# Introduction

Brick making is a traditional industry in India, generally confined to rural and peri-urban areas. Indian brick industry with more than one lakh production units producing about 140 billion bricks annually is the second largest brick producer in the world after China (Maithal *et al.,* 2003). Brick is the most important building material in the urban areas and has also become useful building material in the rural areas. In future, bricks will be required in large numbers to meet the ever-increasing demand for the construction of dwelling units for the people.

The brick producing regions in India are categorized into two major zones based on the nature of soil e.g. (i) Indo-Gangetic plains and (ii) Peninsular and coastal India. Indo-Gangetic plains, the north and northeast part of India caters about 65% of the total brick production. Good quality alluvial soil is available for brick making in this region. Peninsular and coastal India, consisting of the west, central and southern parts of India accounts for the rest 35% of the total production. This region has shortage of good quality soil for brick making (Maithal *et al.,* 2003).

Bricks have been manufactured for thousands of years in India and brick manufacturing follows the basic steps of centuries past. Brick making is one of the traditional crafts in North (Uttar) and South (Dakshin) Dinajpur Districts (erstwhile West Dinajpur) in West Bengal, India. This is evident from antique bricks of various shapes and sizes found after excavation at Bangarh, and different parts of West Dinajpur (Goswami, 1948). These fine bricks used as wall material have not shown any distinct sign of aging even after more than 2500 years. Bricks are still the preferred materials for temporary and permanent construction for private housing and public buildings.

The district of West Dinajpur came into existence in August 1947, with the partition of Bengal during Indian independence. The economy of this district is based on agriculture. The district lies between $25^0$–10'-55" and $26^0$–35'-15" North Latitudes and $87^0$-48'-57" and $89^0$-0'-30" East Longitudes. It is

situated 15 metre above the sea level. The geographical area of the district is 5340.2 sq. km. The district West Dinajpur has been divided into North (Uttar) Dinajpur and South (Dakshin) Dinajpur on 1st April 1991 with a population of 24,41,794 and 15,03,178 respectively as per 2001 census. The administrative headquarters of the North (Uttar) Dinajpur is Raiganj, while the counterpart of South (Dakhin) Dinajpur is Balurghat. The soil of North (Uttar) and South (Dakshin) Dinajpur districts is alluvial type, a characteristic of Indo-Gangetic plain. It is highly fertile and has great value for agriculture. The main crops are rice, wheat, pulses, jute and oil seeds. There are very few industries in this district and so industrial pollution is negligible here. There is uprise in brick production in the two districts in close proximity of agricultural lands (Figs. 1 and 2). At present there are 94 brick kilns operating in North (Uttar) and South (Dakshin) Dinjapur districts. In 1993-94 total number of brick kilns was 42 and it increased to 94 in 2006-07 (Table 1).

**Table 1.** Shows the number of brick kilns in South (Dakshin) and North (Uttar) Dinajpur districts operating since 1993-94

| Year | Total number of Brick kiln in South (Dakshin) Dinajpur | Total number of Brick kiln in North (Uttar) Dinapur | Total number of Brick kiln in two district |
|---|---|---|---|
| 1993-94 | 20 | 22 | 42 |
| 1994-95 | 20 | 22 | 42 |
| 1995-96 | 20 | 24 | 44 |
| 1996-97 | 25 | 26 | 51 |
| 1997-98 | 26 | 32 | 58 |
| 1998-99 | 26 | 32 | 58 |
| 1999-2000 | 40 | 38 | 78 |
| 2000-01 | 40 | 38 | 78 |
| 2001-02 | 40 | 41 | 81 |
| 2002-03 | 48 | 42 | 90 |
| 2003-04 | 49 | 42 | 91 |
| 2004-05 | 49 | 42 | 91 |
| 2005-06 | 49 | 41 | 90 |
| 2006-07 | 50 | 44 | 94 |

The kilns use soil from agricultural lands. The fertile topsoil is dug out for making the clay, which is the first step of brick making. The underground fire in the kilns reduces the moisture of the surrounding soil. Unplanned excavation of the topsoil has significantly interfered with the natural drainage pattern of the area.

Brick manufacturing is an energy-intensive activity. Bull's trench kilns (BTKs) which are energy inefficient are mainly used for brick production in India. About twenty-four million tones of coal and several million tones of biomass fuels are utilized for the brick manufacturing. In the brick industry coal consumption is approximately 8% of the total coal consumption in the country (Maithal *et. al.,* 2003). The quality of coal used in the kiln varies in calorie values, ash content, volatiles, sulpher content and fixed carbon. Brick kilns are causing air pollution by emanating suspended particulate matter (SPM), sulphur dioxide, nitrogen oxides and carbon monoxide. The particulate matters are mainly due to very small-unburnt coal particles and it varies depending on the quality of coal, feeding practices, duration of coal charging and idle feeding time. It is a common experience that thick black smoke can be seen emanating from the chimneys in a brick field (Fig. 3) Sulphur dioxide is released due to sulphur content of the coal and carbon monoxide arises out of its initial combustion (Jain and Sing, 2000). Gomes and Hossain (2003) mentioned that the severe pollution level could be readily discernible from the thick black smoke emanating from the chimneys and the dismal state of the vegetation in the vicinity of the kilns.

The amount of organic matter is an index of the productivity of the soil, since it is the storehouse of all the essential elements for plant growth and development. It is also a source of cation exchange capacity besides promoting desirable physical and chemical properties of soil. Soil surrounding the brick kilns interact with the fly ash and thereby changes the percentage of organic matter. How far such change occurs is a subject of great importance.

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Measurement of soil pH provides a simple and reliable test to have a first hand glimpse on the nature of the soil. Any ecological change of the soil is reflected in the soil pH. Change in the soil pH brings several plant nutrients either available or unavailable depending on the change of the pH. Absorption of pollutants by the soil is first reflected in the change of the soil pH. It may be mentioned that smoke and fumes from industrial plants, especially those containing sulphur dioxide frequently lower the pH of soils in the vicinity of the industry (Daubenmire, 1959). It is also to be noted that soil acts as a buffer. Determination of soil pH in the surrounding soil of the brick kilns may give some idea about the extent of pollution on the soils surrounding the brick kilns. The fly ash, which is coming out from the brick kiln chimneys year after year, falls on surrounding field, which may be agriculturally active or inactive. The quantitative assessment of the phosphorous in the soil will throw light on the changes in the soil ecosystem, surrounding the brick kilns. Precipitation of the fly ash from the brick kilns is likely to add potassium to the soil. There is little information regarding how this added potassium reacts in the soil system. A quantitative estimation of available potassium may throw light on the present status and future use of soil in and around the brick kilns.

Soil surrounding brick kilns receive fly ash and other pollutants due to burning of coal during brick ripening process. After receiving the fly ash it is unknown to us whether these soil are usable for normal agriculture. If, it is so, then how far it can be used. The pollution surrounding the brick kiln is well known but no scientific work has been done on the effect of such soils on the growth of root and shoot after germination of plant seeds.

An occupational health hazard is anything in the work place that has the potential to cause harm to the human body. Air pollution levels near brick kilns pose serious occupational health hazards and adversely affect the surrounding environment (Aslam *et al.,* 1994). Health hazards vary greatly depending on the type of work involved.

The workers of brickfield are denied of minimum health care. These workers are migrant in nature and generally come from different state of India namely, Bihar, Jharkhand, Chattisgarh, Uttar Pradesh and Uttaranchal. They work in a brick kiln for six months i.e. from September to March. The workers often come and stay with their families including children at the working place. The owners of the brick kilns arrange for their temporary shelters. These temporary shelters situated besides the brick kiln away from localities are very much unhygienic and insecure. The workers are not provided with basic amenities like hygienic cooking and bathing place, hygienic lavoratories, safe drinking water and minimum medical facilities (Development Alternatives, 2005).

Apart from these they are also exposed to dust emanating from the kilns not only during their working hours but also during periods of rest. In India very little work has been carried out on the health problems of brick kiln workers.

Thus the main objectives of this study are:

(1) To study the effect of brick kiln emission on vegetation,

(2) To study the effect of brick kiln emission on organic carbon, pH, available phosphorous and available potassium of the soil of the surrounding area of the brickfield.

(3) To study the effect of extract of soil collected from brickfield on the growth of shoot and root, after germination of plant seeds.

(4) To study the health problems of the brick kiln workers.