Impact of Brick Kiln Emission on Wild Vegetation growing around Brick Kiln Industry

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Abstract

The present study investigated the impact of brick killn emission on wild vegetation with the help of quadrat method. Overall 43 wild plant species were studied around the brick kiln area (ie at 100 m, 300m and 500m distance from brick kiln industry) and from control locality. Out of 43 studied plant species, 34 species were reported from 100 m, 33 species from 300 m, 36 species from 500 m and 37 species from control locality. 28 plant species were common and reported from all the localities (ie from 100 m, 300m and 500 m distance from brick kiln and from control locality) and 6 species were reported only from control locality. No specific species were reported from 300 m and 500 m localities & 6 species were not reported from control locality. The frequency distribution was also studied at all the localities. The frequency class equations at 100 m, 300 m and 500 m distance from brick kiln industry did not follow the Raunkiaer's law of frequency distribution. These localities represent heterogeneous wild vegetation. The frequency class equation at control locality follow the Raunkiaer's law of frequency distribution. This locality represents homogeneous wild vegetation.

Keywords: Brick Kiln Emissions, Vegetation, Frequency Distribution

Introduction

Brick kiln is a small scale industry mostly situated in rural and periurban areas. This industry provides one of the important basic requirements for construction of buildings (Le and Oanh, 2010). Asia produces about 1300 billion bricks per annum which is 86.67% of the world's brick production (Dakhina Mitra, 2017). China is the largest brick producing country in the world which is followed by India (Skinder et al, 2014; Basu et al. 2016; Maheshwari and Jain,2017).

India has more than 1,40,000 brick kilns throughout the country. The annual production of brick in India is about 200 billion which employed about 10 million workers (Sarita Rupam, 2017). In India , this sector is largely unorganised and operates on a seasonal basis from October to June because moulding and drying are done in the open space (Maithel, 2013).

Coal is most widely used fuel in the brick killn industry. Besides coal , the industry also consumes fuel wood , saw dust, rice husk, baggasse, used rubber, tires, plastic, waste oil etc. (D Monte, 2017; Rob Jordon, 2017). The coal used in majority of brick kilns include Assam coal, Slack Coal and/or lignite which contain high percentage sulphur and ash (25-30%) (Bhanarkar et al, 2002)

The manufacturing activities of brick kilns lead to environmental degradation (Asghar S, 2002; Mazumdar et al. 2018). The brick kilns emitted significant quantities of gaseous and particulate pollutants. The brick kiln operations which starts from digging of the earth and run up to the unloading of fired bricks, make the area dusty. In brick kilns, the pollutants are released through both stack emission and fugitive emission (Gao T et al. 2014; Kulkarni NG and Rao AB, 2016; Narain S and A. Roychowdhury, 2016). The amount of dust that evolved from non-chimney sources in brick kiln is very high. This dust creates highly dusty conditions in and around the brick kiln area. (Mazumdar and Debnath, 2016). The emission from brick kiln is largely depends on the quality of fuel being used and the type of kiln. Due to lack of modern technology and inefficient burning of fuel, the traditional brick kilns emitted alot of pollutants during the brick production. The main pollutants release from brick kiln include CO_2, CO, NO_x, SO_2 ,

particulate matter (PM) including black carbon and number of other additional compounds. (Joshi and Dudani, 2008; Skinder et al. 2014; Khalid and Masab, 2015)

Rich biodiversity of plant is good indicator of health, related to a particular habitat and its potential of sustain life. The pollutants released from the brick kiln have adverse impacts on biodiversity of surrounding vegetation in the area (Turner et al. 2005; Gupta and Narayan, 2010; Fatima, 2011) so it is essential to study the impact of brick kiln emission on wild vegetation growing around brick kiln industry.

Objective of the Study

The objective of the study is to examine the impact of brick kiln emission on wild vegetation growing around brick kiln industry.

Review of Literature

N. Subramanian (2019) studied the effect of brick kiln on the environment. He considered bricks as traditional building materials. He found that the industry consumes more than 35 millions tons coal per year. He classified brick kilns into intermittent kilns and continous kilns. Similar study was also carried out by Dakhina Mitra (2017). Skinder et al. (2014) reviwed the impact brick kiln emission on the environment. They concluded that air pollutants released from the brick kiln in the rural areas as a real problem to the vegetation and human health. Skinder et al. (2014) described that brick kiln emission is one of the main cause of environmental degradation. This is because of the emission of sufficient quantities of particulates and gaseous pollutants. Such kind of study was also worked out by some workers like Bhanarkar A.D. et al. (2002), Le H.A. Oanh N.T. (2010); De-Sarker D, Kundu S (1996).

Salih Mutlu et al. (2009) studied the effect of cement dust on the diversity of plants growing around a cement factory. They identified 36 plant species at a distance of 2000meter from the cement factory. Out of 36 plant species only 12 species were reported up to 100m around the cement factory. On the basis of this study , they concluded that 24 plant species are sensitive to dust released through cement factory. Shafiq, M. And Iqbal, M.Z. (1987) studied the plant sociology around the stone quarries and processing plants of Karachi and Thatta districts. They observed the reduction in the number of plant species around cement factories.

Gupta and Narayan (2010) studied the long term impacts of brick kiln industry on biomass and diversity structure of plant communities. They recoded 72 angiospermic plant species distributed in 25 families across different sites and seasons. They found highest number of species in rainy season and lowest in summer. Both these workers concluded that long term activity of brick kiln industry affect the characteristic of soil, plant biomass and diversity of plant communities.

Achakzai et al. (2017) used Air Pollution Tolerance Index (APTI) to screen out tolerant and sensitive plant species in the vicinity of brick kiln. They studied nine plant species, out of them, *Calotropis procera* and *Alternanthera pungens* were most tolerant while *Malva neglecta* was most sensitive. They suggested that the tolerant plant species could be grown in the brick kiln area.

Danjuma et al. (2014) studied frequency class distribution of vegetation in the dryland of north western Nigeria by using quadrat sampling. They suggest that the human activities and climate affects the vegetation.

Mahajan and Fatima (2017) studied frequency, abundance and density of plant species in the campus of Fergussan College, Pune by list count quadrat method. They recorded 40 plant species in the campus and concluded that the type of vegetation was heterogeneous.

Material and Methods

The present study was carried out around brick kiln area at Gosaiganj , Dist.-Sultanpur (U.P.) . It is located at 26:26 latitude and 82.07 longitudes and is situated at elevation of 104 meter above sea level. The control locality was the campus of Rana Pratap P.G. College located at Dist - Sultanpur (U.P.).

The vegetation analysis was conducted during December 2020 to January 2021 with the help of quadrat method. The size of quadrate used during study was 1mx1m. In all 10 quadrat were laid randomly at each locality ie. 100m, 300m, 500m, and control site. The name and number of plant species in each quadrat were noted in the field note book.

The frequency represents the chance of finding a species at a particular area in a particular trial sample. The frequency is expressed as a percentage and calculated as follows –

$$\% \text{ Frequency} = \frac{\text{Number of Sampling units in which species occurred}}{\text{Total number of sampling units studied}} \text{x100}$$

After determining the percentage frequency of each species, different species were distributed among Raunkiaer's (1934) five frequency classes – A,B,C,D and E depending upon their frequency. Raunkiaer's proposed following law of frequency –

$$A>B>C \underset{<}{\overset{>}{-}} D<E$$

He also proposed a normal frequency diagram in which percent values of different frequency classes were A=53, B=14, C=9, D=8 and E=16. The frequency diagrams were recorded for each locality and compared with normal frequency diagram.

The percentage frequency of each class was calculated by-

$$\%\text{Frequency}= \frac{\text{Number of species falling in frequency class}}{\text{Total number of species recorded}} \text{x100}$$

Results and Discussion

Overall 43 wild plants species were studied around the brick kiln areas and also from control locality. These plants species were *Tridex daisy, Solanum xanthocarpum, Croton bonplandianum, Solanum nigrum, Euphorbia hirta, Achyranthes aspera, Ageratum conyzoides, Parthenium* *hysterophorus, Xanthium strumarium, Oxalis corniculata, Amaranthus viridis, Rungia pectinata, Sida acuta, Spilanthes paniculata, Sonchus brachytus, Argemone mexicana, Vernonia cinerea, Molvastrum trrcuspidatum, Eclipta prostrata, Lysimachia arvensis, Caesulia axillaris, Alternanthera sessilis, Peristrophe paniculata, Hyptis suaveolens, Solanum incanum, Nepeta hindostana, Anisomeles indica, Leucas aspera , Melilotus indicus, Datura stramonium, Cannabis sativa, Euphorbia thymifolia, Launaea asplinefolia, Acalypha indica, Phyllanthus niruri, Dichanthium annulatum, Cynodon dactylon, Muhlenbergia capilaris, Bothriochloa pertusa, Setaria viridis, Elusine indica, Oplismenus burmanii* and *Paspalidium flevidum*.

Out of 43 species 34 species were reported from 100m, 33 species from 300m , 36 species from 500m and 37 species from control locality, (Table-1). 28 species were common and reported from all the localities (ie from 100m, 300m and 500m distance from brick kiln and from control locality). Six species reported only from control locality ie. *Datura stramonium, Cannabis sativa, Euphorbia thymifolia, Launaea asplinefolia, Acalypha indica* and *Phyllanthus niruri*. These species can be considered as sensitive because they were not reported from brick kiln area. Six species ie. *Solanum xanthocarpum, Xanthium strumarium, Rungia pectinata, Nepeta hindostana, Anisomeles indica* and *Solanum incanum,* were reported only from brick kiln areas (ie not reported from control locality). These species can be considered as tolerant at brick kiln areas.

Table 1 – Distribution of Plant Species around Brick Kiln Industry

S.No.	Name of Species	100m	300m	500m	control
1	*Tridex daisy*	✓	✓	✓	✓
2	*Solanum xanthocarpum*	✓	✓	✓	×
3	*Croton bonplandianum*	✓	✓	✓	✓
4	*Solanum nigrum*	✓	✓	✓	✓
5	*Euphorbia hirta*	✓	✓	✓	✓
6	*Achyranthes aspera*	✓	✓	✓	✓
7	*Ageratum conyzoides*	✓	✓	✓	✓
8	*Parthenium hysterophorus*	✓	✓	✓	✓
9	*Xanthium strumarium*	✓	✓	✓	×
10	*Oxalis corniculata*	✓	✓	✓	✓
11	*Amaranthus viridis*	✓	✓	✓	✓
12	*Dichanthium annulatum*	✓	✓	✓	✓
13	*Rungia pectinata*	✓	✓	✓	×
14	*Sida acuta*	✓	✓	✓	✓
15	*Spilanthes paniculata*	✓	✓	✓	✓
16	*Sonchus brachytus*	✓	✓	✓	✓
17	*Argemone mexicana*	✓	✓	✓	✓
18	*Vernonia cinerea*	✓	✓	✓	✓
19	*Molvastrum trrcuspidatum*	✓	✓	✓	✓
20	*Eclipta prostrata*	✓	✓	✓	✓
21	*Lysimachia arvensis*	✓	✓	✓	✓
22	*Cynodon dactylon*	✓	✓	✓	✓
23	*Muhlenbergia capilaris*	✓	✓	✓	✓
24	*Bothriochloa pertusa*	✓	✓	✓	✓
25	*Setaria viridis*	✓	✓	✓	✓
26	*Elusine indica*	✓	✓	✓	✓
27	*Caesulia axillaris*	✓	✓	✓	✓
28	*Alternanthera sessilis*	✓	✓	✓	✓
29	*Peristrophe paniculata*	✓	✓	✓	✓
30	*Oplismenus burmanii*	✓	✓	✓	✓
31	*Hyptis suaveolens*	✓	✓	✓	✓
32	*Solanum incanum*	✓	×	×	×
33	*Nepeta hindostana*	✓	✓	✓	×
34	*Anisomeles indica*	✓	✓	✓	×
35	*Leucas aspera*	×	×	✓	✓
36	*Melilotus indicus*	×	×	✓	✓
37	*Paspalidium flevidum*	×	×	✓	✓
38	*Datura stramonium*	×	×	×	✓
39	*Cannabis sativa*	×	×	×	✓
40	*Euphorbia thymifolia*	×	×	×	✓

41	*Launaea asplinefolia*	×	×	×	✓
42	*Acalypha indica*	×	×	×	✓
43	*Phyllanthus niruri*	×	×	×	✓

The frequency diagram (ie distribution of species in Raunkiaer's five frequency classes – A,B,C,D and E) at 100m, 300m, 500m and control locality were – (Table2)

Table 2- The Frequency Class Value at 100 m, 300m, 500m and Control Locality along with Raunkiaer's Normal Frequency Class Value

Frequency Classes	Class Value	Raunkiaer's Value	Frequency Class of Vegetation			
			100m	**300m**	**500m**	**Control**
A	0-20	53%	26.47%	18.18%	55.55%	54.05%
B	21-40	14%	67.64%	78.78%	41.66%	16.21%
C	41-60	9%	5.88%	3.03%	2.77%	5.40%
D	61-80	8%	0.0%	0.0%	0.0%	10.80%
E	81-100	16%	0.0%	0.0%	0.0%	13.51%

At 100 mm distance from brick kiln industry, the frequency class A constitutes 9 species (26.47%), Class B constitutes 23 species (67.64%) and class C constitutes 2 species (5.88%). No Species was reported from class D and class E . The frequency class equation was A<B>C>D=E. (Fig1)

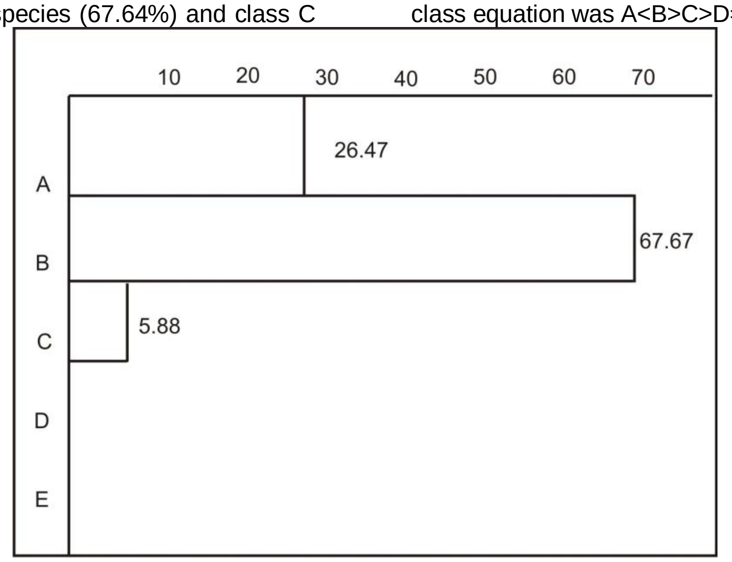

Fig 1 - Frequency Class Diagram at 100m

At 300 m distance from brick kiln industry the frequency class A constitute 6 species (18.18%), class B constitute 26 species (78.78%) and class C constitute only one species (3.03%). No species was reported from class D and class E. The frequency class equation was A<B>C>D=E (fig2)

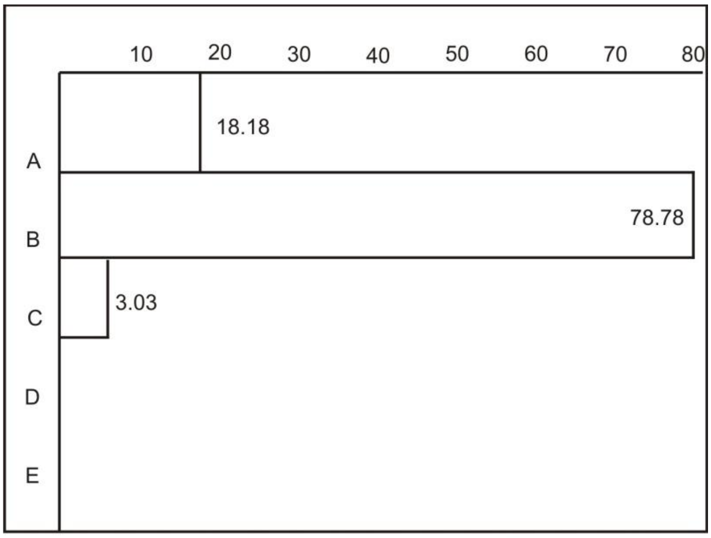

Fig 2 - Frequency Class Diagram at 300m

At 500 m distance from brick kiln industry, the frequency class A constitute 20 species (55.55%), class B constitute 15 species (41.66%) and class C constitute only one species (2.77%). No species was reported from class D and class E. The frequency class equation was A>B>C>D=E (fig3)

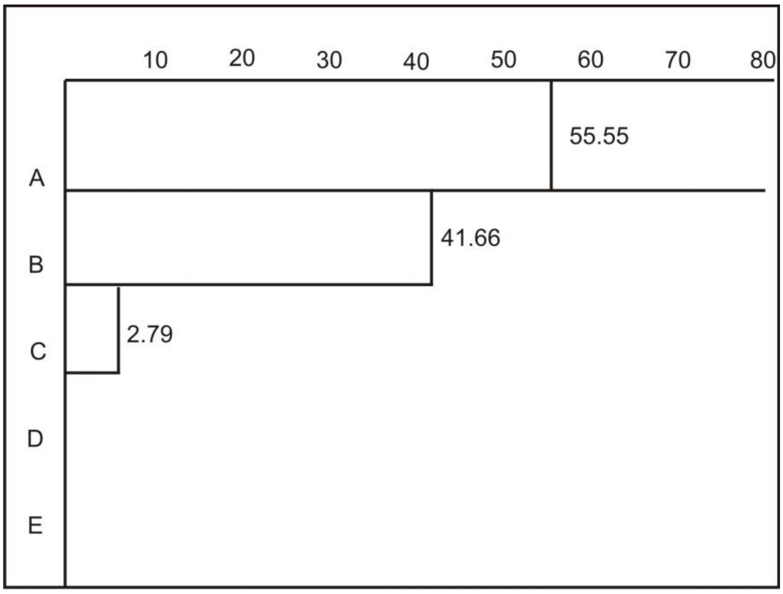

Fig 3 - Frequency Class Diagram at 500m

At control locality, the frequency class A constitute 20 species (54.05%), class B constitute 6 species (16.21%), class C constitute 2 species (5.40%), class D constitute 4 species (10.80%) and class E constitute 5species (13.51%). The frequency class equation was A>B>C<D<E (fig4)

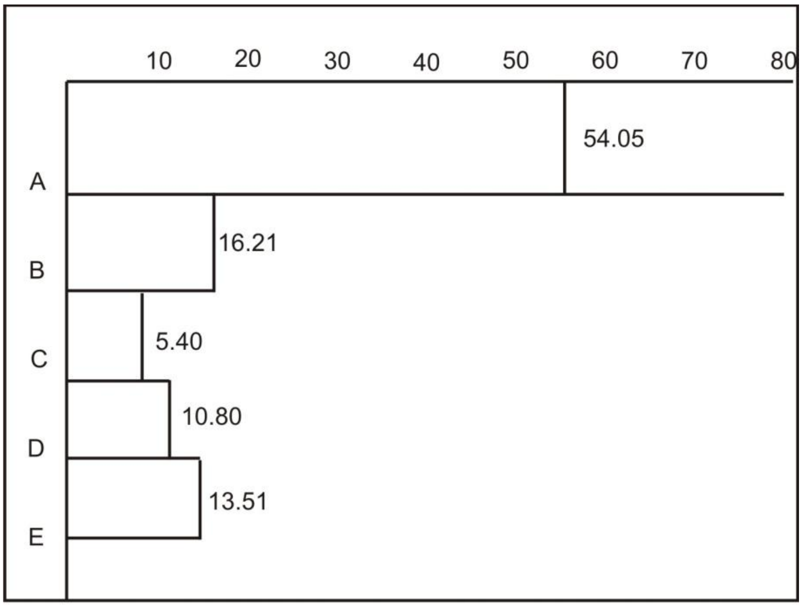

Fig 4 - Frequency Class Diagram at Control Locality

The frequency class equations around brick kiln area (ie 100m, 300m, and 500m distance from brick kiln) did not follow the Raunkiaer's law of normal frequency distribution (ie A>B>C $\geq\!\!=\!\!\leq$ D<E). The frequency class equation for control locality follow the Raunkiaer's law of normal frequency. Thus the present ecological study suggests that the area around the brick kiln were heterogeneous in nature while the control locality was homogeneous in nature.

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