ASSESSING THE IMPACT OF FLYASH ON CROP PRODUCTIVITY AND SURROUNDING ENVIRONMENT IN AND AROUND KOLAGHAT THERMAL POWER STATION, PURBA MEDINIPORE,WESTBENGAL

Mousumi Basu

Faculty member of Prafulla Chandra College, Kolkata

Department of Geography

ABSTRACT:

Power sector has played a vital role in the economic development since the initial planning of our nation. Thermal power generation dominates the power sector accounting almost 64 % of total power generation in India. KTPS is situated on the eastern bank of river Rupnarayan near Mecheda railway station. It is about 55 km from Kolkata. It covers a part of Panskura–II (now known as Kolaghat) and Sahid Matangini community development block of Tamluk subdivision. This power station is operated by West Bengal Power Development Corporation Ltd., having six power generating units of total 1260MW capacity. This paper seeks to assess the impact of fly ash generated by KTPS on the surrounding environment and also to analyse the imapact on crop productivity in and around Kolaghat Thermal Power Station.Satellite image (Resourcesat-2; LISS-3, band 4) is used to identify the landuse change and various statistical methods are applied to assess the impact of fly ash. Recent land use map of KTPS and its surrounding area shows changing land use characteristic of this region. KTPS acquired area was formerly covered by paddy field. KTPS repeatedly dumps fly ash on the adjoining farm land and often pump their ash slurry directly into the nearby river. As a result soil is getting contaminated and climate is being polluted by various hazardous gases. Some remedial steps have already been taken by the authority of WBPDCL to minimize the negative impact of fly ash. It can be concluded that KTPS can play a positive role in regional planning if proper management is being taken.

Key words: KTPS, Fly ash, PM, TSS, ash slurry

- **INTRODUCTION:**

The effective use energy is essential for economic growth which is depended upon the rate of improvement in per capita energy consumption. India has a fast growing energy market. Still 80% of energy requirement is fulfilled by fossil fuels. But unfortunately, fossil fuels are the major source of pollutants, greenhouse gases, and other trace atmospheric varieties. Coal plays major role to run thermal power plants.

- **OBJECTIVE OF THE STUDY**

The primary objective of this work is to know that how the fly ash affects the local agricultural production along with the livelihood of the inhabitants and how to mitigate these problems. The objectives are –

1. To know the causes and consequences of environmental problems in the surrounding area of KTPS.
2. To know the status of thermal plants in Kolaghat.
3. To know how excessive emission of fly ash is affecting the cropping pattern.
4. To know the present situation of the of agricultural land holders in this area.
5. To know that how the local administration is involved to solve these problems.
6. To give probable suggestions and to draw a conclusion about the future of this project.

- **METHODOLOGY**

Most of the analysis of the data and information is based upon intensive field work including data collection and empirical observations in field work. For Primary data collection, I have taken15 families of each village(total 19 villages) of four gram panchayats of kolaghat(Pulsita,Amalhanda and Kola-I GPs) block and(Santipur-I GP) of Sahid Matangini block (15familiesX19 villages=285 families). For secondary data collection, Topographical maps, LANDSAT imageries, questionnaire, literature reviews has been used. Field work includes visit to three sites, official discussions, and interview with the executives, staffs and labours of associated plants and photographs. All these field observations, samples and data are analyzed in qualitative and quantitative way.

1. LOCATION AND AREA – Kolaghat Thermal Power Station (KTPS) :

Kolaghat Thermal Power Station is situated on the banks of the Rupnarayan River in the East Midnapore district of West Bengal and 55 km from Kolkata. It covers a part of Panskura–II (now known as Kolaghat) and Sahid Matangini community development block of Tamluk subdivision. It is also the headquarters of the Panskura–II CD block (Fig.No.1). This thermal Powers Station is managed by West Bengal Power

Development Corporation Limited (WBPDCL).The Kolaghat Thermal Power Plant (KTPS) was established during India's sixth plan period(1980–1985). When the plant first become operational KTPS had only one 210 MW unit. The plant's first expansion took place in 1985 when additional five units with 210 MW capacities were added. Currently the plant has a total of six units with a capacity of 1260 MW. The KTPS covers about 900 hectares of land out of which 871.89 hectares lie in the Panskura-II block and the rest in the Sahid Matangini block, Talmuk. KTPS extends from 22°25'25"N to 22°25'50"N and 87°51'45" E to 87°52'28"E. It is the southernmost district of Burdwan division of West Bengal.

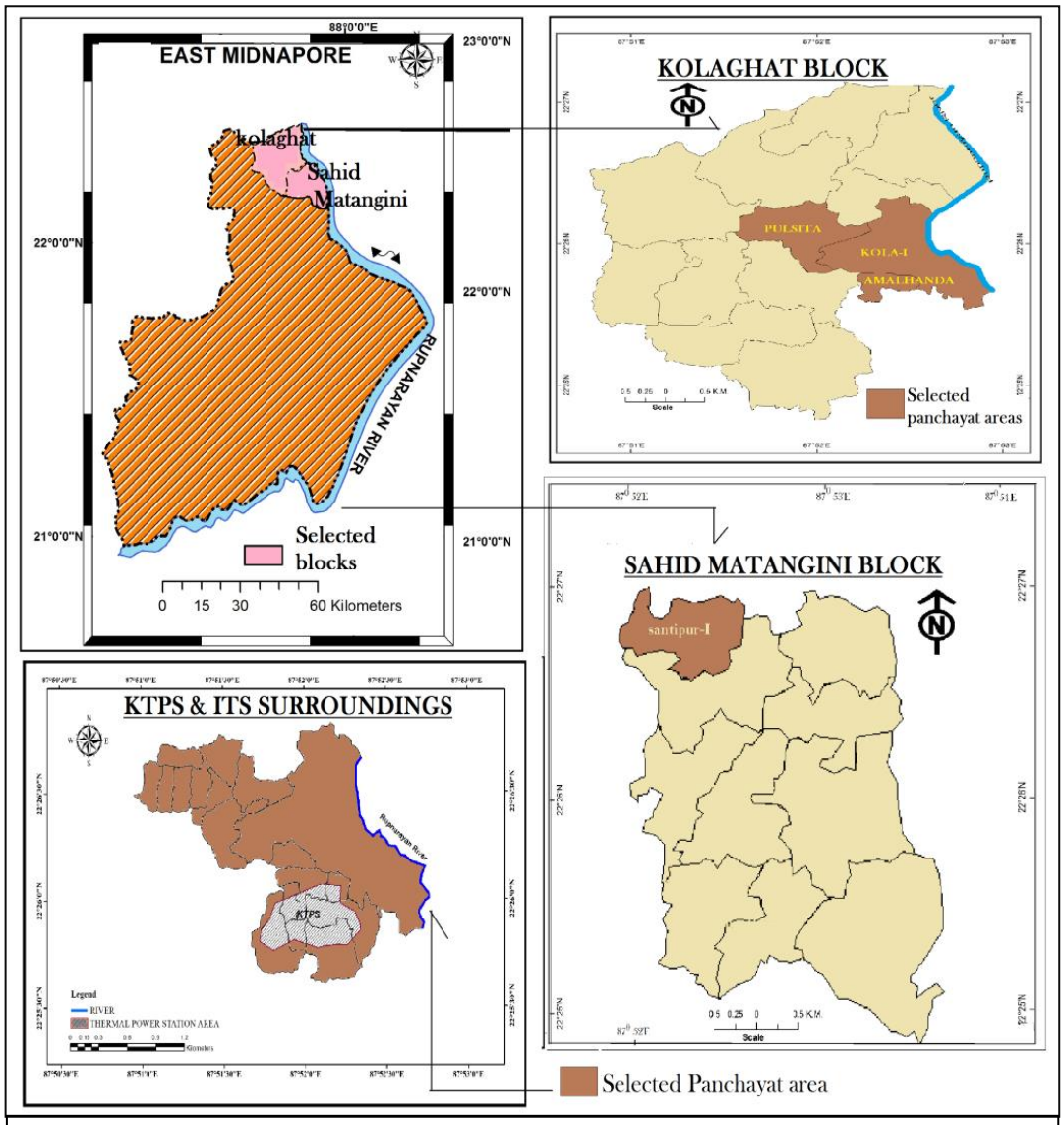


Fig.no.1- Location of the study area

Source: District planning map series & Panchayat office, Kolaghat Block office

2. STATUS OF BANDEL THERMAL POWER STATION (KTPS) :

Kolaghat Thermal Power Station (KTPS) covers almost 900 hectares of area in respect to total study area. KTPS commenced its production in February, 2010 with latest technology and sophisticated control equipment to ensure the quality of production (Table no.1). Total usable coal for production is about 17000MT and total ash generation is about 6800MT among which 5440MT is fly ash and 1360MT is bottom ash which is generated per day. Total power generation is 1260 MW (6x210 MW) and collecting ash from stage I and stage II are 98.5% and 99.78%respectively(Table no.5and Fig.5.1).Today, with six operational units the total installed capacity of the station stands at 1260 MW(Table no. 2 Table 3 and Fig no.2).

Table no.1 Important Dates in the History of KTPS

Unit	Synchronisation	COD
1	13.08.1990	09.09.1990
2	16.12.1985	09.03.1986
3	24.06.1984	12.10.1984
4	29.12.1993	01.04.1995
5	17.03.1991	14.05.1991
6	16.01.1993	01.01.1994

Table no.2: Capacity of KTPS

Sl No	Units	Capacity (MW)
1	Unit-I	210
2	Unit-II	210
3	Unit-III	210
4	Unit-IV	210
5	Unit-V	210
6	Unit-VI	210
Total Capacity		1260

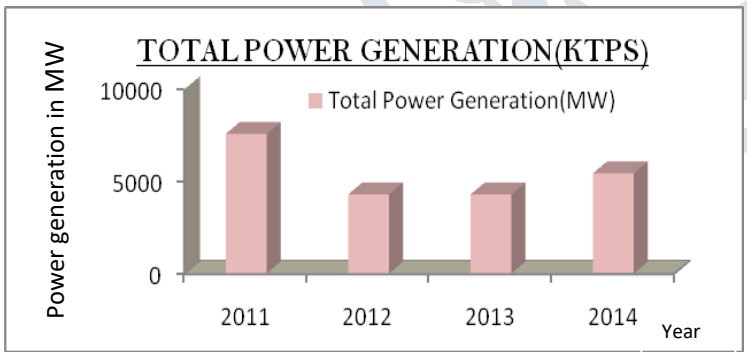


Fig.2-Year wise Total power generation of KTPS

Table No. 3 Total Power Generation

YEAR	Total Power Generation(MW)
2011	7560.881
2012	4280.794
2013	4280
2014	5420

3. Types of raw material:

Following types of raw materials are used to generate power. Like-coal(pulverized),oil(HFO and LDO), gas(NO_3),water, lubricating oil, various chemicals (HCL,H_2SO_4,NaOH,Sodium Hypo chloride, non-ferric aluminium, poly electrolyte).The proportion of coal: oil: gas: water: chemicals – 8:0.5:0.25:1:0.25 (Fig.no.3 & 3.1).

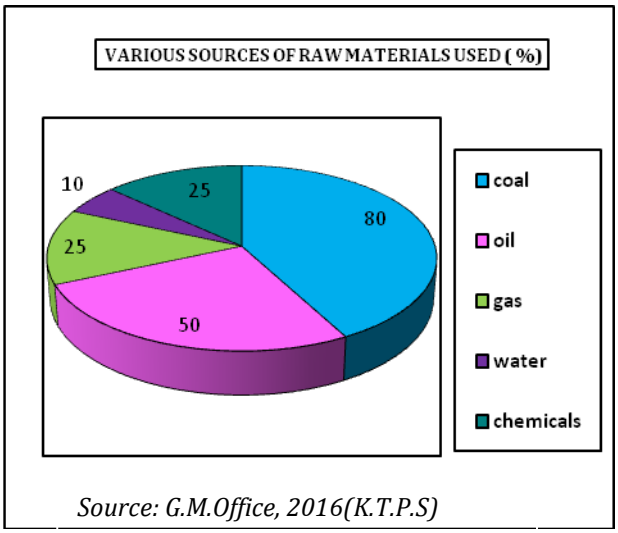


Fig.no.3.Various sources of raw materials (KTPS)

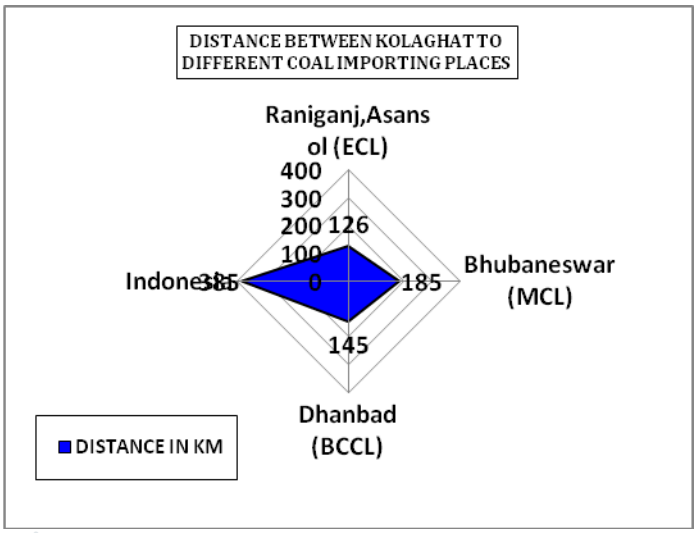


Fig no. 3.1 Distance of various coal importing centers from KTPS

4. Fly ash Generation:

Fly ash is one of the residues generated from combustion of coal. This fly ash is generally captured by Electrostatic precipitators or other particle filtration equipment before the flue gases reach to the chimney. Bottom ash is collected in boiler bottom ash hopper and stored in ash silo .Then it is removed together with bottom ash which is known as coal ash. Fly ash mainly includes substantial amount of silicon dioxides (SiO_2, both amorphous and crystalline), calcium oxide (CaO) etc. Basically fly ash is a heterogeneous material composed by SiO_2, Al_2O_3, Fe_2O_3, and occasionally CaO.Total ash generation per day is 6800Metric Tonne, out of which 5440 MT is fly ash and 1360 MT is Bottom ash. KTPS also has cenosphere facility. A cenosphere is a lightweight, inert, hollow sphere made largely of silica and alumina and filled with air or inert gas., typically produced as a byproduct of coal combustion at thermal power plants.

5. Fly ash and BottomAsh Generation:

Fly ash has a very large demand for construction of roads, railway track, and embankment, cement factory, land filling etc. From Kolaghat Thermal Power station, fly ash is taken by CGCRT, Calcutta to produce bricks with clay and fly ash.(Fig..no.5,5.3and Table-4)

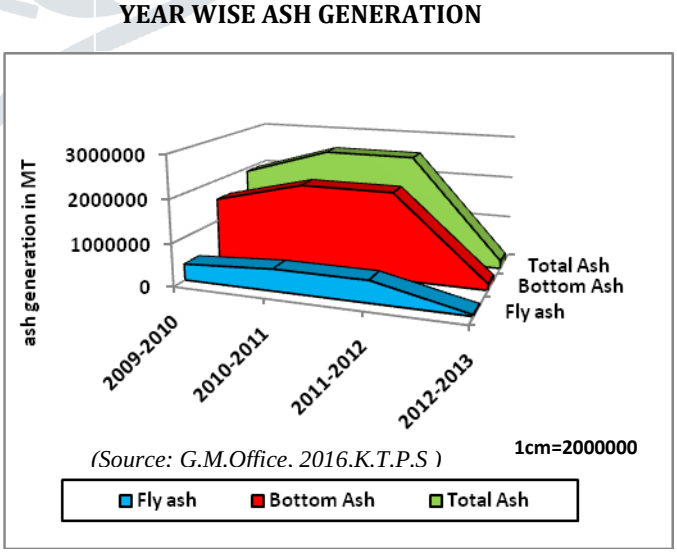


Fig.5.-Year wise ash generation

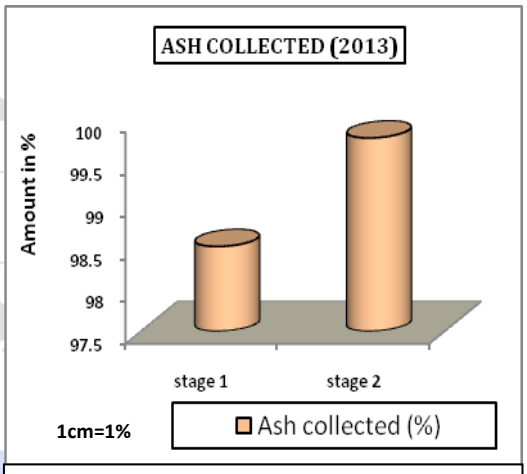
Table no.4- Ash Generation

YEAR	Fly ash	Bottom Ash	Total Ash
2009-2010	382623	1530486	1913109
2010-2011	509939	2039760	2549699
2011-2012	509319	2037277	2546596
2012-2013	37178	148712	185890

Table no.5- Stage wisePower Generation in MW

STAGE	power generation capacity(MW)	Ash collected (%)
1	210	98.5
2	210	99.78

5.1 Fly ash utilization : As a long term strategy, WBPDCL made a deal with Japan. At the cost of 171million yen under OEFC loan assistance, K.T.P.S conducts an Engineering study on Fly ash utilization for KTPS. More than 1200000 cubic meter of fly ash–clay brick is produced by Kolaghat boiling center. Bottom ash is mainly used for low land filling or embankment purpose(Table 7and Fig.5.2)



Source:G.M.Office,(K.T.P.S),2016
Fig.5.1. Ash Collection (KTPS)

Table no.6-Ash generation/Day

Types of ash	*Total ash generation in MT/Day*
Fly ash	5485
Bottom ash	1256

Table no.7-Uses of Fly ash

Uses	Utilization of Fly Ash
Cement factory	75
Brick Field	22
Asbestos Factory	3

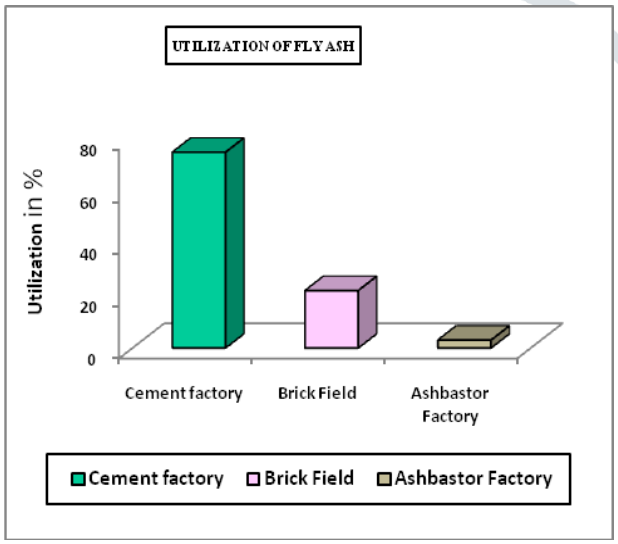


Fig. 5.2- Utilization of ash (KTPS)

Source: G.M.Office, 2016 (K.T.P.S)

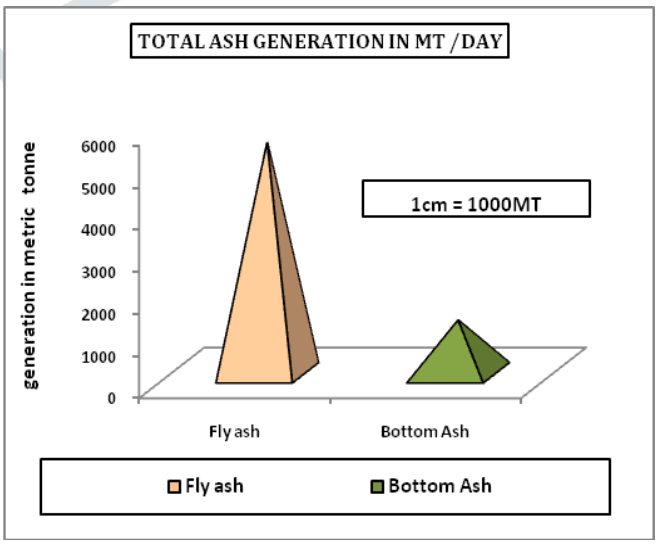


Fig.5.3Total Ash generation (KTPS)

Source: G.M.Office, 2016 (K.T.P.S)

6. POWER SUPPLY:

Total power generation by KTPS is about 1260MW (6 x210 MW) with all its six units. Each unit of stage 1 is connected to the 220KV grids through 235 MVA.15.75 KV delta star steps up transformer, i.e. generator transformer. Similarly, each unit of stage 2 is connected to the 400 KV grids through 235 MVA.15.75 KV delta star steps up transformer. (Fig.no.6).

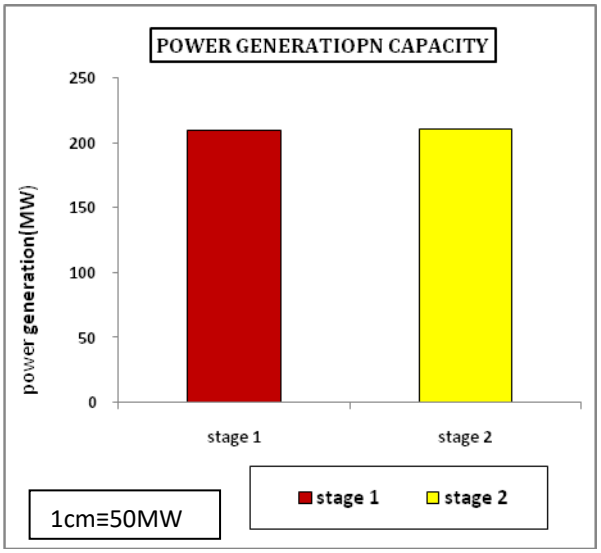


Fig.no. 6- Power Generation Capacity by KTPS
Source: G.M.Office, 2016 (K.T.P.S)

7. ENVIRONMENTAL IMPACT OF KTPS:

Unburnable mineral material becomes ash.The concentration of most trace elements in coal ash is approximately 10 times more in concentration than the original coal. Emission of green house gases (CO2, SO2 etc.) is another cause of air pollution(Fig.no.7.1,7.2,7.3). The treated effluent from ETP (physico-chemical type) is recycled to make ash slurry and the rest is discharged to local canals (Denan canal, Banpur__canal, Midnapore canal) and Rupnarayan River. The inhabitants of the surrounding area are facing severe air pollution problem due to fly ash generation by the industry. They also alleged that Midnapore canal, Denan canal are filled up with thick layer of ash. The crops and vegetation have been damaged due to fly ash emission and wet ash effluent from the industry. The field survey show that more than 100people are affected due to fly ash exposure and 50%-55% is affected with asthmatic disorder due to fly ash exposure (Fig.no.7).

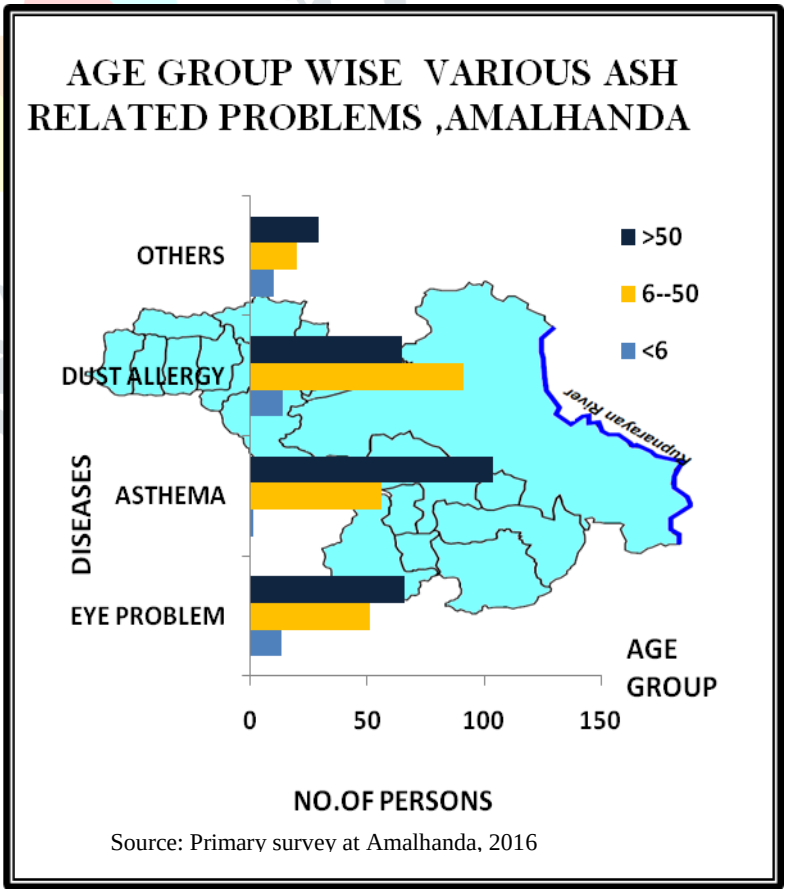


Fig. 7-Various ash related problems around KTPS

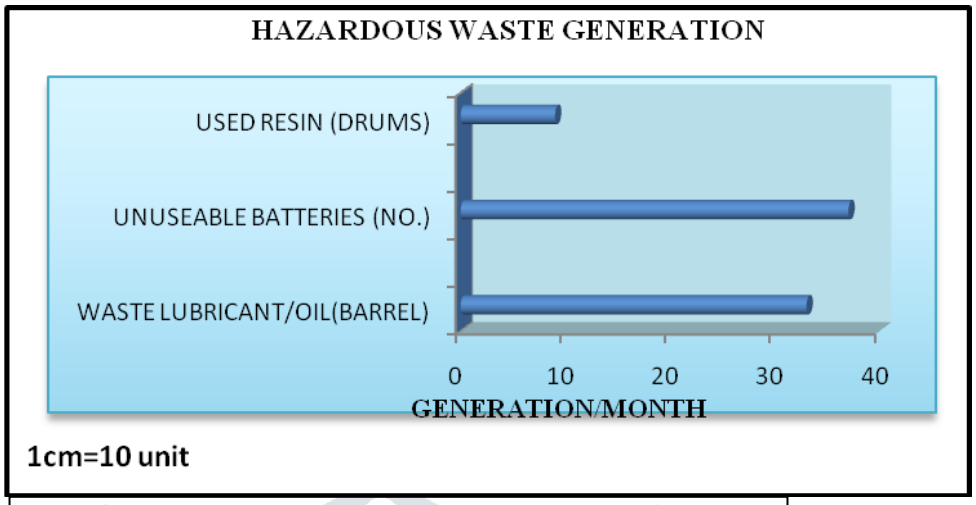
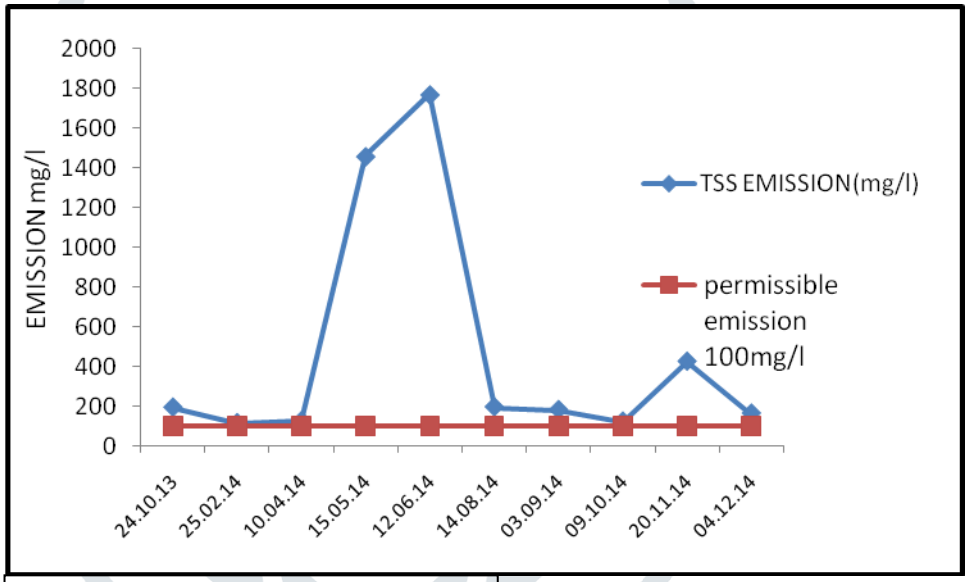
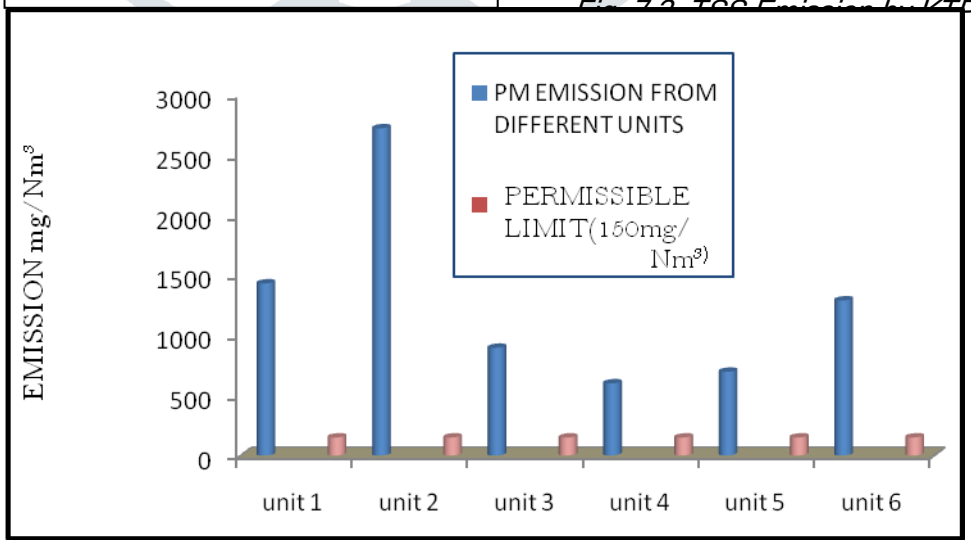


Fig.7. 1-Emision of Hazardous waste material by KTPS



Source: G.M. Office, K.T.P.S,

Fig. 7.2. TSS Emission by KTPS



Source: G.M. Office, K.T.P.S, 2016

Fig. 7.3. -PM Emission by KTPS

8. RISK ASSESSMENT IN AND AROUND KTPS :

For Risk Assessment of Kolaghat thermal power plant, the impact on environment in and around 40 km radius of KTPS is analyzed. Followings are important area to concern.

- To find out the impact of the fly ash on major commercial crop and cropping pattern.
- To identify the change in land use and land cover and land quality degradation due to fly ash (Fig. no.8).
- Impact on ground water and water bodies due to the thermal plant's waste water.
- Impact on air quality due to the flue gas emissions from KTPS chimney.

The present investigation summarizes various water and soil quality parameters of the samples collected from 13 sites of the Kolaghat Thermal Power area. The results of the Parameters significantly fluctuated over different seasons. It is recognized that the fly ash is the major problem in and around Kolaghat thermal power station. The utilization of enormous amount of coal has created various environmental problems near KTPS. Carbon die oxide is one of the main greenhouse gas associated with the emission by this thermal power plant.

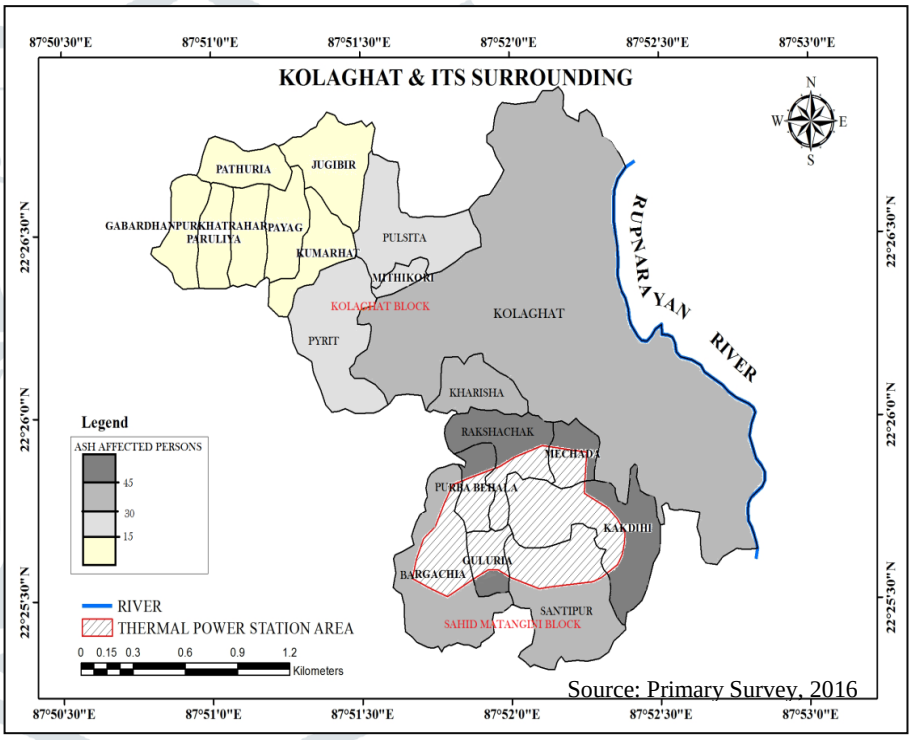


Fig.no.8- Risk Assessment in and around K.T.P.S

Some mitigation methods to resolved the problem—

- Latest pollution control device should be used to control air pollution.
- ESP has to be replaced every year.
- The fly produced by the power plant should be used to construct the road, like the mission of Pradhan mantri Gram SarokYojana.
- Wall should be constructed on the surrounding area which covers the KTPS to minimize the spreading of fly ash.
- Plantation programme should be practised in the surrounding area to control pollution.

9. CHANGING PATTERN OF LAND UTILIZATION AND ITS IMPACT ON CROP PRODUCTIVITY IN AND AROUND KTPS :

Kolaghat thermal power station has a number of advantages, but, the lack of proper treatment of fly ash generated from this plant is detrimental to the quantity and quality of crop production in the surrounding area of KTPS. It is also responsible for some changes in surrounding land utilization pattern. Studies were made to assess the impact of Thermal Power Plant located at Kolaghat on vegetation and soil in the surrounding areas. The evaluation of the maximum concentration of air pollutants such as SO_2, NO_2, and other suspended particulate matter is usually considered for environmental impact assessment. The effect of the power plant's emission on water, soil, and eco-physiological characteristics, such as pH, DO, water conductivity, organic matter concentration in soil, Leaf injury symptoms, number and distribution of plant species; chlorophyll content in leaves, percentage of photosynthesis activities, accumulation in algae etc.are considered. This study noticed the elimination of some medicinal plant species, first the trees then the shrubs and lastly the herbs and grasses from the surrounding areas of thermal power plant.

- Santipur-I Gram Panchayat is under Sahid Matangini Block of East MidnaporeDistrict.

  Total area of this gram panchayat is about 7 sqkm. Total irrigated land is about 0.21sqkm and total 'khas' land is about 0.53 sqkm.

- The Kolaghat Thermal Power Plant acquired area was covered by 'paddy field and 'Kash Bon'.

- The paddy field and arable lands are reduced and turned mostly into settlement area (Fig no. 9.1). A paddy field is a flooded tract of arable land used for growing semi aquatic rice. Paddy cultivation should not be confused with cultivation of deep water rice, which is grown in flooded conditions with water more than 50 cm (20 in) deep for at least a month.
- Huge amount of fly ash is generated by the KTPS and this fly ash covers the valuable agricultural lands and ultimately this leads to loss fo fertility of soil in the surrounding area of KTPS (Fig no.9.2).
- Some of the portion agricultural lands had taken by KTPS for ash disposal ground. This plant generates a huge amount of fly ash on combustion of coal which is becoming a major environmental issue. KTPS is now facing a fly ash management problem. Open dumping of fly ash deteriorates the groundwater quality by runoff. In the present investigation, the ground water samples were collected from nearby areas of KTPS at six locations during the period of Jan 2016 to May 2016.

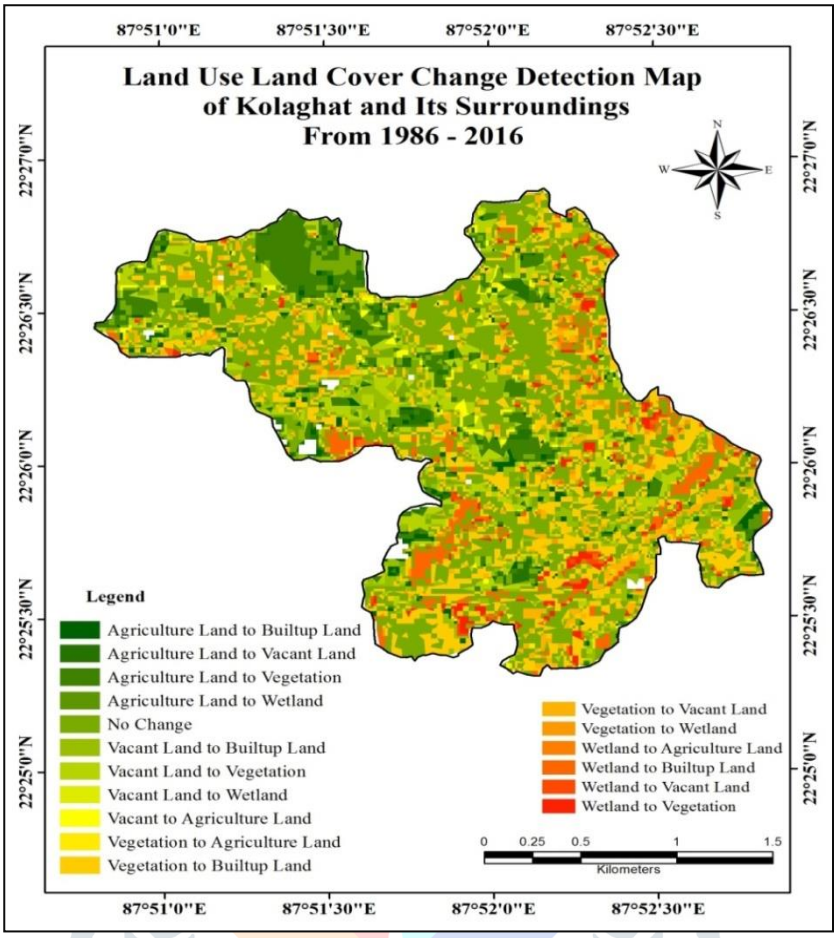
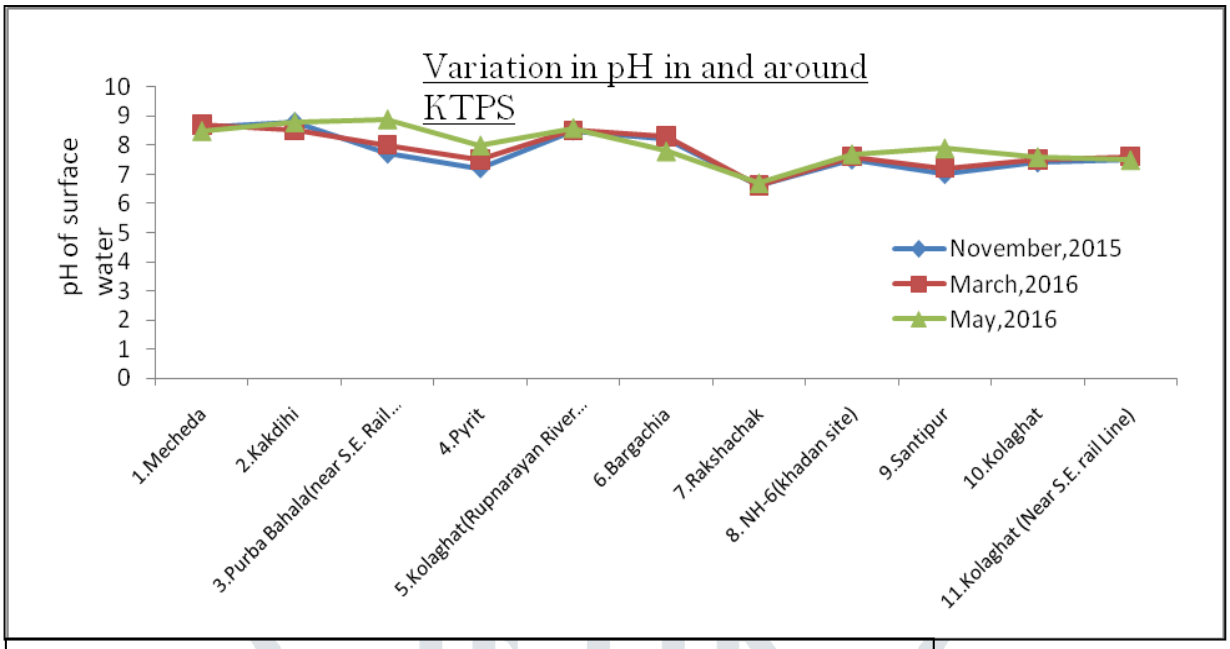


Fig.9.1 – Land-use& Land cover change detection map around KTPS

The samples were taken to the laboratory and analyzed for physico-chemical properties and metal content. The physico-chemical analysis was done for the parameters like pH, Turbidity, Temperature, Electrical Conductivity, Alkalinity, Total Dissolved Solids, Total Hardness, Calcium Hardness and Magnesium Hardness. The concentration of Turbidity, EC and Alkalinity was exceeding the standard at all locations and shows that the groundwater of the area is not safe for drinking (Fig no.9.2).Though fly ash can be used in concrete and brick making, soil-stabilization treatment and other applications, but very small quantity of total ash produced by KTPS, is currently utilized in such applications. Most of the ash generated from this power plant is disposed off in the vicinity of the plant covering several hectares of valuable agricultural land. Here ash is mainly used in two purposes, namely, ash dyke construction and filling of low-lying areas. Coal ash has been successfully used for structural fill.

Since most of the Thermal Power Plants in India are located in areas where natural materials are either scarce or expensive; the availability of fly ash is bound to provide an economic alternative to natural soils.



Source: Soil Testing by Advanced Researched and Testing Laboratory, Kolkata

Fig. no .9.2: Variation in pH in and around KTPS

- Cement factory formerly was earlier covered by 'Kash Bon' that is a remarkable change for the landuse pattern of the area (Fig. 9.1).
- Major changes have been found in settlement area and un-metalled road turned over metalled roads. Roads are an integral part of the transport system. A country's road network should be efficient in order to maximize economic and social benefits. They play a significant role in achieving national development. Here it is noticed that roads development ultimately enhances the mobility and take people out of isolation and therefore poverty. For instance, the government has popularized this belief by emphasizing that for any economy to develop, transport must start off first which will later stimulate other sectors to develop in an orderly fashion.

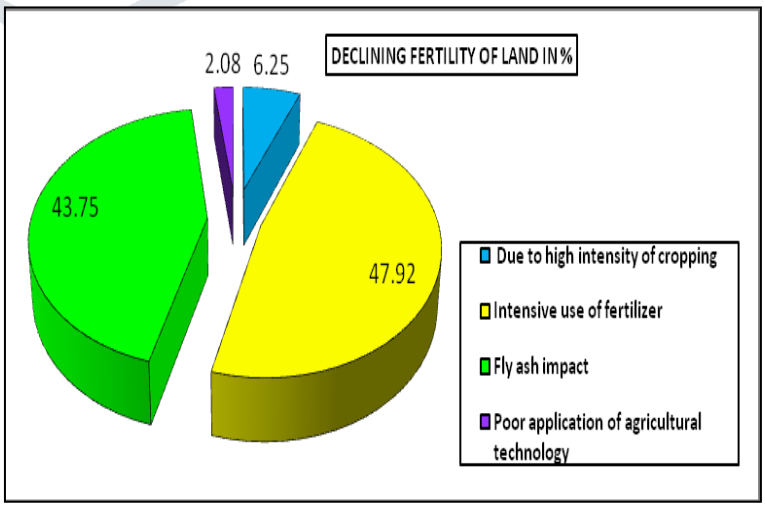
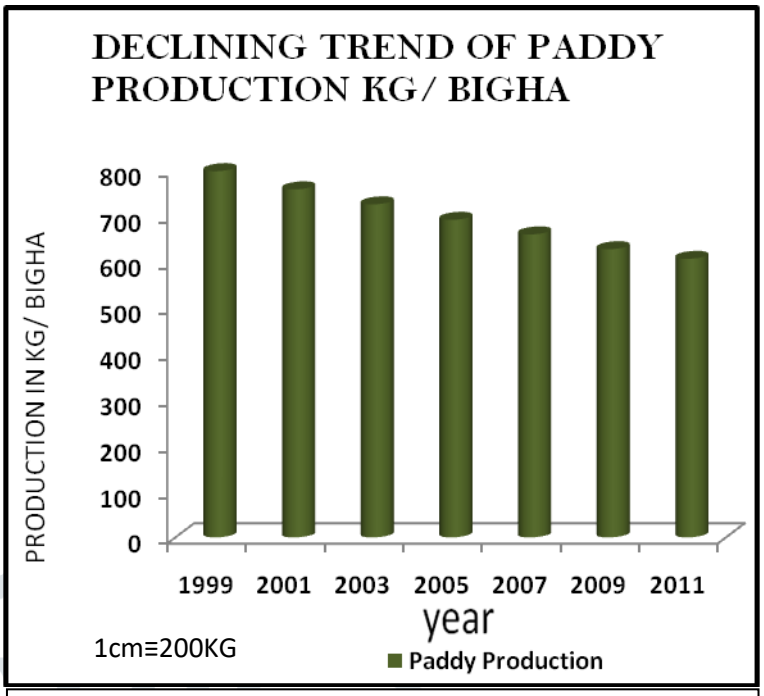


Fig.9.3- Declining fertility trend of land around KTPS

- The area of fallow land and vacant land has shrinked and those areas are complemented with settlement and brick field areas.

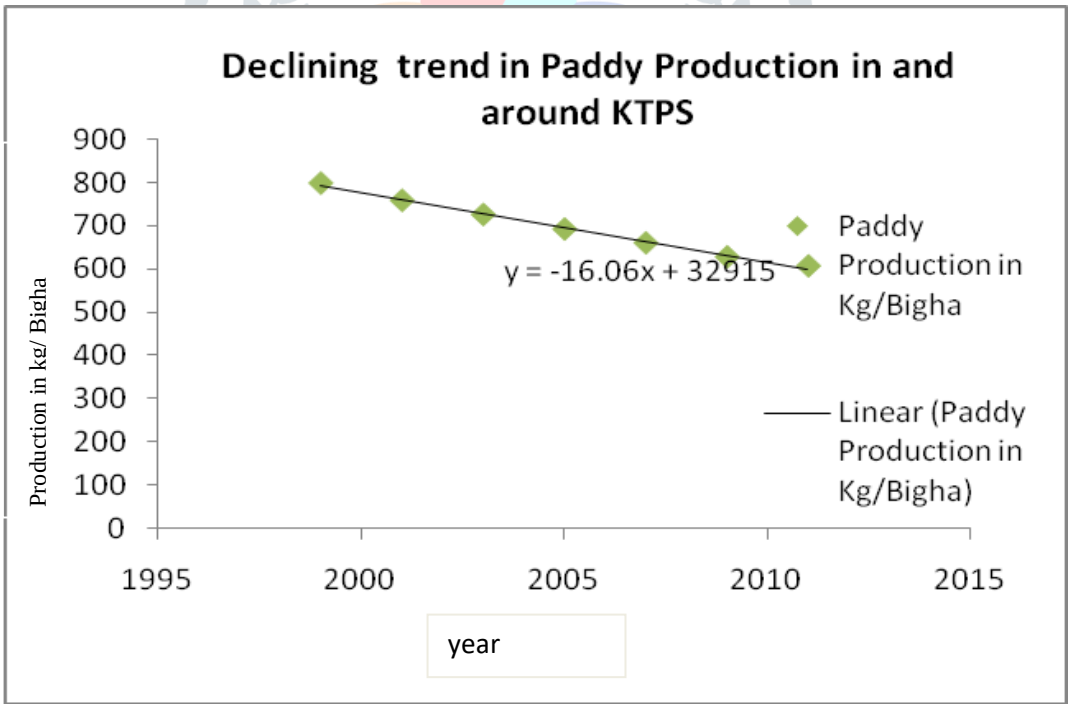
- The marshy land area have found along the Rupnarayan River which is the main river flowing along the eastern part of kolaghat block.

- The landuse map shows that the agricultural land and the forest land occupied by the distinguished area. The settlement area is now present in the forest zone (Fig. no. 9.1).



(Source: Revenue & settlement,kolaghat block development

Fig No. 9.4- Declining paddy production around KTPS



Source: Field Survey, 2016 and Kolaghat Block Agricultural Office

Fig No. 9.5- Declining paddy production around KTPS

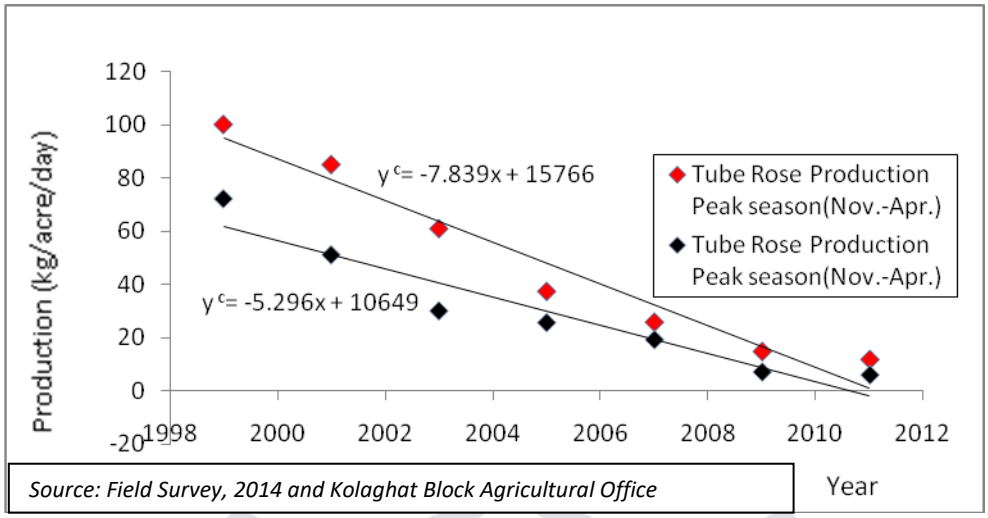


Fig No.9.6- Declining tuberose production around KTPS

Table no. 8: Declining Trend of Paddy & tube rose Production

Year	Paddy Production in Kg/Bigha	Year	Tube Rose Production (kg/Acre/Day)	
			Peak season(Nov.-Apr.)	Off season(Apr.-July)
1999	798.48	1999	100	72
2001	758.78	2000	85	51
2003	726.12	2002	61	30
2005	692.42	2004	37.5	25.6
2007	660.6	2008	26	19.2
2009	628.33	2010	15	7.1
2011	607.33	2012	12	6

(Source: Revenue & settlement ,kolaghat block dvelopment office)

➢ SUGGESTIONS

Suggestions are discussed likewise :

✪ Application of better technology for controlling the emission of fly ash should be introduced. For example to reduce boiler efficiency loss due to blow down. All volatile treatment/ zero solid treatment and modification of furnace related to ID Fan vane and scoop control may be introduced. Definition of Boiler Efficiency is "The percentage of the total heating value." In other word, it is a rate how the boiler runs efficiently. The actual calculation for the boiler efficiency is the followings;

（Steam value per hour : kg）×（h2－h1）×100

Boiler Efficiency＝ (Fuel consumption per hour: kg）×（Fuel low calorific heating value: kcal/kg）

h2: The ratio enthalpy of feed water (kcal/kg)

h1: The ratio enthalpy of steam (kcal/kg)

- ✪ After the combustion of the coal in the boiler, 20% of the ash is collected at the bottom of the boiler called bottom ash and 80% is carried along with flue gases called fly ash. Bottom ash is mixed with water and made into sludge form and sent through pumps into the ash ponds. The Electro Static Precipitator is used to collect the ash particles in the flue gases.

- ✪ Transportation of ash from ash ponds in properly covered vehicles should be stared to avoid spillage of ash. There are some guidelines but Central Pollution Control Board to protect the environment, conserve top soil and prevent dumping & disposal of ash .

- ✪ The industry should take adequate measures to avoid spreading of dust during excavation, loading unloading and transportation of ash.

- ✪ Proper utilization of fly ash will not only minimize the disposal problem but will also help in utilizing precious land in a better way.

CONCLUDING REMARK:

If we consider agricultural development along with industrial developer, it will be difficult to come to conclusion weather the establishment of thermal power station is justified or not, nobody can deny about the infrastructural and economic development of an area after the establishment of a plant. On the other hand according to environmental impact assessment, fly ash has already caused enormous damage to the local agricultural land and river ecology and if this trend countries for few years more, the area will surely face difficulty in persuading profitable economic activities and problems of the local people will increase. Whereas WBPDCL has suggested some better application of advanced technology to control the emission of fly ash and few afforestation programmes have already taken by plant authority in the surrounding areas to maintain the environmental quality and ecological balance.

References:

1. Annon (2006): Summary Report of the Study on Post-clearance Environmental Impacts and Cost-Benefit Analysis of Power Generation of India; National Environmental Research Institute (NEERI)
2. Annual Reports of Kolaghat Thermal Power Plant (KTPP)
3. Annual Report published by West Bengal Pollution Control Board, 2004.

4. Basu, S.R.(2005):Recent Findings on the River Dynamics of Bengal: Post Farakka Condition of the Off take and Bank Erosion of the River Bhagirathi- Hugli, Geog. Rev. of India,Vol. 67,No.4, pp.315-346.

5. Berkavoa, V. (2007). Application of Remote Sensing and GIS for Change Detection from Various Data Type of Remote Sensing M.A Thesis (unpublished).

6. Census of India (2001,2011), Series-22, West Bengal, Part X-A and B District Census Handbook, East Medinipore, Town and - Village Directory and Primary Census Abstract, pp 78-81.

7. Economic Survey,2009-10,2010-11

8. Estimation of area and production of principal crop in West Bengal,(2008-09), Evaluation wing, Directorate of Agriculture, Govt. West Bengal.

9. Kumar,S. "Coal Ash Utilization: An Overview" ,Seminar organised by CAII,November'98

10. K.,Chakraborty T. K. & Das A. K. "Coal ash utilization - Threat and Opportunity" Seminar organized by CAII, November, '98

11. O'Malley, L.S.S. (1905) Indian Civil Service, Bengal District Gazetteers: East Medinipore

12. Ramachandra TV, Ramakrishna YB, Krishnadas G, Bhat SP, Mahapatra. DM, Aithal BH. Environmental Profile and People's Livelihood Aspects in the Vicinity of Coal Based Thermal Power Plant at Yellur Panchayat, Udupi District, CES Technical Report 12604/2012

13. Saigo B. (2005). Nigeria. W. P& Cunningham: M.A. Global Environmental Issues National Open University of & Environmental Science

14. Santra, A., Mitra, D., and Mitra, S., (2011), Spatial modeling using high resolution image for future shoreline prediction along Junput Coast, West Bengal, India. Geo-Spatial Information Science, 14(3), pp 157- 163.

15. Santra, A., Mitra, D., and Mitra, S., (2013), Change detection analysis of the shoreline using Toposheet and Satellite Image: A case study of the coastal stretch of Mandarmani- Shankarpur, West Bengal,India .

16. Sau. P.K "Role of thermal power Plant in Regional Planning".

17. Sengupta B. & Paliwal S. K. "Strategies to control pollution from coal based thermal power plants in India" Journal o CAII, July '97.

Website assistance:

18. www.Google.co.in

19. www.wikipedia .com

20. www.agaportal.de/pdf/nachhaltigkeit/eia/eia_tuerkei_kraftwerk.pdf

21. http://mospi.nic.in/Mospi_New/upload/concepts_golden.pdf on 04.10.2014