

Impact of Fly Ash on Agriculture and Surroundings at Budge Budge Block-1; Pujali (South 24 PGS, West Bengal)

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Abstract

Development is a process by which something becomes more advanced, it has two sides positive and negative. Maximum developmental work has occurred for people, in that case, some bad consequences impact our surrounding natural environment and affect the man, directly or indirectly. In present study we have tried to show the generation of thermal power as a developmental parameter, how it impacts the environment surrounding the station, a case study on Pujali area. This area was an agricultural zone before the establishment of the power plant Budge Budge Generating Station (BBGS), or Calcutta Electric Supply Corporation Limited (CESC) or Budge Budge Calcutta Electric Supply Corporation Limited (BBCESC). The main occupation of people was cultivation. But CESC has acquired a huge amount of fertile agricultural and residential lands. Gradually the agricultural land was mostly abolished. Moreover, the fly ash, which is produced from coal burn, has created a layer on the leaf. Soil and water have been polluted which affected the crop productivity and caused various types of skin diseases and asthma-related diseases in the inhabitant of the area.

Keywords: Agriculture, Environment, Fly Ash, Human health, Land use, Thermal power plant.

Abbreviations: A.D.O.: Agricultural Developmental Officer/ Office; Al- Aluminium; BBGS: Budge Budge Generating Station; BCCI: Bharat Coking Coal Limited; B.D.O.: Block Developmental Officer/ Office; C: Celsius; Ca: Calcium; Cd: Cadmium; CESC: Calcutta Electric Supply Limited; CO: Carbon Monoxide; CO₂: Carbon dioxide; CT: Census Town; E: East; ECL: Eastern Coalfields Limited; Fe: Ferrous; G.P.O.: Gram Panchayat Office; HYV: High-yielding variety; IADP: Intensive Agriculture District Programme; K: Potassium; KV: Kilo Volt; K₂O: Potash; Mg: Magnesium; M.M.: Millimetre; MCL: Mahanadi Coalfields Limited; M.W.: Megawatt; N: Nitrogen / North; Na: Sodium; NO_x: Nitrogen oxides; NOAA: National Oceanic and Atmospheric Administration; O₂: Oxygen; P: Phosphorous; PGS: Parganas P^H: Potential of Hydrogen; P₂O₅: Phosphate; QGIS: Quantum Geographical Information S: South/ Sulphur; Ti: Titanium; Si: Silicon; SO_x: Sulphur oxides; SPSS: Statistical; Package for Social Science; Sq. Km: Square Kilometre; SPM: suspended particulate matter.

Introduction

The main economic source for the livelihood of the residents of this region was agriculture. Because of gradual industrialization in the region after independence, the agricultural land has begun to reduce. Among other crops produced in this region, the paddy was considered as a principal crop. In 1993 the CESC set up its 250 Megawatt (M.W.) thermal power plant in the name of Budge Budge CESC Ltd. in Budge Budge Block-I segment on the Hooghly River bank by acquiring

almost 225 acres area and started to generate electricity from 1997 according to the source of Budge Budge Generating Supply head office (Basu, 2017). Now, this region is under the Pujali municipality. Other two units of the capacity of 250 M.W. were added each according to the information of CESC head office. It is the main source of electricity supply center in whole Kolkata (Millenniumpost, 2019) but locals trace the reasons for the reduction of the agricultural production in the nearby localities are being hampered by the fly ash.,

while the opinion of the Department of Agriculture, Govt. of West Bengal does not subscribe to this view fully. Fly ash pollutes not only air but also pollutes agricultural land, water bodies more over the water of the river Hooghly (Basu, 2017).

Though CESC has implanted many trees inside the boundary area, it is not the solution to these problems. They should take more careful action to prevent leakage of fly ash in surrounding areas.

Objectives

- To find out the reality of the problem related to the fly ash.
- To find out the land-use change and agricultural deficiency.
- To find out the environmental problems and human health issues.

Material and Methods

Keeping in view the above objective the following methodology have been followed.

- Primary data and secondary data have been collected and analysed by statistical tool like correlation, pie graph, trend line etc. using Statistical Package for Social Science (SPSS) and Microsoft Excel software.
- Soil samples were collected by following a grid system and tested (soil pH, salinity N, P, K & Organic carbon) in laboratory.
- A comparative study has been done on the base of Landsat satellite image by using land use and land cover map, prepared with the help of Quantum Geographical Information System (QGIS).

Location of Study Area

Budge Budge block- I is situated on the bank of the river Hooghly and North-Western part of 24 Parganas (South or S) district. The extension of this block is 22°21'17" North (N) -22°26'16" N and 88°06'34" East (E)-88°12'40" E. It is bordered by the district Howrah in the western part, Budge Budge block -II in the southern part and Maheshtola in the north-eastern part. There are two municipalities, seven census towns, thirteen mouzas and six Gram Panchayats (village council) are there in this block. Location maps are shown in Fig. 1(a) and 1(b) It is a part of the delta of Ganga-Brahmaputra. The main river is the river Hooghly but it is not that wide here and the region is on the alluvial plain of the lower delta plain. Mixed alluvium is the geological nature of this region. The river Hooghly has formed a meander here. The flow of silt is much. The rainwater of the region goes to this

river. The river and rainwater are the main source of water for cultivation. Fishing in the river is quite enjoyable and silt is used by the brickfields. Since the region is based on the alluvium the character of the soil is of a variety. They are clay and loamy. In Short, the soil in this region is fertile, having organic influences. Though in the past vegetation was fairly noticeable here. But with the growing process of industrialization, the vegetation is going to be almost nowhere. The municipality in the locality and CESC are planting trees and are taking an adequate interest in tree plantation. The residents of this region use various types of plants like coconut, areca-nut, palm, bamboo, mango etc. The monsoon is prominent here. The temperature in the summer (May) usually rises to 39° Celsius (C) while 10°C is the lowest in the winter (December-January). The humidity varies from 75%-98% during the rainy season (July to October) and recorded rainfall is approximately 256 mm. A Norwester and a depression formed in the summer and winter season frequently. Aman and Boro, which are two types of the paddy are the main crops of this region. Besides, wheat, pulses and different kinds of oilseeds and other seasonal crops also grow here.

The Function of Thermal Plant and Fly Ash Generation

In a thermal Plant, coal is combusted in a complex process through various machines and then a high amount of temperature originates and generate high temperature steam and electricity is produced. The generated electricity power 132 Kilo Volt (KV) electric transferred to step up for industry and 6.6 KV transferred for domestic use. Ash is generated from the combustion of pulverized coal and sent to the boiler by conveying belt. Steam and ash also generate the electricity is generated (Kumar *et al.*, 2013). The electricity is generated through the processing steps shown in Fig.2. Electrostatic precipitator, sluice gate, crusher, pump, clinker cooling conveyor and slurry pump are used in thermal power for a handling system of ash.

Use of Coal- Coal and oil which are necessary for the generation of power at the CESC power plant here are brought by train from Eastern Coalfields Limited (ECL), Bharat Coking Coal Limited (BCCL) and Mahanadi Coalfields Limited (MCL) companies.

Bottom Ash - Here mainly two types of ash are generated - the wet and the coarse grain ash and is stored in an ash Pond. Then it removes from the plant to other places. The approximate amount is 42% overall (Basu, 2017).

Fly Ash - Another ash is stored in a silo tank, and sent for

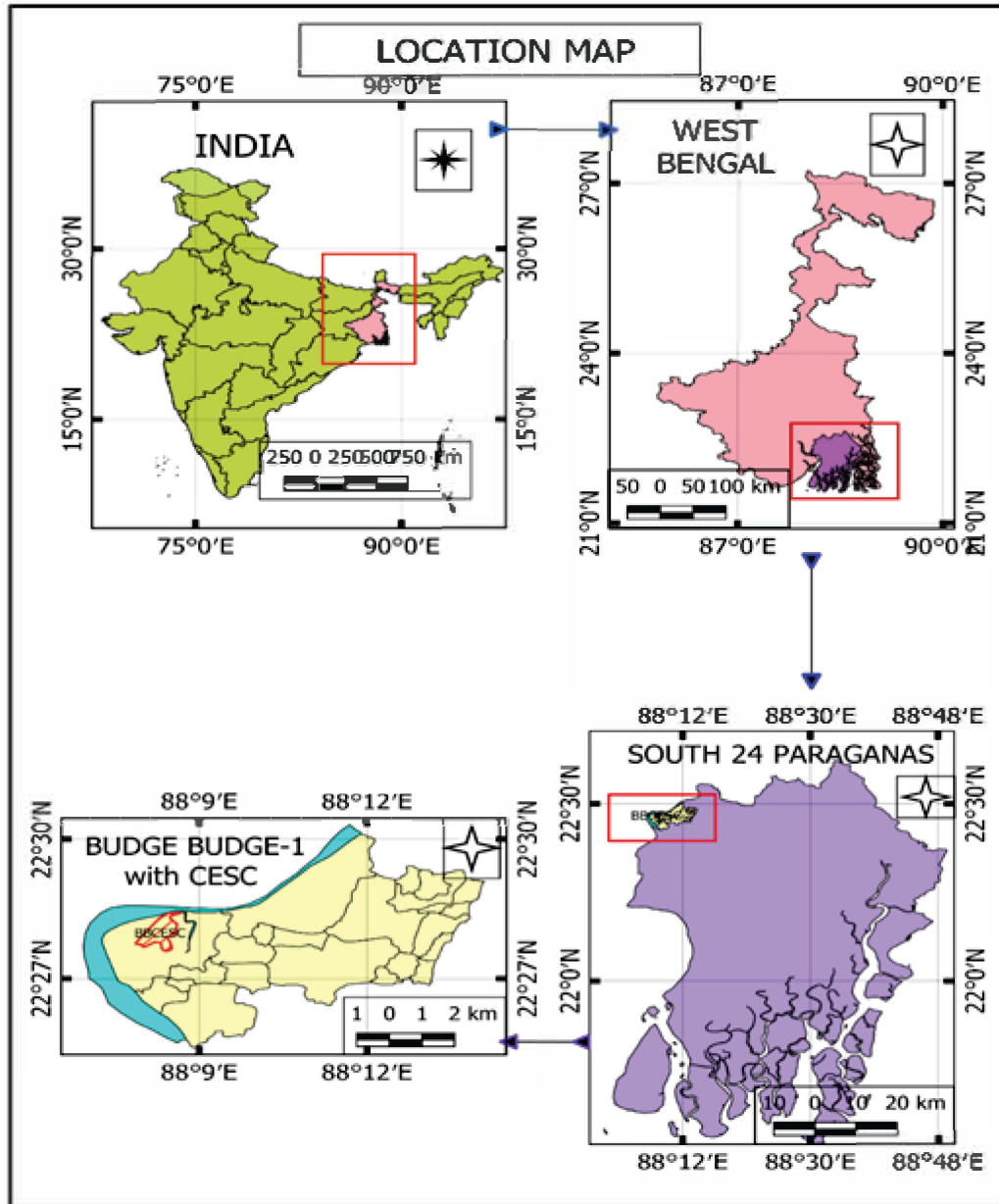


Fig. 1(a). Location Map compiled by Dhole, M. (2021) using QGIS.

utilization. According to the report of Fly Ash Facts for Highway Engineers, fly ash is separated finely after the combustion of pulverisation and is moved from the combustion chamber by exhaust flue gases which is dry and smooth. For that, it can fly in the air. The approximate amount is 50% of overall (Basu, 2017).

Flue gas – At the time of combustion, various types of poisonous gases are generated and measured in the laboratory at every 250 MW power generation, it is approximately, Sulphur oxides (SOx) 310 Unit, Nitrogen

oxides (NOx) 370 Unit, Carbon Monoxide (CO) 11-12%, Carbon dioxide (CO₂) 15.2% and Oxygen (O₂) 4.5% respectively and it is emitted 8% approximately in air. A huge amount of water vapor also emits in air.

Properties of Fly Ash

Physical Properties

According to Basu *et al.*, (2009) and Murugan and Vijayarangam, (2013) the Physical Properties depend on the percentage of ash quantity in coal, quality of coal, combustion process and capacity of the boiler.

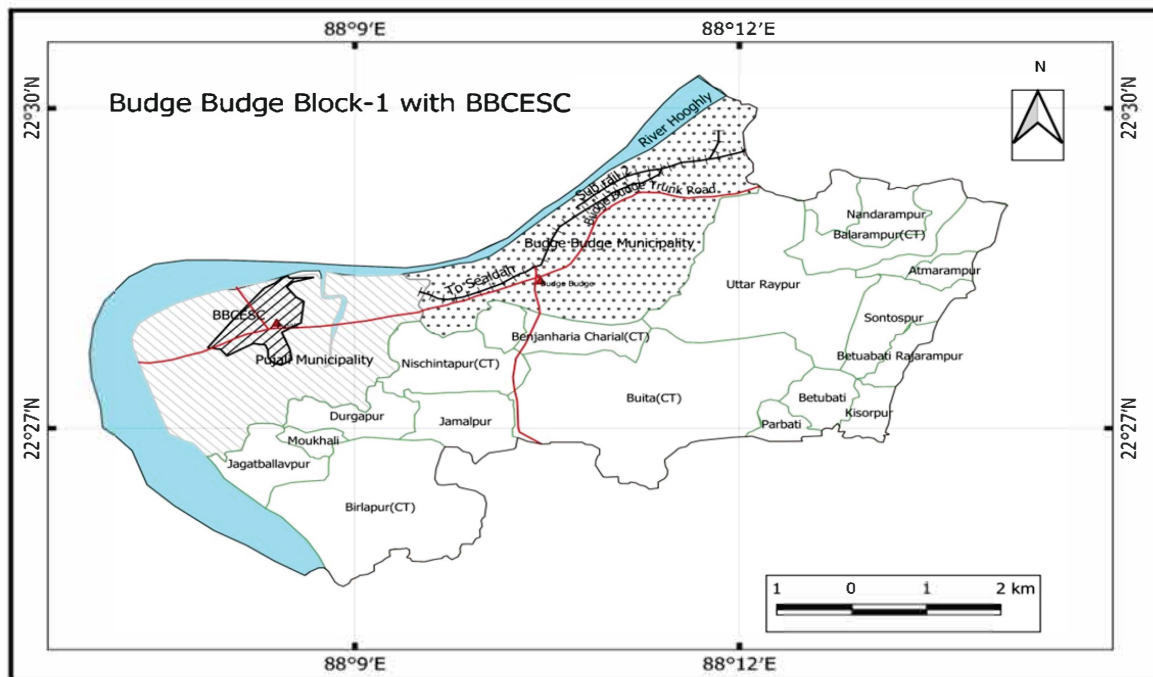


Fig. 1 (b). Location Map, Budge Budge-1 with BBCESC, compiled by Dhole, M. (2021) using QGIS.

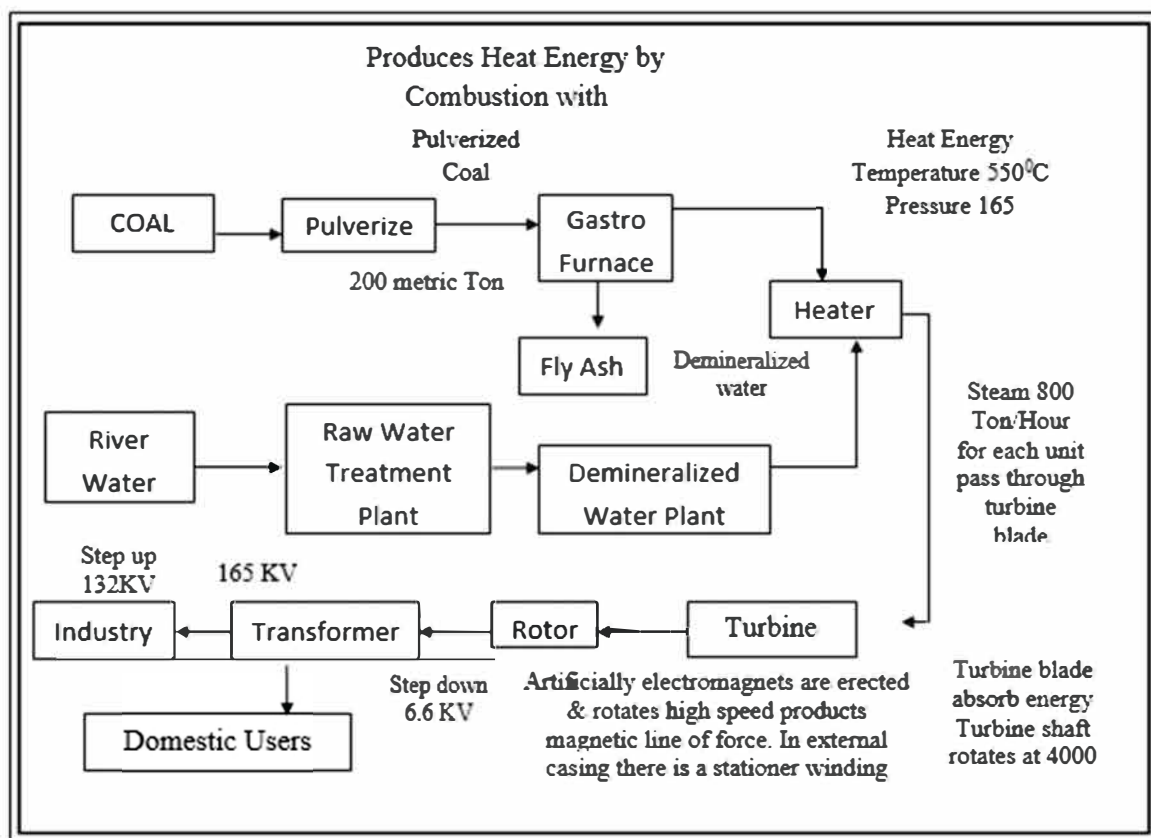


Fig. 2. Process of Electricity Generation compiled by Dhole, M. (2021)

Fly ash contains 65–90% approximately silt loam texture particles whose diameter is less than 0.01 mm. This particle increases dust formation and it is the main cause of the spread of pollution (Basu *et al.*, 2009). Some chemical properties influence this property, which are Potential of Hydrogen (P^H), Bulk density, Nitrogen, Phosphorus, Electrical conductivity, Organic carbon etc. (Basu *et al.*, 2009).

Chemical Properties

According to (Basu *et al.*, 2009) and the laboratory expert of BBGS introduced some chemical properties. The chemical properties Aluminium, Ferrous, Silicon (Al, Fe and Si) are in vast quantity and some small amounts of chemicals are Calcium, Potassium, Sodium, Titanium and Sulphur (Ca, K, Na, Ti and S). Fly ash contain some micronutrients which are benefited for soil and plant nutrients Phosphorus, Calcium, Magnesium (P, K, Ca, Mg) but some are toxic i.e., Cadmium and Nitrogen (Cd and N) (Basu *et al.*, 2009).

Amount of Fly Ash

The statistics and picture are available from the year 2001–2006 (BBGS head office report, 2006) about the power generation and fly ash, there are no considerable changes in the quantity shown in table-1 and fig.3. In 2014 power generation amount was 23073.33 M.W. that means the power generation amount has increased, that is also indicating the coal use and ash generation have also increased.

Problems from Fly Ash and Others

- I. According to local residents there was a large sector of the agricultural fields and due to its location and fertile soil, various types of crops were being produced but a large area (more than 225 acres) has now occupied for the three Units of the project. According to the information provided by the CESC

head office the land-use system of surroundings has changed that are shown in two satellite images of different decades 1990 and 2020 in fig. 4. Many farmers have lost their jobs and cultivated fields. As a result, the production rate is gradually decreasing.

- ii. Ash has created a layer on the upper part of the leaves which affects the activities of plants in the region. The pond water, underground water and river water is gradually contaminated by toxic chemicals that come from ash. As a result, the zonal ecosystem is crippling.
- iii. Due to establishment of this project the settlement pattern and job types have changed. The decrease rate in agricultural production has inspired people to convert agricultural fields into high land and it is being used in another economic sector (Mondal, 2018).
- iv. Various types of machinery noises create noise pollution.
- v. According to the primary data, that fly ash and toxic chemicals have increased health-related problems like allergies, eye problems, asthma and heart-related problems.

Agriculture

The Area Under Seasonal Vegetable

Some changes were observed in the cultivation of Kharif (Brinjal, Ladies-finger, Cucumber), Rabi (Cabbages, Onion, Potato) and summer (Brinjal, Tomato) crops during the period which are shown in table-2. Since the paddy is considered as the principal crop in the region, other crops had been taken care of for cultivation along with the paddy to the extent possible.

Crop Intensity

Cropping intensity is defined by the degree and level of

Table.1. Power & Ash generation related information of BBGS

Year	Generation Of Power in Megawatt (M.W.)	Quantity of Coal in Metric tons (M.T.)	Total Ash (Tones)	Fly Ash (Tones)
2001	3242.73	1790879	800536	696466
2002	3288.85	1932162	911208	792751
2003	3321.78	2026795	763318	664087
2004	3507.03	2085282	741218	644860
2005	3783.52	2233092	885696	770556
2006	3346.86	1981466	680584	592108

Source : BBGS head office report, 2006

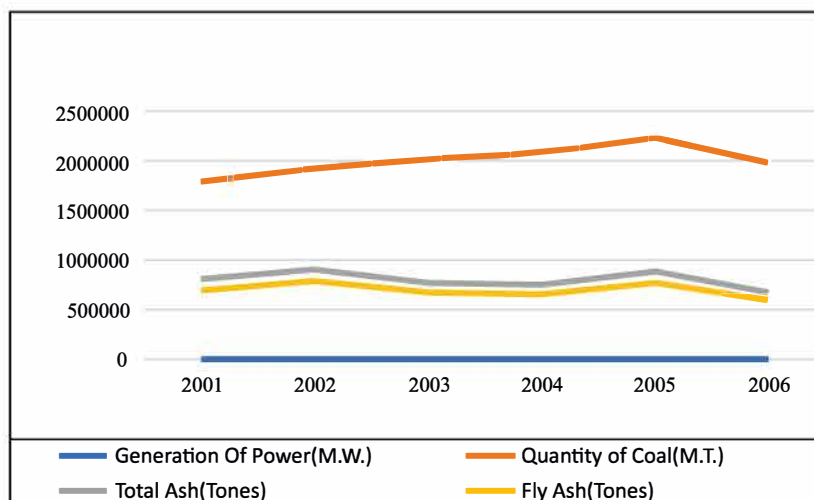


Fig. 3. Power & Ash generation related information of BBS

cultivation of and production of the usable lands in the region. From the year 1997-2005 (Agricultural Report 2006), there were ups and downs in the rate of production shown in fig.5, table-3 and its causes were the extent of involvement of the people in cultivation, while huge lands and sufficient agricultural labours were available before, but with the process of gradual industrialization and particularly with the advent of the CESC power plant, acquisition of huge lands and employment in the industry has slowdown the agricultural process in the region. Other, reason for that is traced to the contaminated water, polluted climate-disrupting natural growth of production in all respects of crops. Impact and negative relationship among fly ash, crop intensity and production are shown in table-3 and fig.6 & 7.

Area, Production and Productivity of Different Crops

According to Table-4, it may be mentioned that land use for food grains has been diminished and affected due to the setting up of the thermal power plant. Lands used for paddy crops are in a manageable position. Table-5 indicates the differential nature of the production pattern. From the years 1997-2000 the production of Boro is a slightly lower trend but in the years 2001 and 2002 the rate of production fell miserably while the production of Aman had gone up in the subsequent years are known from table-5. According to the Agricultural Report 2006, productivity showed in table-6. The reasons were cited for variability in the fertility of the soil (Agricultural Report 2006), and the climate (NOAA). The table-5, a comparison may be drawn between the amounts of production of the years 1996-1997 and from 1998-2000 (Agricultural Report 2006). The greater fall during the

period from 1998-2000 had been responsible for the depletion of land, less fertility of the land, non-availability of the required number of agricultural workers and lack of right encouragement among the cultivators. Since the paddy is considered as the principal crop, the High-yielding variety (HYV) was used effectively for the cultivation of 'Aman' and the production was comparatively better than the production of 'Boro' in 1998-1999. The production of oilseeds, pulses, wheat and summer vegetables was badly affected. It is worthwhile to mention here that the production process is affected at times by the insects, lack of advanced knowledge in the system, and for use of harmful pesticides by the poor cultivators of the region who are mainly involved in the process of cultivation essentially for their livelihood. Hopefully, at present with the initiative of the Government of West Bengal has taken effective steps for arranging awareness programs, given proper training to the cultivators and supplied modern instruments and pesticides to them. Further, there are now more developmental scopes regarding agricultural improvement because this area has been implemented under the supervision and guidance of the Intensive Agriculture District Programme (IADP).

Yearly Production of Various Crops

Pulses - According to the Agricultural Report 2006, Pigeon pea, Green gram, Lentil, Toor, Gram etc. pulses are produced in good quantities. Table-5 shows that pulses in the years 1996-1997 generally pigeon pea, green gram etc. pulses were produced but production of these crops suffered a sudden setback from the years 1997-1998 to 2000-2001. The reasons for such fall were being carried on the experienced under the research.

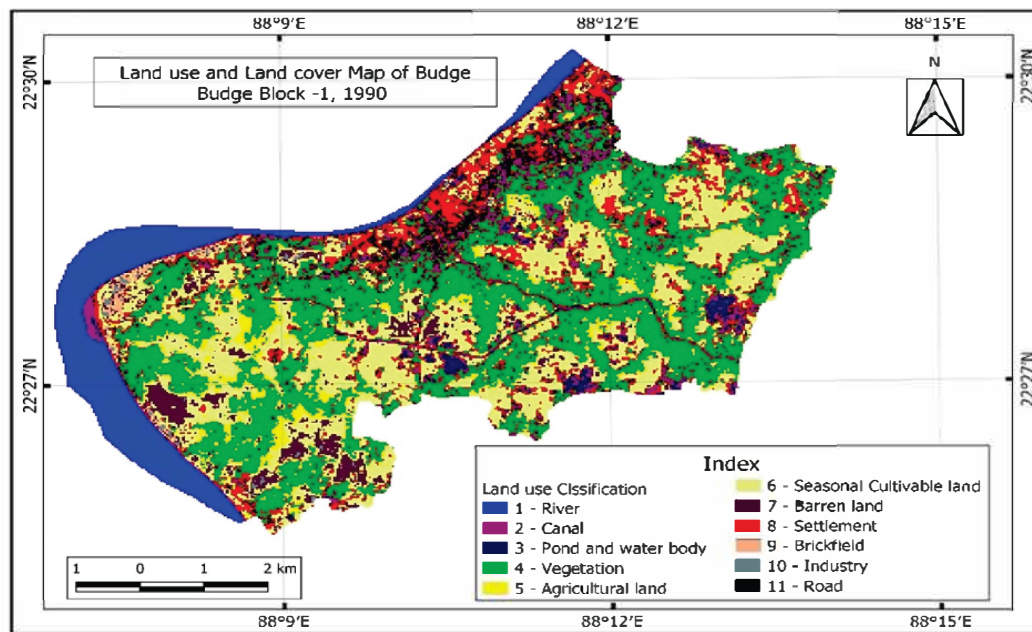


Fig. 4(a)

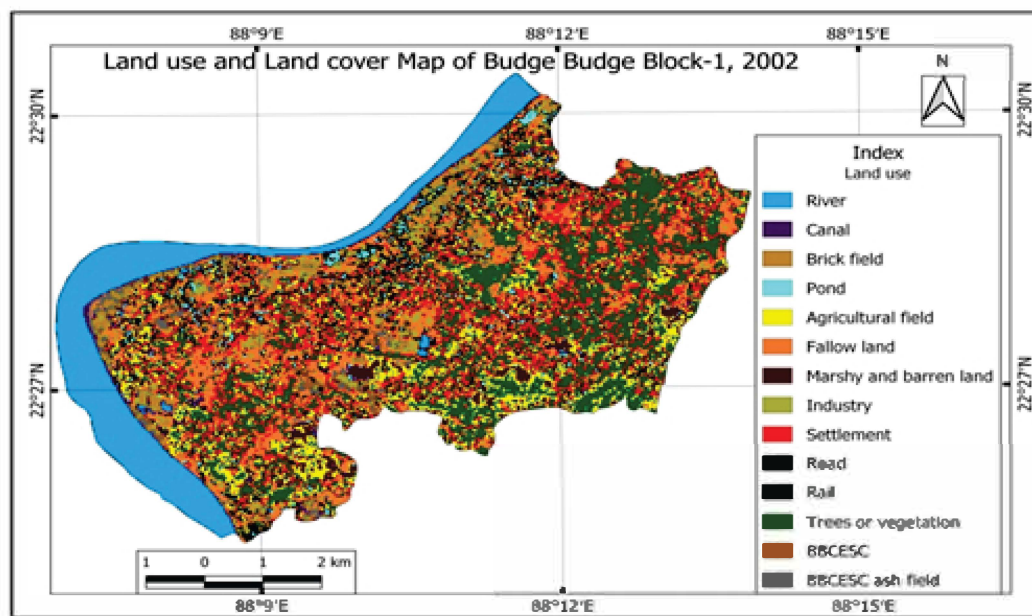


Fig. 4(b)

Fig. 4(a & b). Land use and Land Cover Map of Budge Budge Block-1, 1990 & 2020 compiled by Dhole, M. (2021)

Thereafter there was some rise in the rate of production.

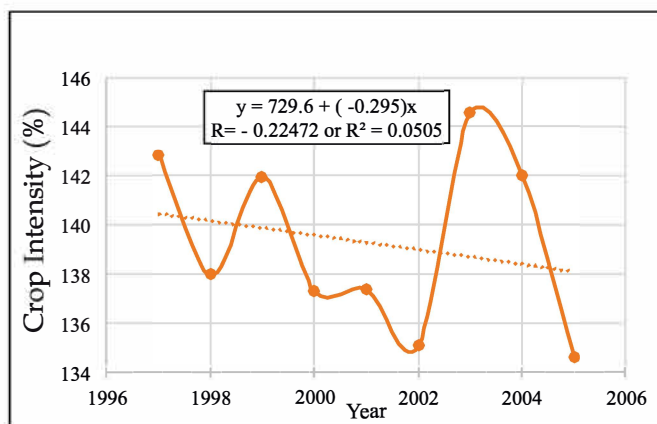
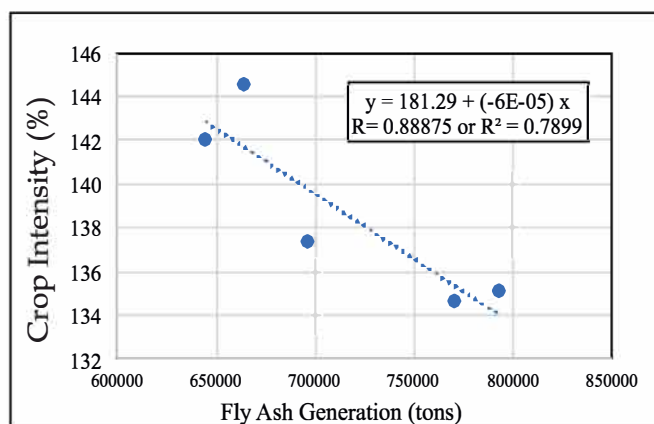
Oilseeds- Oilseeds are not the essential crops in this region. Only mustard seeds and Sesame are cultivated. Only in 1999, 2000 and 2002 the Oilseeds, Mustard seeds and Sesame were produced satisfactorily. In the later year, interest was noticed among the cultivators in the cultivation of the peanut.

Other crops - The spice crops like - bay leaf, chili, ladies-finger are among the crops that are worst affected by the fly ash. Since the ash directly falls on the leaves of the small trees of such crops whereby the culms and leaves including the total system of the production process of these crops become weak, hampers expected full flowering and bearing of crops and consequently fail to attain desired productivity. But the cultivation of

Table.2. Area under seasonal vegetation

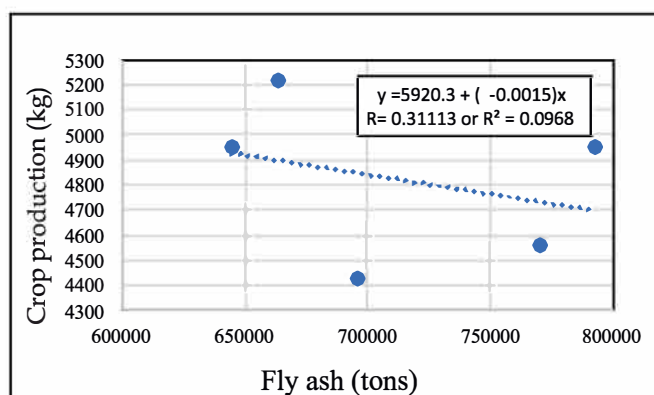
Vegetables	Brinjal	Amaranth	Pumpkin	Other ground	Cucumber	Tomato	Been
Kharif Crop	32	6	2	10	4	0	0
Summer	41	10	10	15	0	30	0
Rabi	0	0	0	0	0	40	5
Vegetables	Green been	Others root & Tuber crop	Ladies finger	Other vegetation	OtherLeafy Veg	Watermelon	Cauli flower
Kharif Crop	10	4	24	3	10	0	0
Summer	0	0	0	0	0	15	0
Rabi	0	0	0	0	0	0	15
Vegetables	Cabbage	Knolkhol	Beet	Carrot	Sweet potato	Onion	Radish
Kharif Crop	0	0	0	0	0	0	0
Summer	0	0	0	0	0	0	5
Rabi	20	20	10	5	5	5	0

Source: Agricultural Report, 2006 A.D.O. Budge Budge Block-1 & District Census Handbook 24 PGS (S), 2001

**Fig.5. Crop intensity in Budge Budge Block-1****Fig.6. Relationship between crop intensity and fly ash generation****Table.3. Relationship between crop and fly Ash**

Year	Intensity (%)	Crop Production (Kg)	Fly Ash (Tons)
2001	137.36	4428.06	696466
2002	135.08	4954.69	792751
2003	144.53	5218.64	664087
2004	142.04	4950.32	644860
2005	134.65	4560.23	770556

Source: BBGS head office report, 2006; Agricultural Report, 2006 A.D.O., Budge Budge Block-1; District Census Handbook 24 PGS (S), 2001.

**Fig.7. Relationship between crop production and fly ash generation**

turmeric and particularly potatoes are not disturbed in any way. On the contrary, ash contributes to the cultivation of potatoes to its size, growth and helps retain humidity and provides nourishments in the production of potatoes.

Variation of Pesticide Application

According to the information from the A.D.O. of this block, it was observed that during 1998–1999 to 2000–2006 the use of different kinds of pesticides increased considerably. The motive behind the use of such pesticides is to control the infestations of various types of insects which attack to the crops and waste it.

Soil Characteristics

Soil sample was collected randomly from some mouzas of study area and after its test in laboratory in the University Calcutta by researcher. The result shows that the character of soil on the bank of the river Hooghly is alkaline in nature. Soil P^H on the north-west part of the region is 7.5 indicating the salted nature. In the middle part of this region, the quality of the soil is of an adequate standard for cultivation, whereas soil on the north-east and south-east sides of the river is somewhat salt-affected, showing the level of P^H is 6.5 or a little less. In short, the soil in this region is reasonably suitable for cultivation.

Organic Carbon

The more organic carbon in the soil is referred to as more fertility (Koley, 2016). The localities like Raipur, Rajibpur, Ramchandrapur and Nischintapur which are situated in the north-east part of the Budge Budge Block-1 are more or less having the impact of organic carbon and elsewhere in the region, this level is of a medium of standard, according to the soil test result and test kit

reference.

Average Phosphate/Potash (P_2O_5/K_2O)

The influence of P_2O_5 has been centred much in the north of Raipur and elsewhere in the region it is less observed (Agricultural Report, 2006). The study is being carried on to find out the result.

The impact of K_2O is also much in the north-east and south-east of the region and other places, it is relatively less (Agricultural Report, 2006). The deficiency of these nutrient components affect plant in various ways like reduction of resistance power, disruption of plant growth etc. As a result, the crop production is disrupted in this region, i.e., Budge Budge Block-1.

Crop Production Before and After the Production of Ash in CESC

The thermal Plant has affected the production of crops in this region. Though the Department of Agriculture denies it. Because of the views expressed by the two sides on the subject, there can be no denial that cultivation in the region has somewhat been affected after the establishment of the CESC power plant. If the table no. 4, 5 & 6 i.e., the total crop area, the total production and the total productivity to be considered, it can be said that before the fully production of ash i.e., from 1997 to 2000 (considered with the table no. 1 and 4,5) the total crop area and total production were comparatively more than after the ash production. Both, total crop area and the total production have decreased gradually with the time mainly after the starting periods of ash.

At the same time, it needs to be appreciated that with the advent of industrial projects in the region the scope of economic development and other infrastructural facilities have become possible which may pave the way

Table.4. Area of crops

Area (Hectare)							
Year	Amon	Boro	Wheat	Pulses	Oil Seeds	Crops & Vegetables	Total
1997	2095	665	5	167	10.75	323	3265.75
1998	1951	665	1	100	7	431	3155
1999	1965	670	0	113	12	485	3245
2000	1958	528	1	134	12	507	3140
2001	1966	548	0	105	3	518	3140
2002	2345	220	12	129	16	366	3088
2003	2345	400	12	145	4	398	3304
2004	2279	380	10	148	7	423	3247
2005	2040	375	8	158	10	487	3078

Source: Agricultural Report, 2006 A.D.O., Budge Budge Block-1; District Census Handbook 24 PGS (S), 2001.

for the overall wellbeing of the people. If we consider the overall social wellbeing and agricultural development side by side because of the industrialization in the region, it is rather difficult to conclude whether the CESC Power Plant is just or unjust. But it is apparent from the various aspects of the study conducted that there are certain reasons which are affecting the cultivation process at least and it is possible to overcome all these by taking proper attention and adopting effective remedial measures. There can be no denying the fact that in a developing economy like ours, we need development in agriculture as well as industrial growth for economic progress.

Land Utilization and its change

According to the District Census Hand Book 24 PGS (S), Census of India 2011, the total cultivable land areas in the region are 62 hectares, non-agricultural land 278.3 hectares, net sown area 727.5 hectares etc. (District Census Hand Book 24 PGS (S), Census of India, 2011).

Before the establishment of CESC here, this area was under Gram Panchayat or village council and this area was under the agricultural field and swampland according to the information of Rajibpur G.P.O. and B.D.O. of this block. A large amount of crop was produced here and local people were engaged in this work. As per its location beside the riverbank, some brickfields were situated in that portion. Some jute

Table.5. Yearly Production of crops

Production (Kg/Hectare)							
Year	Amon	Boro	Wheat	Pulse	Oil Seeds	Crops & Vegetables	Total
1997	3790.7	1928.5	22.5	146.75	7.8	103.5	5999.75
1998	3236.8	1940.47	3	60.35	4.7	45	5290.32
1999	1886.19	2125.9	0	77.7	7.78	72	4169.57
2000	2594.8	1462.56	2.6	73	8.7	48.2	4189.86
2001	3423	876.25	0	71.21	3.6	54	4428.06
2002	4184.7	634.7	18	101.69	12	3.6	4954.69
2003	3967.46	1109.2	5.58	117.1	1.9	17.4	5218.64
2004	3679.45	1143.7	4.37	109.7	3.6	10.2	4951.02
2005	3233.66	1178.25	3.72	125.4	4.2	15	4560.23

Source: Agricultural Report, 2006 A.D.O., Budge Budge Block-1; District Census Handbook 24 PGS (S), 2001.

Table.6. Productivity of crops

Productivity (Kg/Hectare)							
Year	Amon	Boro	Wheat	Pulse	Oil Seeds	Crops & Vegetables	Total
1997	3705	2900	4500	1650	1150	13000	26905
1998	3454	2918	3000	1138	1240	15560	27310
1999	2169	3173	3000	2156	1010	15135	26643
2000	2903	2770	2570	2401	1080	15437	27161
2001	3637	1599	2000	2647	1200	16920	28003
2002	3730	2885	1500	4380	1970	2950	17415
2003	3389	2773	465	3388	1691	16600	28306
2004	3136	2907	465	3638	2007	16100	28253
2005	3048	3142	465	3888	2461	15000	28004

Source: Agricultural Report, 2006 A.D.O., Budge Budge Block-1; District Census Handbook 24 PGS (S), 2001.

industries were situated nearby but this project has changed the scenario from a block map to the socio-economic condition with a land-use system. The scenarios are-

- This project has changed the administrative setup also, because the north-western part of this block was under the Pujali G.P.O. before the CESC establishment and due to the population growth, this area was converted into the Pujali Municipal and the area was covered almost 8.32 Square Kilometre (Sq. Km). according to the information of Rajibpur G.P.O. and B.D.O.
- Also, many mouzas have become Census Towns (CT) and some parts of mouza around the municipal area are included gradually (District Census Hand Book 24 PGS (S), Census of India, 1991 & 2001). In this way, the block area is decreasing. Now the area of Budge Budge-I is 26.55 Sq. Km only. All these information was collected from the report of (District Census Hand Book 24 PGS (S), Census of India, 2011).
- After this project started the settlement pattern and economic sector changed. So, the agricultural fields were converted into high land that are shown in table- 7,8 and fig. 8(a) and (b) and sold at a high price. Many new industries and brickfields are spreading

in their area (Mondal, 2018).

- As this area has become an urban area, the infrastructure has changed, which attracts people for a good economy and amenities. So, it has become a denser settlement area.
- Swamp and wetland are filled up for building structures. In this way, land-use patterns have changed.

Impact on the environment

- According to Sett, (2017) though the thermal project sector is an asset to us, still it creates various types of environmental problems. As this power plant is a coal pulverization base company and uses a huge amount of coal for combustion, so enormous ash is generated which fly in the air, dissolve in water, it mixes in the river, canal and in drinking water through a leakage water pipe. It affects the pond and other wetlands. The water becomes contaminated because coal contains some toxic trace elements like mercury, molybdenum, chromium, cadmium and arsenic. (Thermal Watch CAG, 2021).
- Ash (fly & bottom) impact on ecology: When the coal combustion process is activated, a large amount of alkaline dust is produced that increases the P^H level of soil, sometimes 8-12 are the value of soil. It affects local plants and animals of the regional ecosystem.

Table.7. Land use and land cover area of budge Budge-1, 1990

Landform	Area in 1990 (Sq. Km.)
River	5.157
Canal	3.5469
Pond and water body	0.8352
Vegetation	18.9063
Agricultural land	2.6676
Seasonal Cultivable land	11.8449
Barren land	1.9611
Settlement	5.5485
Brickfield	0.2898
Industry	0.1854
Road	2.5803

Table.8. Land use and land cover area of budge Budge-1, 2002

Landforms	Area in 2002 (Sq. Km.)
River	7.173
Brick field	0.8469
Canal	0.8658
Pond	1.0341
Agricultural field	6.1524
Fallow land	7.5249
Marshy and barren land	1.8036
Industry	1.6065
Settlement	9.0117
Road	1.2591
Rail	4.8411
Trees	11.4867
BBCESC	1.3743
BBCESC ash field	0.8901

Source: Compile by Dhole, M. from Land use and land cover map in QGIS (2021).

- As it is a coal-based plant, a large amount of coal stored in the stagger is situated beside residency. In the winter season, the carbon gases spread & hover in the whole area with the northern wind. It creates a vomiting tendency and obstruction in the respiratory system of local people. As fly ash is light in volume, it can fly everywhere in the surrounding area and enter the human body through oxygen inhalation. So, many diseases take up residence in the body and are attacked by asthma, stomach, heart-related diseases. Many types of skin diseases are attached to the local people. Also, allergies have increased at a high rate, mainly dust allergies. The cold starts with some people.
- Fly ash, flue gases and water vapor are very good heat absorbers. These types of SPM spread out in this region and gradually there is increased in the temperature comparison to other regions. So, regional temperature change has happened here (Fulekar, 2010; Thermal Watch CAG, 2021).
- This plant has been changing the regional water quality of the river Hooghly. Heat and dust particles with toxic acid molecules are added in rivers (Sett,

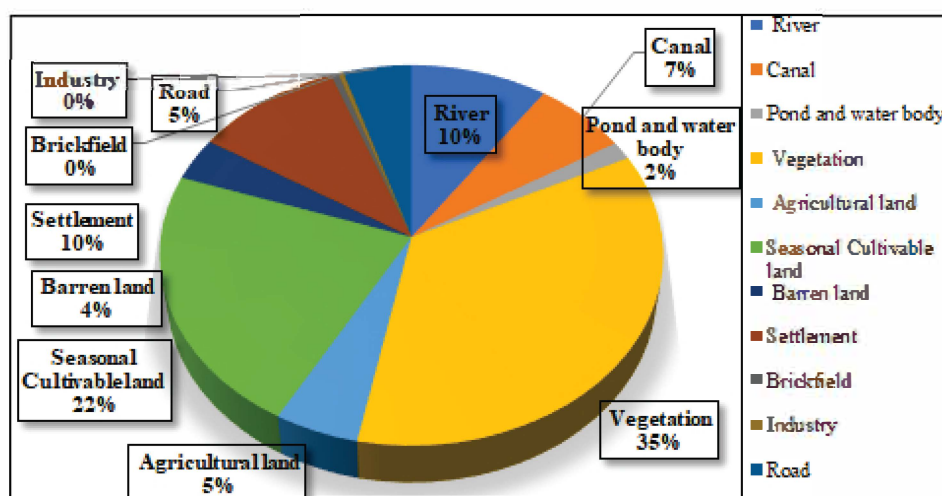


Fig. 8(a). Land use and land cover area of Budge Budge-1, 1990

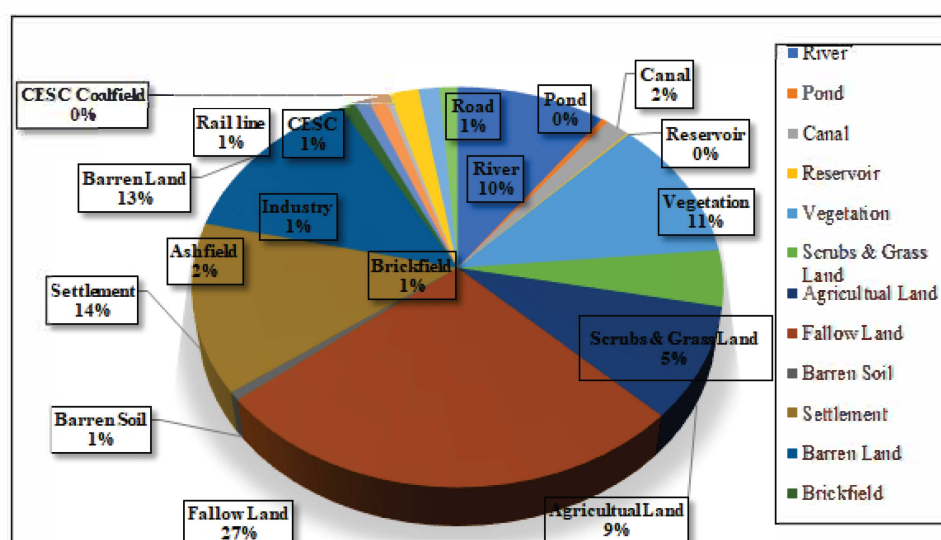


Fig. 8(b). Land use and land cover area of Budge Budge-1, 2002

2017). So, the river water becomes contaminated and damages the local ecosystem.

- Fresh air is not sufficient because of the high rate of suspended particulate matter (SPM) and harmful gases emitted from this project area. But the air quality is comparatively fair (< 51 according to Air Quality Index) as far as the project area, which has measured by the AccuWeather application.
- Due to the lack of proper maintenance, the roadside canal, drain and wetland are fully congested in ash, obstructing the flow of water. So that, the area inundated after rain. Agriculture is damaged particularly in the Pujali municipality and nearby areas for drainage and canal disorder.

Impact of Ash on Crop Production, Land Use System and Surrounding Environment

Fly ash's impact on the environment and agricultural production process in the region is becoming more intense shown in fig.5 & 6 and table-3. Local people's perceptions about the impact of fly ash on agriculture

and the environment are shown in fig.7, 9-13 and table-9-13. Most of the local people have accepted and agreed that here it has some serious problems and it has swallowed all people by various types of pollution and chronic diseases. In this way, ash impacts harmfully from crop production to the land-use system change. Though different remedial steps have been taken by the authority to lessen the impact of the ash-like ash is being removed by ships in Bangladesh.

Results and Discussion

Based on the total report some hypotheses are considered that, fly ash and bottom ash have affected not only the environment of this region but also it has decreased the fertility rate of cultivated land. It has been affecting the health of local people since its establishment. Now a day different types of allergies affect people with other skin diseases.

Test result-1, For the first test, it has gone through statistical analysis in SPSS software and provided diagrams and data tables to show the impact of ash production on crop production, intensity, productivity

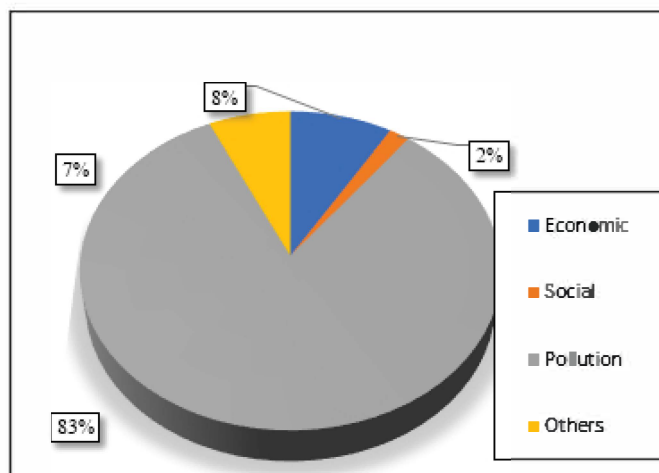


Fig.9. Main problems at locality due to CESC

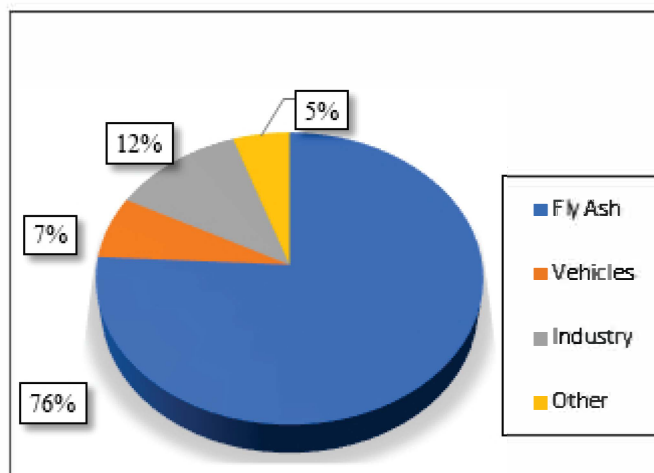


Fig.10. Types of air pollutions

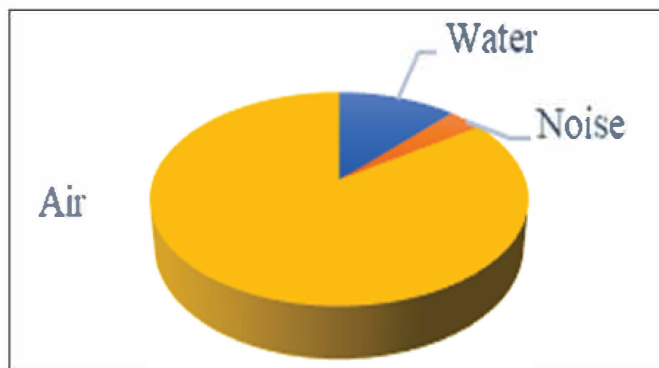


Fig.11. Types of pollution according to people

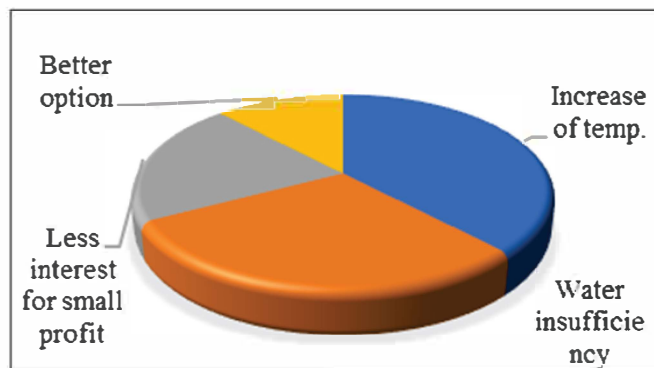


Fig.12. Others causes responsible for low crop production

Table.9. Main problem in your locality due to CESC

Types	Frequency	Percentage
Economic	5	8.6
Social	1	1.7
Pollution	48	82.8
Others	4	6.9

Table.10. Air Pollution responsible

Types	Frequency	Percentage
Fly Ash	44	75.9
Vehicles	4	6.9
Industry	7	12.1
Other	3	5.2

Table.11. Types of pollution, mainly affected people

Types	Frequency	Percentage
Water	7	15.9
Noise	2	2.3
Air	49	84.5

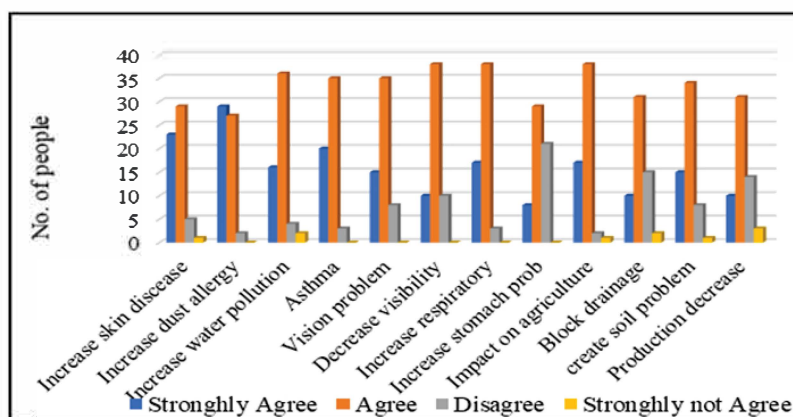
Table.12. Any other condition responsible other than fly ash

Condition	Frequency	Percentage
Incr ease of temp.	22	37.9
Water insufficiency	17	29.3
Less interest for small profit	12	20.7
Better option	7	12.1

Table.13. Peoples' response about various local problem

Likert Scale	Strongly Agree	Agree	Disagree	Strongly not Agree
Increase skin disease	23	29	5	1
Increase dust allergy	29	27	2	0
Increase water pollution	16	36	4	2
Asthma	20	35	3	0
Vision problem	15	35	8	0
Decrease visibility	10	38	10	0
Increase respiratory	17	38	3	0
Increase stomach prob	8	29	21	0
Impact on agriculture	17	38	2	1
Block drainage	10	31	15	2
create soil problem	15	34	8	1
Production decrease	10	31	14	3

Source: Primary Survey from field for table. no. 9-13

**Fig.13. Local people's response about various local problems**

and reduction of the crop area. In Pearson's two-tail test at 5% significance, it is proved that null hypotheses between ash production and crop intensity and reduction of crop area are failed, which is shown in Table.14. Therefore, it can be said that ash impacts agriculture in this area. Also, it is shown in a scatter diagram, constructed in excel, the correlation between ash and crop intensity is strongly negative ($R = -0.88875$ or $R^2 = 0.7899$), the trend intensity rate with time is also stopped down. The relationship between ash and crop production is also negative, but the relationship is weak. From table- 4, crop area reduction and fluctuation matter are visible.

Test result-2, For the second hypothesis to show the impact of ash on the environment, especially on the physics of local people some statistical tests and diagrams are also done. A Non-Parametric, namely independent sample test is done to prove the hypotheses. One sample chi-square test and Kolmogorov-Smirnov test at a 5% level of significance have rejected the null hypotheses about the impact of ash on various diseases of local people and various kinds of pollution like air, water, noise pollution. So, it is proven that ash impacts not only agriculture but also human beings.

Suggestions

The following remedies can be taken for a better result in this area:

- i. If authority would take some new technologies so that the fly ash ejaculates less in an amount from the

chimney or filter the smoke by scrubber or other absorbing machines before it mixes in air. Machinery should check-in time so that they do not pollute the environment over the permission level in the air.

- ii. Pollution control activities of emission of flue gases needed proper handling (Flue tacks, electrostatic precipitators and wet electrostatic precipitators), the ambient air monitoring system, solid cum hazardous waste management, effluent recycling and conservation, ash handling and utilization, etc.
- iii. The authority should take care of the sewerage and local drainage system in the project and surroundings.
- iv. Basu, (2009) said that fly ash has some positive factors. It acts as soil and contains many micro-nutrients. If ash is handled properly, it can increase the yield rate of crops and develop soil character (Sahu *et al.*, 2017).
- v. At the time of loading-unloading and transfer from the plant, a huge amount of fly and bottom ash disseminated. Management should be concerned about it.
- vi. According to Basu, (2017) fly, ash is used in various ways in this day. If the ash is used to make various items like blocks, with the help of new technology a huge amount of ash can be converted and possibly to reduce pollution from fly ash. But here is another problem, when flying ash loads in the ship some amount of ash leaks and mixes in the water of Hooghly that contaminate water in this sector. These

Table.14. Correlations

		Crop Intensity of Budge Budge Block-1 in Percentage (%)	Production in Tones	Crop Production in Kgs/Hectare	Area in Hectare
Crop Intensity of Budge Budge Block-1 in Percentage (%)	Pearson Correlation	1	-.889*	.406	-.139
	Sig. (2-tailed)		.044	.279	.721
	N	9	5	9	9
Production in Tones	Pearson Correlation	-.889*	1	-.311	. ^b
	Sig. (2-tailed)	.044		.610	.000
	N	5	6	5	5
Crop Production in Kgs/Hectare	Pearson Correlation	.406	-.311	1	.270
	Sig. (2-tailed)	.279	.610		.483
	N	9	5	9	9
Area in Hectare	Pearson Correlation	-.139	. ^b	.270	1
	Sig. (2-tailed)	.721	.000	.483	
	N	9	5	9	9

*. Correlation is significant at the 0.05 level (2-tailed).

b. Cannot be computed because at least one of the variables is constant.

aspects should be looked into by authority.

Conclusion

People are facing livelihood problems i.e., pollution through fly ash in the locality every day. Fly ash impediments encountered obstructing in the matter of full growth of trees, plants, smooth and healthy cultivation in the region. There is no doubt that generation of power is appreciable. It helps to bring about progress and the welfare of the people and the country in many ways. But it needs to be kept in view about the resulting adverse side effects in the nearby regions.

Civilization is moving forward very fast and electricity is a very essential for fast-moving life nowadays. So that only science and high technology can save and move civilization to keep a balance between development and environment.

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