (1975–76 to 2008–09)**

Landuse Categories	1975-76 (hectares)	2008-09 (hectares)	Change (%)
Flower Cultivation	17.76	5.32	-70
Vegetation	31.96	28.41	-11.10
Agricultural Land (Excluding flower cultivation	42.67	44.99	+5.43
Water Bodies	9.47	9.47	0.00 (No Change)
Settlement	9.44	14.20	50.42
Fallow land	7.10	13.02	83.38
Wasteland	0.00	2.99	---
Total (in hectares)	118.40	118.40	---

Source: Revenue and Settlement, Kolaghat Block Development Office, 2010, Borodangi Gram Panchayat Office, 2010

of waste land. The cartographic representation along with the map also clearly shows the negative and positive change in different categories in land use in the study area.

Recommendations

The KTPP authority has planted trees surrounding one ash pond. But there are four more such ash ponds which also require dense plantation immediately. The cultivation of flowers such as sunflower, china rose is possible on the ash mixed soil. The plant authority may employ some private agencies to examine the possibility of cultivation of such flowers on some parts of ash pond by making a layer of soil on it. If it is possible, it will be extremely helpful to stabilize the ash on the ash pond. The technological development on ash disposal and management in different developed countries should be taken into consideration for examining its feasibility in our country.

The local administration (Zilla Parishad) has the responsibility to look after the processes of utilization of ash from the ash pond. Although the plant authority is the owner of these ash ponds, the Zilla Parishad invites tender from different private agencies for utilization of the ash in different activities. In this connection it can be said that the administration should be well aware about the spreading of ash during the time of transportation and must lay down strict rules and regulations so that private agencies must take precaution while transporting dry ash from one place to another failing which they should be penalised.

There must be some long term planning of the plant authority regarding the clearing of the sediments and deposit these away from the river so that the navigability of the river increases and can be maintained througout the year. The West Bengal Pollution Control Board (WBPCB) has already forfeited the caution money deposited by Kolaghat Thermal Power Station as penalty for not taking adequate measures to arrest the process of spreading of fly ashes to the surrounding area. According to WBPCB, the fly ash has already caused enormous damage to local economic activities and river ecology. They observed that this has also compelled many farmers to abandon the agricultural activities and sell their lands to others who has changed the land character and if this trend continues for some more years, the region will face difficulty in persuing profitable economic activities and hardship of the people will increase. They suggested application of better technology in controlling the emission of fly ash and more afforestation in the surrounding area in order to absorb considerable fly ash.

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