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GIS Based Evaluation and Management of Soil Reaction for Environmental and Agricultural Sustainability Around a Thermal Power Plant

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ABSTRACT

The alkaline fly ash (pH 8.3-8.6) emitting from Kolaghat Thermal Power Plant (KTPP), West Bengal, India, effectively renders the soil reaction (pH 7.58-8.01) of the adjacent land. The soil-fly ash mixtures predict the increase in pH influenced by fly ash. At 5% level of significance within 4 km from KTPP, calculated t-values exceed the tabulated ones which ascertain that the fly ash affects the soil reaction. Temporal soil reactions (2011, 2013 and 2015) show the highest change (12.3%) followed by 11.4% and 11.3% in the adjacent areas within 4 km. The probable soil pH of the affected area is estimated by the developed equation, Soil pH_{n+r}= soil pH_n + 1.09127 x10^{-5}x r x (d_m - d_i) x c. Here 'n' indicates year and 'r' represents the addition of year; d_m denotes maximum distance of affected area and d_i, distance within affected area in km; 'c' indicates capacity of thermal power plant in mega watt. The functional logic of GIS for estimation of lime requirement is y_{1i} = 3 +(6.7- x_{ij})x10) and for gypsum requirement is y_{2i} = 0.021x X_{ik} (x_{il} - x_{im}) ton per hectare, where i stands for circle position; j, for pH of soil-buffer suspension of i^{th} circle, k, for CEC of i^{th} circle; l, for initial ESP of i^{th} circle; m, for desirable ESP of i^{th} circle. For soil reaction management, GIS Model recommends application of gypsum (1-2 ton $hectare^{-1}$) to abate the additional impact of fly ash shedding yearly and liming of $CaCO_3$ at the rate of 1.8-3.0 ton $hectare^{-1}$ is suggested to the areas outside of the impact zone for environmental and agricultural sustainability.

INTRODUCTION

Soil reaction is the most important property which affects the availability of several plant nutrients. It is also helpful to quantify the amendments needed for reclamation of soils. Decomposition of plant residues and breakdown of soil organic matters depend on the soil pH. Soil-borne diseases are influenced by soil pH (Brady & Weil 2012). Evaluation is the process of estimating the potentiality for alternative patterns of utilization. Soil pH is a parameter of soil, which is included in land. This assessment reflects the property of soil and consequently indicates that the land can be used for what purpose. It also suggests the improvement of the soil for specific objectives (FAO 1976). Management is the process of achieving the desirable goals with proper utilization of available resources following the improvement of hindering parameters. Soil pH management is the adaptation of technology for expected change for suitable land use (Rossiter 1995). The major adverse impacts of thermal power plant are on agricultural lands, which are sources of livelihood of the lion's share of people of India. Huge amount of fly ash is being emitted into the surrounding environments. Adjacent land of the thermal power plant is one of the important components of the life support system and has been over used and abused causing infertility of soil (Mishra & Mohanty 2010). To abate the problems, agricultural sustainability has been introduced. The farming is practiced without the knowledge of land capabilities. Land resource evaluation predicts the consequences of change. According to the soil properties, the soil units are selected on the basis of evaluation to provide the highest returns per unit area and conserving the natural resources (Gomez et al. 1996). The adverse effect of fly ash on soil properties was observed by Adriano et al. (2002). Patil & Katpatal (2008) studied the Chandapur district of Maharastra, India, in the concern of coal mines and its impacts on surroundings. Information about land use change is necessary to update land cover maps and for effective management and planning of the resources for sustainable development (Alphan 2003). A scaling sustainable agricultural system aims at developing new farming practices that are also safe and do not degrade the environment (Lichtfouse et al. 2009). The soils of Kolaghat block are stained by the fly ash and consequently wrong practices of crop selection and poor yield are being observed that leads to the poor socio-economic condition of the people (Dasgupta & Paul 2011, Adak et al. 2016).

The present study attempts to evaluate the soil reaction and to manage it for agricultural sustainability in the affected areas of KTPP.

MATERIALS AND METHODS

The Kolaghat Thermal Power Plant (KTPP) is situated at 22°28'16' N and 87°52'12' E in Kolaghat block on the right bank of the Rupnarayan river in the rural agricultural area of Purba Medinipur, West Bengal, India (Fig. 1a & b). The coal fired KTPP has a total installed capacity of 1260 MW generating about 7500-8000 tons of fly ash every day by consuming a total of 18000 tons of coal (Dasgupta & Paul 2011). The soil is developed from Gangatic alluvium and belongs to the new alluvial soil (Inceptisols). It is divided into thirteen agricultural circles, namely Kola-I, Kola-II, Gopalnagar, Baishnavchak, Khanyadihi, Pulsita, Sagarbarh, Amalhanda, Deriachak, Bhogpur, Siddha-I, Siddha-II, Brindabanchak. The distance of circles from Kolaghat Thermal Power Plant (KTPP) has been stated (Table 3). 130 soil samples were collected from different locations and in different years, namely 2011, 2013, 2015 of the selected areas. The soil samples were air dried separately in the laboratory in the room temperature and ground in wooden pestle or mortar. These are passed through a 0.5 mm sieve. Thus, the processed soil samples were stored in polythene bags within cartons with proper labeling and were used subsequently for the measurement of soil pH. Reaction of soil samples were determined after equilibrating the soils with water for 30 minutes in the ratio of 1: 2.5 soil: water (w:v) (Jackson 1976) and using a combined electrode pH meter. Cation exchange capacity (CEC) has been assessed by the mixed indicator method. Exchangeable sodium has been estimated by flame photometer (Hesse 1971). For management of soil pH, lime requirement is reassured by SMP method (Shoemaker et al. 1961). Gypsum requirement is also estimated for lowering the soil pH by applying Schoonover method (1952). Paired *t* distribution has been tested for significance of the right tail area (Freund et al. 2006). For spatial and temporal soil reaction evaluation and management, GIS technology is used (Burrough & McDonnell 1998).

RESULTS AND DISCUSSION

Effect of fly ash on soil reaction: The pH of new alluvial soil is around 6.3. The soil of the area within 4 km from KTPP is affected by the shedding of fly ash (Dasgupta & Paul 2011, Adak et al. 2016). It consequently alters the soil

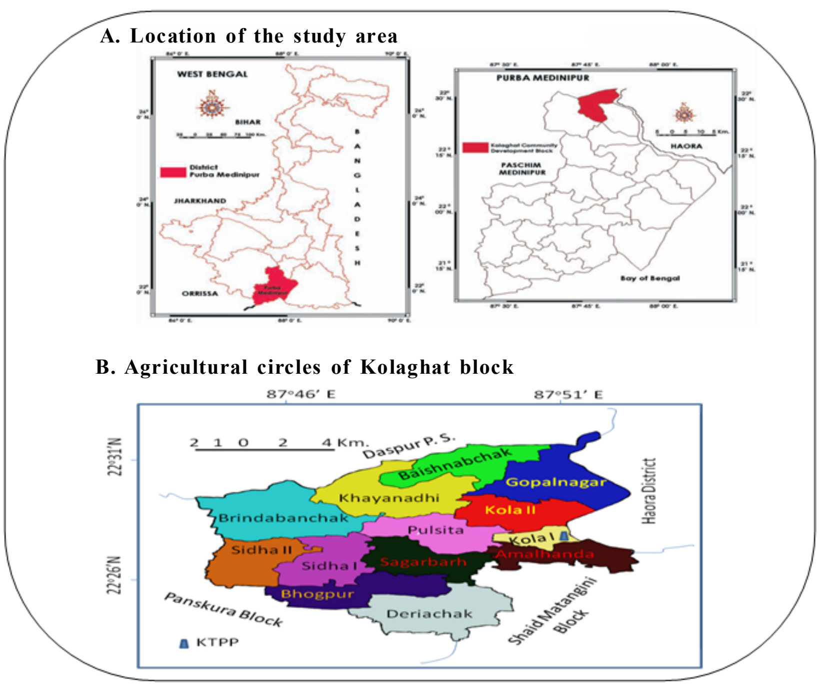

Fig. 1a & b: Area map of Kolaghat block.

Table 1: pH of different soil fly ash mixtures.

Sl. no.	% of soil	% of fly ash	pH soil: water = 1:2.5	pH status
1	100% soil (control)	-	6.41	acidic
2	90% soil	10% fly ash	6.56	neutral
3	80% soil	20% fly ash	6.74	neutral
4	70% soil	30% fly ash	6.90	neutral
5	60% soil	40% fly ash	7.14	neutral
6	50% soil	50% fly ash	7.35	neutral
7	40% soil	60% fly ash	7.54	alkaline
8	30% soil	70% fly ash	7.79	alkaline
9	20% soil	80% fly ash	7.96	alkaline
10	10% soil	90% fly ash	8.15	alkaline
11	-	100%fly ash	8.41	alkaline

Table 2: % of pH change over soil pH_{2011}.

Circles' names	Radius from power plant	Soil pH_{2011}	Soil pH_{2013}		Soil pH_{2015}	
		Average pH	Average pH	% of change over 2011	Average pH	% of change over 2011
Kola-I	<4 km	6.80	7.30	7.4	7.57	11.3
Kola-II	<4km	7.16	7.52	5.0	7.81	9.1
Gopalnagar	4-8km	7.28	7.66	5.2	7.93	12.3
Baishnabchak	8-12km	6.74	6.63	-1.6	6.39	-5.2
Khayanadhi	4-8km	6.08	5.97	-1.8	5.95	-2.1
Pulsita	<4km	7.05	7.42	5.2	7.70	9.2
Sagarbarh	<4km	7.16	7.62	6.4	7.87	9.9
Amalhanda	<4km	7.18	7.70	7.2	8.00	11.4
Deriachak	8-12km	6.05	5.97	-1.5	5.88	-2.8
Bhogpur	8-12km	6.06	5.97	-1.5	5.92	-2.3
Siddha-I	4-8km	6.15	6.05	-1.6	6.07	-1.3
Siddha-II	8-12km	6.08	5.96	-2.0	6.06	-0.03
Brindabanchak	8-12km	6.22	6.21	-0.02	6.38	2.6

pH. The present reaction of the soil in the areas reflect the nature of alkalinity with pH ranging from 7.5-8.2 (Table 1). The pH of soil mixed with different percentage of fly ash shows the increasing trend and gradually the alkalinity developed. The pH of fly ash ranges from 8.3-8.6 which is high in alkalinity (Fig. 2). Alkaline nature of fly ash (pH 8.42) is affecting the soil properties at the adjacent site of thermal power plant (Singh et al. 1995, Basu et al.2009, Adak et al. 2016).

Distribution of fly ash and soil reaction: The distribution of fly ash is reflected by soil reaction of the different circles in respect of 2015 (Table 2). The circles are situated within 2 km radius of the power plant and are highly affected (pH>7) with the emitted fly ash. Addition of fly ash increased the pH of amendments from 6.15 to 7.05 (Gond et al. 2013). But, the upland situation of Kola-I (pH 7.57) and Kola-II (pH 7.81) helps to reduce the fly ash impact to some extent by washing down through rain water. Within the diameter of 2- 4 km the trend is decreasing. The circles of radius of 4-8 km are unaffected. Though the circle Amulhanda (pH 8) is situated in the radius of 4 km, it is highly affected due to geographical position towards the south direction of wind and its land situation is low (Fig. 3). The pH of the nearest circles tends to be alkaline (pH>7) due to the effect of fly ash. Rest of circles (>4km) have pH of acidic ranges (pH<7) because of intensive cultivation and use of acidic fertilizers available in the local market. These areas are unaffected by fly ash.

Change in soil reaction with time: Temporal soil pH is represented here in the fashion of soil pH_n where n stands for the year. Through the passage of time, fly ash accumulates on the adjacent circles i.e., Kola-I, Kola-II, Gopalnagar, Amulhanda, Sagarbarh, Pulsita and results the increase in soil reaction by changing soil pH. Application of fly ash has invariably been associated with the corresponding increase in soil pH (Sharma & Kalra 2006). In 2015 Gopalnagar shows the highest positive change in soil reaction, that is 12.3%, followed by Amalhanda (11.4%), Kola-I (11.3%),

Table 3: Soil reaction in spatial and temporal distribution with fly ash impact.

Circle	Year	pH of soil samples											$\sum d_i$	$\sum d_i^2$	$t_{.05}$ distribution	Significance
Kola-I	2011	7.59	7.48	7.10	7.26	7.01	7.45	7.42	7.06	6.90			2.95	1.200	5.81>1.86	HA
	2013	7.83	7.62	6.91	7.58	7.29	7.81	7.67	6.88	6.82						
	2015	8.26	7.89	7.02	7.71	7.50	8.03	7.91	6.98	6.92						
Kola-II	2011	7.24	7.49	7.38	7.66	7.59	7.42	7.54	6.81	7.18	7.29		5.00	2.893	7.56 >1.83	HA
	2013	7.51	7.78	7.67	7.80	7.81	7.57	7.68	7.15	7.33	7.20					
	2015	7.84	8.12	7.94	8.18	8.16	7.91	7.89	7.52	7.78	7.26					
Gopalnagar	2011	7.73	7.32	7.71	7.59	7.88	7.83	7.70	7.67	7.58	7.49		2.50	0.717	7.82>1.83	HA
	2013	7.84	7.51	7.87	7.74	7.99	7.91	7.88	7.75	7.69	7.60					
	2015	8.01	7.69	8.08	7.93	8.09	8.03	7.95	7.88	7.82	7.52					
Baisnab-chak	2011	7.34	6.70	6.01	6.78	7.08	6.48	7.01	6.19	6.23	6.17	6.40	-1.88	1.234	-1.88 <1.81	NA
	2013	7.63	6.81	5.87	6.52	6.95	6.33	6.88	6.09	6.10	6.16	6.28				
	2015	7.51	6.85	5.89	6.56	6.72	6.16	6.59	5.86	5.83	6.19	6.35				
khayanadhi	2011	6.21	6.22	6.19	6.00	5.82	6.08	6.49	6.02	5.54	5.93		-0.70	0.3766	-1.16 < 1.86	NA
	2013	6.10	6.02	6.03	5.85	5.68	5.92	6.63	5.97	5.63	5.87					
	2015	5.94	5.72	6.20	5.81	5.80	6.14	6.52	6.05	5.60	6.02					
Pulsita	2011	7.52	7.95	7.72	7.46	7.61	6.98	7.54	7.36	6.70	7.86		2.70	1.121	4.09 >1.83	HA
	2013	7.71	7.83	7.89	7.62	7.80	7.19	7.72	7.25	6.82	7.87					
	2015	7.83	7.92	8.10	7.89	8.02	7.45	7.93	7.34	7.09	7.83					
Sagarbarh	2011	7.85	7.87	7.80	7.54	7.85	7.36	7.69	7.90	7.59	7.65		2.00	0.561	4.73 >1.83	HA
	2013	8.11	7.95	7.74	7.68	7.92	7.37	7.80	7.97	7.58	7.78					
	2015	8.17	7.94	7.72	7.87	8.01	7.59	7.99	8.16	7.70	7.95					
Amalhanda	2011	7.95	7.82	7.76	7.64	7.70	7.69	7.82	7.69	7.81	8.02		2.20	0.700	4.49 >1.83	HA
	2013	8.00	7.89	7.83	7.79	7.88	7.84	7.85	7.83	7.89	8.00					
	2015	7.92	7.96	8.09	7.98	8.05	8.08	7.99	8.04	7.98	8.01					
Deriachak	2011	6.18	6.13	6.21	5.99	5.85	6.08	6.62	6.01	5.53	5.90		-1.00	0.4446	-1.62 < 1.83	NA
	2013	6.11	6.02	6.04	5.87	5.73	5.98	6.74	5.85	5.64	5.82					
	2015	5.98	5.85	5.91	5.79	5.62	6.18	6.64	5.78	5.81	5.94					
Bhogpur	2011	6.26	6.12	6.21	6.02	5.89	6.21	6.59	6.04	5.57	5.90		-0.71	0.4327	-1.09< 1.83	NA
	2013	6.00	6.02	6.11	5.91	5.73	6.19	6.81	5.96	5.68	5.99					
	2015	5.82	5.95	5.99	5.78	5.85	6.14	6.77	5.98	5.76	6.06					
Siddha-I	2011	6.59	6.32	6.27	6.14	5.82	6.00	6.64	6.03	5.68	5.91		-0.90	0.8292	-0.99 < 1.83	NA
	2013	6.35	6.22	6.13	5.99	5.74	5.91	6.88	5.92	5.73	5.83					
	2015	6.08	6.14	5.83	5.80	5.91	6.15	7.01	6.05	5.82	5.71					
Siddha-II	2011	6.26	6.45	6.30	6.01	5.93	6.19	6.68	6.07	6.40	5.91		-0.90	0.2850	-1.89 < 1.83	NA
	2013	6.13	6.32	6.16	5.88	5.78	6.17	6.80	5.98	6.23	5.85					
	2015	6.24	6.52	6.01	5.75	5.83	6.24	6.57	5.98	6.12	6.04					
Brindaban-chak	2011	6.31	6.72	6.34	6.02	5.93	6.12	6.55	6.14	6.48	6.09		0.00	0.531	0.00 < 1.83	NA
	2013	6.19	6.81	6.49	5.82	5.80	5.98	6.64	5.95	6.72	6.10					
	2015	6.11	6.84	6.54	5.61	5.73	6.02	6.78	6.07	6.88	6.12					

HA: highly affected; NA: not affected

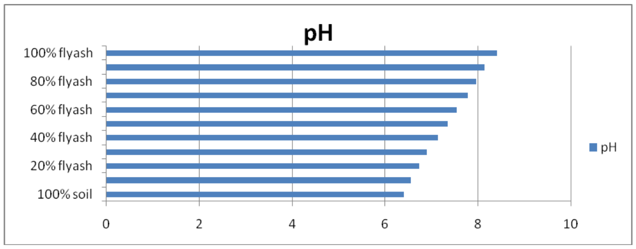

Fig. 2: pH of soil fly ash mixture.

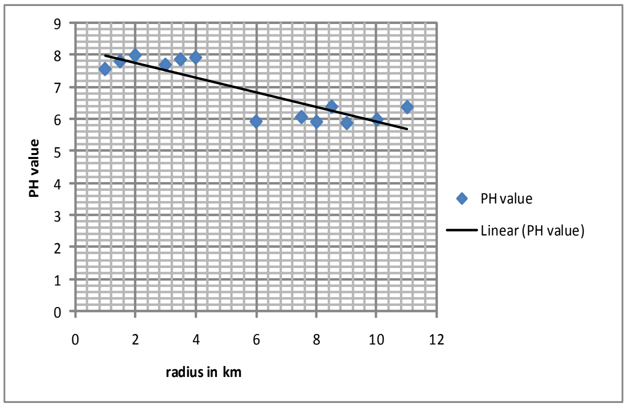

Fig. 3: Distribution of soil pH_{2015} over distance from KTPP.

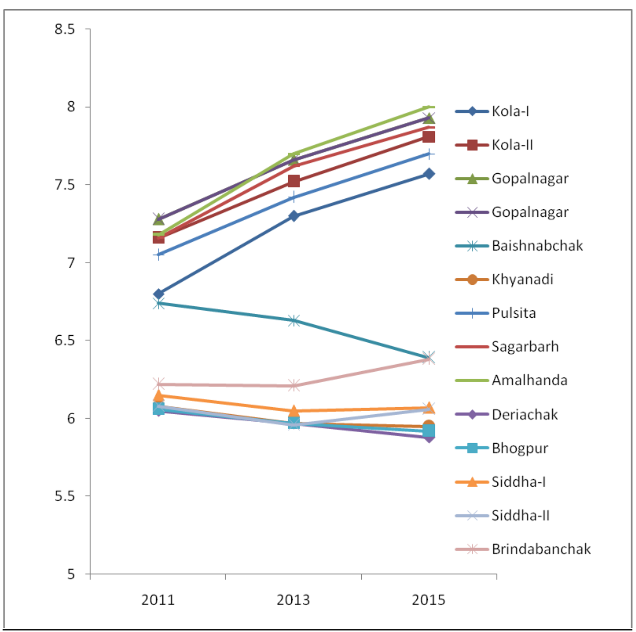

Fig. 4: Change of soil pH over time.

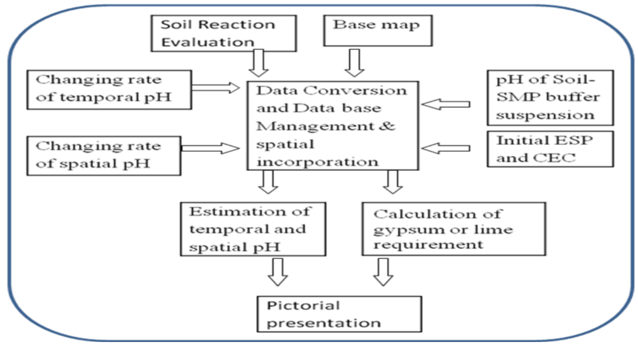

Fig. 5: GIS model for soil reaction evaluation and management.

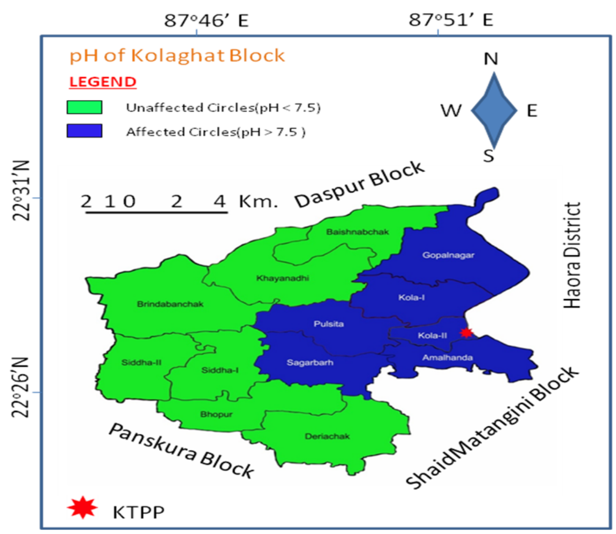

Fig. 6: GIS map of soil pH around Kolaghat thermal power plant.

Sagarbarh (9.9%) and Pulsita (9.2%) are in the position of direction of monsoon wind in India. Rest circles like Baishnabchak, Khyanadi, Siddha-I, Siddha-II, Bhogpur, Deriachak are having the reduced soil reaction (pH<7) than the previous ones due to the use of acidic fertilizers available in market for intensive cultivation. Brindabanchak is showing little increase (2.6%) in soil pH owing to less usage of acidic fertilizer and regular use of soil amendment. The trends are showing the upward direction that suggests the positive impact of the fly ash on soil reaction in the nearer circles (<4 km) like Kola-I, Kola-II, Gopalnagar, Amulhanda, Pulsita, Sagarbarh (Fig. 4).

Statistical significance of impact of fly ash on soil pH: Difference between the pH for the year 2015 and 2011 has been considered for *t* distribution at 5% level of significance of the alternative hypothesis, i.e., pH increases with the accumulation of fly ash (pH>7) over the passage of time. The estimated *t* value exceeds in the all circles within the radius of 4 km from the thermal power plant (7.82 to 4.09). It is significant for the alternative hypothesis which suggests that the fly ash affects the soil pH of the adjacent area within 4 km from the KTPP. The *t* values decrease with rise in distance from the power plant and significance is ob-

Table 4: Rate of soil pH change over year, distance and capacity of power plant:

Radius from power plant	Average pH of the circumference 2011	2013	2015	$pH_{2013}-pH_{2011}$	$pH_{2015}-pH_{2013}$	Average rate of change per year = (Col.3 +Col.4)/(2015-2011)	Average rate of change per Megawatt per year (Col.5 /1260)	Average rate of change per km per MW per year within affected area (Col. 6 /Col.1)
1km	7.03	7.1	7.15	0.07	0.05	0.03	2.381×10^{-5}	2.381×10^{-5}
2km	7.16	7.22	7.28	0.06	0.06	0.03	2.381×10^{-5}	1.19048×10^{-5}
3km	7.18	7.27	7.36	0.09	0.09	0.045	3.5714×10^{-5}	1.19048×10^{-5}
4km	7.28	7.36	7.38	0.08	0.02	0.025	1.9841×10^{-5}	0.496032×10^{-5}
5km	7.05	7.07	7.1	0.02	0.03	0.0125	0.99206×10^{-5}	0.198413×10^{-5}
						Average of 6^{th} column		1.09127×10^{-5}
6km	6.74	6.63	6.39	-0.11	-0.24	-0.0875	Not affected	-
7km	6.08	5.97	5.95	-0.11	-0.02	-0.0325	Not affected	-
8km	6.15	6.03	6.08	-0.12	0.05	-0.0175	Not affected	-
9km	6.07	6.12	6.04	0.05	-0.08	-0.0075	Not affected	-
10km	6.05	5.98	6.03	-0.07	0.05	-0.005	Not affected	-
11km	6.24	6.21	6.14	-0.03	-0.07	-0.025	Not affected	-
11km	6.04	6.09	6.03	0.05	-0.06	-0.0025	Not affected	-
12km	6.56	6.42	6.4	-0.14	-0.02	-0.04	Not affected	-

served within the affected areas, namely Kola-I, Kola-II, Gopalnagar, Pulsita, Sagarbarh, Amalhanda. The rest circles reflect the acceptance of null hypothesis that is no impact of fly ash on the soil pH (Table 3).

Assessment and prediction of soil reaction: To estimate the change in soil pH, five undisturbed soil samples at every circumference starting from 1 to 12 km radius have been observed from 2011 to 2015. In the present capacity (1260 MW) of Kolaghat thermal power plant, the rate of soil pH increase by every year is different in the points ranging from 0.0125 to 0.045. The pH change is also observed greater in the radius within 4 km from the power plant. Electricity producing capacity of the power plant has been brought into account and calculated the rate of change per MW per year. Negative change in soil reaction suggests that no impact of alkaline fly ash on soil pH (Table 4). The average rate of change in pH is 1.09127×10^{-5} per km per MW per year.

The pH can be roughly estimated to predict the possible change of pH of the soils of affected area around the coal-burned thermal power plant by the tentative equation assuming that soil pH_{n+r} reaches up to pH of fly ash coming out from the power plant if cultural practices remain same or soil is not disturbed. This is as follows:

$$\text{Soil pH}_{n+r} = \text{soil pH}_{n} + 1.09127 \times 10^{-5} \times r \times (d_m - d_i) \times c \quad ...(1)$$

Here ‘n’ indicates year and ‘r’ represents the addition of year; d_m denotes maximum distance of affected area and d_i, distance within affected area in km. ‘c’ indicates capacity of thermal power plant in megawatt (MW).

Soil reaction management for agricultural sustainability: This is required for agricultural sustainability in the affected area of coal-fired thermal power plant. Gypsum requirement is estimated for alkaline soil having pH more than 7.5. The mean pH of every circle is calculated and on the basis of it, gypsum requirement is found out (Table 5). After neutralization with applied gypsum, every year near about 1-2 ton of gypsum per hectare must be applied to abate the effect of fly ash on soil pH. Lime requirement is estimated for soil of acidic nature. This is due to cultivation with acidic inputs. Rate of change in pH is being considered for estimating $CaCO_3$ circle-wise for every year after maintaining soil pH between 6.5 and 7.5 which is ideal for cultivation (Table 6).

GIS model for soil reaction evaluation and management: GIS technology has been deployed to strategically manage soil pH and produce sustainable recommendation for crop-friendly soil reaction. The evaluated information has been incorporated in developed model and operation of database management system generates query based output (Fig. 5). To estimate the temporal and spatial soil pH geocoordinating the attributes of soil pH with base map has been done through the logical raster calculation, Soil pH_{n+r} = soil $pH_n + 1.09127 \times 10^{-5} \times r \times (d_m - d_i) \times c$, for pictorial outputs. GIS Model has been used as a process that transforms and

Table 5: Requirement of gypsum.

GP names	Soil pH $_{2011}$	Amount of gypsum applied initially (t/ha)	Amount of gypsum added every year to reduce fly ash effect (t/ha)	Changed Soil pH $_{2012}$	Changed Soil pH $_{2013}$	Changed SoilpH $_{2015}$
Kola-I (control)	6.80	control	control	7.01	7.30	7.57
Kola-I	6.80	Not needed	1.0	6.91	6.98	6.95
Kola-II	7.16	Not needed	1. 2	6.90	6.94	7.01
Gopalnagar	7.28	Not needed	1.5	7.06	7.02	7.0 9
Pulsita	7.05	Not needed	1.4	6.91	7.92	6.89
Sagarbarh	7.16	Not needed	1.5	6.96	6.90	6.89
Amulhanda	7.18	Not needed	2.0	7.01	6.96	7.00

Table 6: Requirement of $CaCO_3$.

GP names	Soil pH_{2011}	Amount of $CaCO_3$ applied initially (t/ ha)	Amount of $CaCO_3$ added every year to reduce cultural effect (t/ha)	Changed Soil pH_{2012}	Changed Soil pH_{2013}	Changed Soil pH_{2015}
Baishnabchak (control)	6.74	Control	Control	6.70	6.63	6.39
Baishnabchak	6.74	Not needed	2.0	6.71	6.72	6.75
Khayanadhi	6.08	4.2	2.8	6.53	6.55	6.58
Deriachak	6.05	4.0	3.0	6.60	6.54	6.57
Bhogpur	6.06	4.5	2.5	6.58	6.61	6.60
Siddha-I	6.15	4.2	2.5	6.65	6.62	6.59
Siddha-II	6.08	4.1	2.0	6.54	6.52	6.55
Brindabanchak	6.22	4.3	1.8	6.71	6.70	6.73

combines geographical data and value judgments of criteria that are CEC (x_{ik}), initial ESP (x_{il}) and desirable ESP (x_{im}), pH (x_{ij}) of soil-SMP buffer suspension to obtain information for calculation of lime or gypsum. The functional logic for estimation of lime requirement (y_i), is $y_{1i} = f(x_{ij})$, where i stands for circle position; j, for pH of soil-buffer suspension of i^{th} circle. The equation is $y_{1i} = 3 + (6.7 - x_{ij}) \times 10$ ton per hectare. On the other hand, gypsum requirement (y_{2i}) has been determined through the logical unit of GIS by using mathematical expression, $y_{2i} = f(x_{ik,}\ x_{il,}\ x_{im})$, where i stands for circle position; k, for CEC of i^{th} circle; l, for initial ESP of i^{th} circle; m, for desirable ESP of i^{th} circle. The equation is $y_{2i} = 0.021 \times X_{ik}\ (x_{il} - x_{im})$ ton per hectare. These outputs are presented in pictorial forms (Burrough 1986, Kapetsky & Travaglia 1995). The GIS maps of soil pH have been developed for different times and spaces (Fig. 6) along with the recommendation that suggests the crop adaptation and availability of nutrients.

CONCLUSIONS

Fly ash of Kolaghat thermal power plant alters the soil reaction which hinders the agricultural sustainability of the affected areas. Faulty adaptation and wrong practices are subject to rectify for better production through improvement of soil reaction. Depletion in crop acreage is to be reduced. It encourages the soil reaction management to enhance the yield of crops. Impact of fly ash on soil reaction has been evaluated and its management suggests necessary measures to adopt suitable crops and their practices. Temporal and spatial soil pH has been evaluated and GIS model helps to recommend lime or gypsum for improvement of soil reaction which is an indicator of crop adoption and their nutrient availability. To transfer any technology or rendering any service related to soil reaction it integrates with them for agricultural sustainability.

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