



Soil Quarrying for Brick Kiln and Its Impact on Environment: A Study in Tufanganj Block-I, Koch Bihar, West Bengal

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ABSTRACT: Civilization began with agriculture. Agriculture has played a key role in the development of human civilization. Agricultural activities fully depend on the fertility of the land. But nowadays, agricultural land is decaying at the faster rate. Agricultural land degradation is one of the world's major socio-economic and environmental problems which has been a major global issue since the late 20th century and has remained important in the 21st century because of its adverse impact on land productivity, on the environment, on food security and quality of life. The Study area is lies between Ghargharia-Kaljani-Raidhak-Sankaosh interfluves. The Geographical area is 320.75 sq km which occupies 14 Gram Panchayats with 73 Mouzas. The study area has a special significance in agricultural activities where 64.2% of area Tufanganj Community Development Block-I has been covered by agricultural land and near about 80% people are engaged in agricultural activities of the area. The soil of Tufanganj is alluvial formation, the productivity and soil fertility is healthy in nature. But nowadays the degradation of agricultural land is rapidly increasing. It covers the various forms of soil degradation including erosion and fertility decline, adverse impact on water resources, lowering the productive capacity of agricultural land. The prime objectives of the study are to find out the causes and consequences of soil/land quarrying of the study area and to find out the relationship between soil quarrying on agricultural land and related environmental concern. The analysis will be done by applying various statistical methods and various cartographic techniques.

Keywords: Soil productivity, Land degradation, Soil Quarrying, Decay of agricultural land, Environmental Concern.

I. INTRODUCTION

Agriculture has played a key role in the development of human civilization [1]. When our nomadic ancestors began to settle and grow their own food, human society was forever changed. Agricultural activities fully depend on the fertility of the land [2]. But nowadays agricultural land is decaying at a faster rate. Soil quarrying causes the temporary or permanent decline in the productive capacity of the land [2]. Soil quarrying causes agricultural land degradation. It is a serious environmental issue [3]. The soil of Tufanganj is alluvial formation, the productivity and fertility soil is healthy in nature. About 64.2% land of Tufanganj Subdivision is covered by agricultural land and about 80% of people are engaged in agricultural activities [5].

II. LOCATION OF THE STUDY AREA

Tufanganj Block-1 has been chosen as the study area which is located in the North Eastern Part of Koch Bihar District. The latitudinal and longitudinal extension of the study area approximately is 26°17'50"N to 26°20'N and 89°33'E to 89°37'30"E respectively. The Study area is lies between Ghargharia-Kaljani-Raidhak-Sankaosh interfluves. The Geographical area is 320.75 sq km which occupies 14 Gram Panchayats with 73 Mouzas. The western, southwestern and eastern boundary of the study area is bounded by Koch Bihar, Dinahata and Tufanganj Block-2 subdivision of the same district respectively, while the northern boundary is bounded

with Jalpaiguri District. In a small stretch in the South-East, its boundary is shared with Bangladesh.

Maradanga Mouza is located along the NH-31 and it is located in between Koch Bihar and Tufanganj. Location of Maradanga mouza is about 26°16'30"N to 26°18'30"N latitude and 89°35'45"E to 89°38'30"E. Longitude.

III. OBJECTIVES OF THE STUDY

The objectives of the study are:

- To find out the causes and consequences of soil/land quarrying of the study area.
- To find out the relationship between soil quarrying on agricultural land and related environmental concern.

IV. MATERIALS AND METHODS

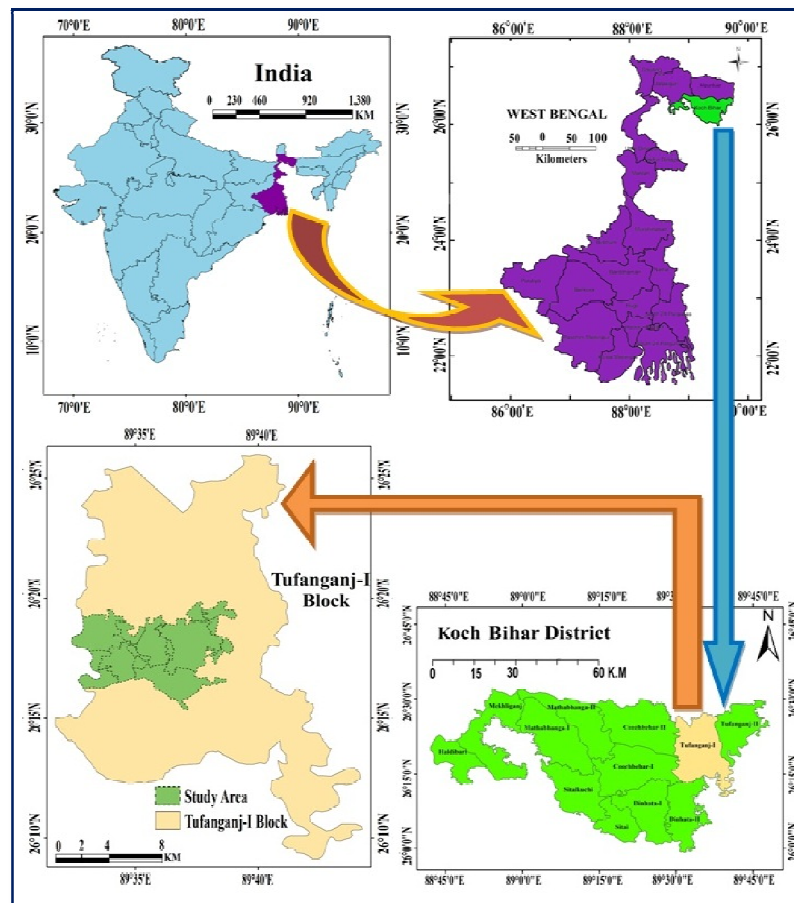
The present study has been conducted with the aim to describe the causes and consequences of soil quarrying in the study area. For this purpose a conceptual framework for describing the possible causes of land degradation. A field survey has also been conducted to explore the effect of soil quarrying on agricultural land, loss of topsoil as well as decrease of production of crops. Further, primary data of various quarrying sites are collected through GPS and processed to establish the above fact. Estimation has been made to assess the loss of topsoil and the degradation of agricultural land.

The Central Building Research Institutes, Roorkee (CBRI) estimates that one single brick consumes 0.002 - 0.003 cubic metre of good quality of soil.

The present author uses this estimation for measuring the loss of topsoil. The author also tried to estimates that about 0.09217 acres or 0.27880 bigha land have been

degraded by 1,00,000 bricks. The analysis will be done by applying various statistical methods and various cartographic techniques.

Map No. 1: Location Map.



V. RESULTS AND DISCUSSION

A. Causes of Land Degradation

1. Soil Quarrying:

(i) **Brick Kiln industry:** Good quality of the soil is required to produce good quality bricks but it is also required for growing various kinds of crops. But, farmers give preference to brick-kilns rather than growing agricultural crops, because brick-kiln owners offer much more money than they can earn from agriculture. Hence, they have forced to lease their agriculture land for four or five years.

(ii) **N.R.E.G.S Project:** By the National Rural Employment Guarantee Scheme agricultural land is excavated for the construction of rural road and pond. This causes degradation of topsoil of agricultural land.

(iii) **Household use:** The most formidable threat to the utilization of land for household use such as the construction of houses. So soils are quarried from agricultural land.

2. Formation of Artificial Levee: Deposition of clay particles in the floodplain area is a natural process. But due to the construction of the man-made levee, the floodplain area does not have any flooding problem. Thus, the floodplain area is becoming unfertile for the levee.

3. Excavation of Pond: Agricultural land is engulfed by the excavation of pond due to various physical and socio-economic causes.

4. Developmental work: Higher population growth, urbanization, unscientific construction of roads, dams, buildings, and other engineering projects adversely affect the agricultural land.

B. Effect of Brick Kiln on Agricultural Land

Good quality soil is required to produce good quality bricks. The manufacturing of bricks is the main cause of topsoil loss and environmental degradation. Bricks are produced continuously during the winter season in the study area. The agricultural land is dug up for the quarrying of soil from a depth of 1 foot to 4 feet. The farmers sell their topsoil to the brick kiln owner via broker or soil suppliers. Farmers give preference to sell their land rather than growing agricultural crops because it helps them to collect quick cash than they can earn from agriculture.

Due to the excessive quarrying of land, the adjacent land remains in high position as compared to the quarried land. It creates a serious problem for the adjacent highland as the water is drained to the lower land. Consequently, during the time of cultivation, the major portion of that irrigated water is drained away towards the lower land. It usually needs much water to the upper land comparative to lower land because of being rapid draining out of the water.

Map No. 2: Location of Brick Kilns in the Study Area.

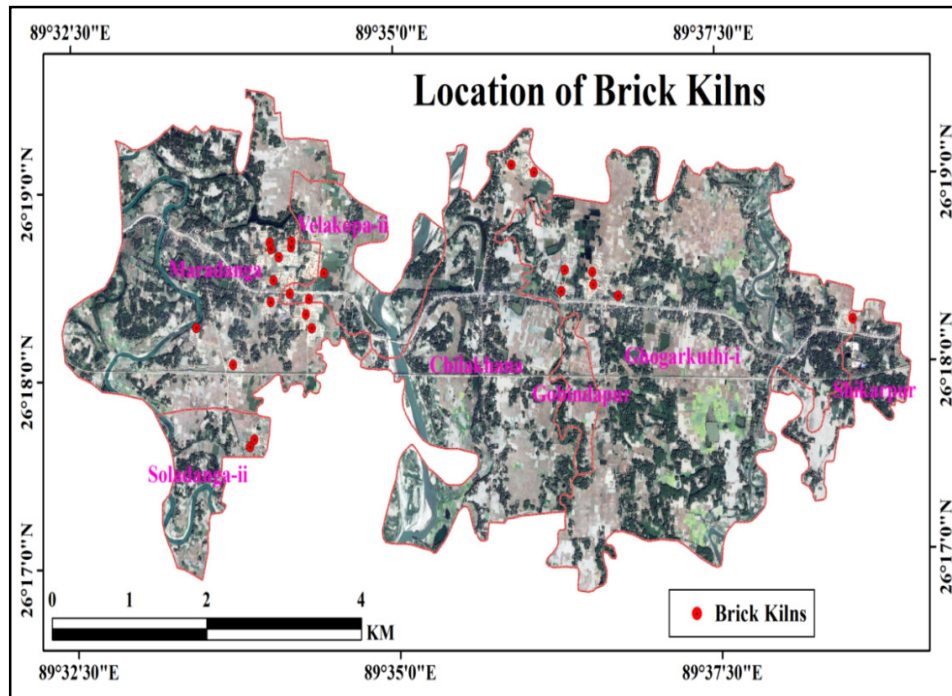


Photo Plate-1 and 2: Land Degradation due to Soil quarrying.



1. Loss of top Soil: In Tufanganj-I block the total area under brick kiln is 361.38 acre where 24 brick kilns are distributed in 6 mouzas (Map No. 2). The Table 1 shows that the maximum area covered by the brick kilns in Maradanga Mouza (229.56 Acre) followed by Ghogarkuthi-I (67.13 acres), Velakopa-II (23.01 acre), Soladanga-II (18.86 acres), Chilakhana (17.17 acre), Shikarpur (3.72 acres). The brick kiln industries collect their new raw materials (good quality soil) from the

nearest agricultural field. From the above calculation in 2015-16, it is clear that 58.6-acre topsoil (with 2 feet depth) were used to produce brick in each season. Thus, the brick industries degrade the topsoil of the agricultural land. The loss of topsoil under various mouzas is as follows: 23.94 acres in Maradanga, 11.92 acres in Ghogarkuthi-I, 11.33 acre in Velakopa-II, and 4.17 acre in Chilakhana, 3.42 acre in Soladanga-II and 1.92 acres in Shikarpur.

Table 1: Details of Land and Land Degradation in Different Mouzas.

Name of the Mouza	Total Area of the mouza (Acre)	Net sown Area (Acre)	Total Area Under Brick Kiln (Acre)	Others Area (Acre)	Area Degraded by Brick Kiln (Acre)	Percentage of degraded of Agricultural land	Actual Area under Kiln(Acre)	Change of Area under Kilns in %
Maradanga	1810.00	1198.46	208.28	381.98	21.46	1.19	233.44	89.22
Soladanga-II	285.53	172.97	18.86	93.70	3.42	1.20	19.78	95.34
Velakopa-II	1108.56	716.60	44.29	368.95	2.91	0.26	56.64	78.20
Ghogarkuthi-I	2757.20	1924.95	67.13	765.12	9.46	0.34	105.98	63.34
Chilakhana	1475.07	1030.43	17.17	425.15	4.14	0.28	50.18	34.22
Shikarpur	290.03	227.58	5.65	58.72	2.05	0.71	16.18	34.92
Total	7726.39	5270.99	361.38	2093.62	43.44	0.56	482.20	74.94

Source: DL and DLRO Office, 2016 and Field Survey, 2015-16.

Map No. 3: Location of Degraded Land and Brick Kiln Industry.

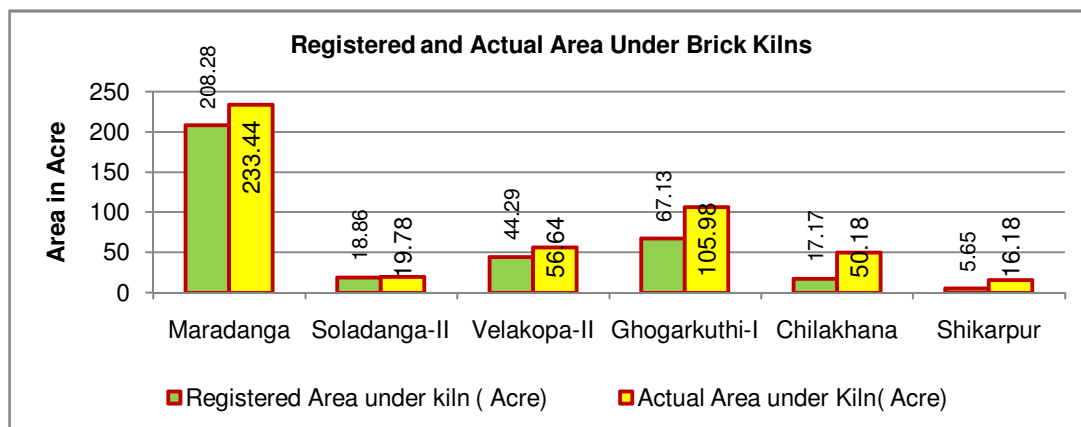
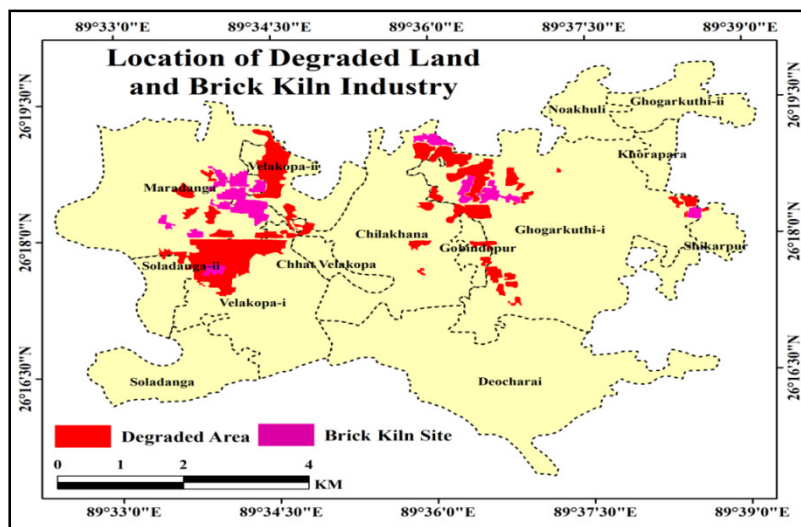


Fig. 1. Registered and Actual Area under Brick Kilns.

Maradanga and Shikarpur mouzas having 1198.46 acres and 290.03-acre net sown area (NSA) in which 21.46 acre and 3.42 acre (with 2 feet depth) are quarried or degraded. 27.78-acre land is being removed in every year in two mouzas. In other Mouzas, topsoil has been degraded in the same way. In Soladanga-II (1.20%), Velakopa-II (1.02%), Ghogarkuthi-I (0.43%) and Chilakhana (0.28%) have also been degraded.

It is evident from Table 1 and Fig. 1 that the total area registered under different kilns in different mouzas of the study area has changed over time. The owners

submitted the documents in the DL & DLRO office, Koch Bihar under brick kilns records lower than the actual land. The actual land found by the researcher has been measured by GPS Oregon eTrex 550. The average rate of change is about 75%. The rate of change is maximum in Soladanga-II mouza (95.34%) followed by Maradanga mouza (89.22%). The minimum change is noticed in the study area in Chilakhana mouza. Table 2 shows that the total area covered by the brick kilns is 359.45 acre and 58.61-acre land has been degraded in different mouzas in the year 2015-16. (Fig. 2 and 3).

The total number of brick kilns is 24 which are located in the above-mentioned 6 mouzas. The total consumption of the topsoil during the session 2015-16 was 117.22 Cubic feet (cft) and they will keep on consuming this amount soil in every year. Fig. 2 shows that the highest

consumption of soil was observed in Maradanga mouza (47.87 cubic feet), followed by Ghogarkuthi-I (23.85 cubic feet), Velakopa-II (22.65 cubic feet), Chilakhana (8.33 cubic feet), and Soladanga consumes 6.84 cubic feet in 2015-16.

Table 2: Annual Loss of Top Soil and Degradation of Land.

Name of the Mouza	No. of Brick Kiln	Total Area Under Brick Kiln (Acre)	Area Degraded by Brick Kiln (Acre)	The annual loss of topsoil (in Cubic feet)
Maradanga	12	208.28	21.46	47.87
Soladanga-II	2	18.86	3.42	6.84
Velakopa-II	2	44.29	2.91	22.65
Ghogarkuthi-I	5	67.13	9.46	23.85
Chilakhana	2	17.17	4.14	8.33
Shikar Pur	1	5.65	2.05	7.68
Total	24	361.38	43.44	117.22

Source: Field Survey, 2015-16.

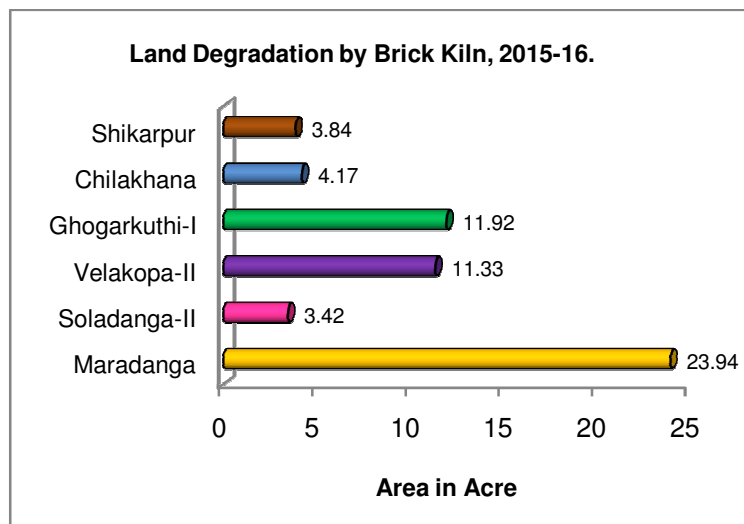


Fig. 2. Land Degradation.

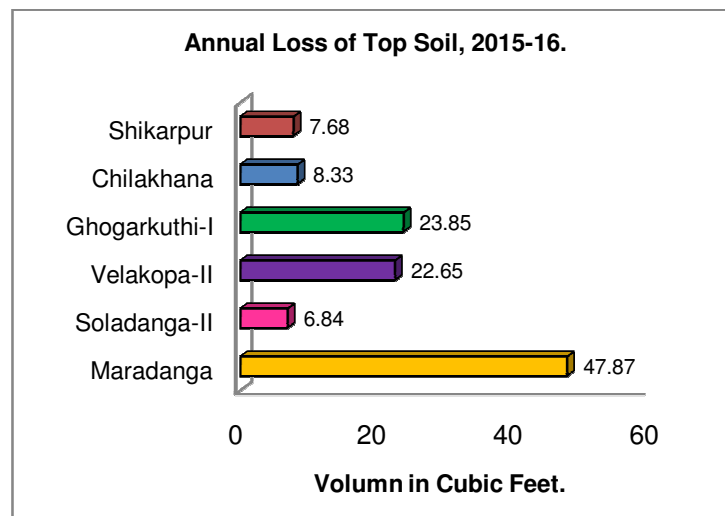


Fig. 3. Annual Loss of Top Soil.

Table 3: Agricultural Land Degradation by Individual Brick Kiln.

S.No.	Name of the Kilns	Total Production (No of Bricks)	Area Degraded by Brick Kiln (Acre) (10 inch x 5 inch x 3 inch) Size of a Brick
1.	SARADA	21,14,344	1.95
2.	VELAKOPA	18,71,550	1.72
3.	NEW MARADANGA	13,81,896	1.27
4.	SURJA(SJBF)	21,16,088	1.95
5.	SONA	21,08,687	1.94
6.	VIVEKANANDA	17,79,971	1.64
7.	GOPINATH	21,83,475	2.01
8.	BENGAL	15,25,689	1.41
9.	NOTH BENGAL I	21,83,475	2.01
10.	NORTH BENGAL II	16,20,378	1.49
11.	INDIA I	18,88,596	1.74
12.	INDIA II	12,67,522	1.17
13.	COOCH BEHAR	21,83,475	2.01
14.	SARAN(HBMC)	15,85,758	1.46
15.	MADAN/ MOHAN I	21,83,475	2.01
16.	MADAN/ MOHAN II	21,83,475	2.01
17.	SAHA I	23,36,229	2.15
18.	SAHA II	21,51,895	1.98
19.	DELUX	20,18,212	1.86
20.	SUMANA I	30,63,983	2.82
21.	SUMANA II	20,77,976	1.92
22.	SUN (JYOTI)	22,20,688	2.05
23.	RRS I	14,03,103	1.29
24.	RRS II	16,84,275	1.55
	Total	471,34,213	43.44

2. The Depth of Quarrying Land: The process of quarrying is gradually spreading more widely. As a result, all the lands are becoming lowered by soil quarrying. Sometimes some of the land owner make lower than the adjacent land. The farmers cut down 1.5 feet while the neighboring land is cutting down by 1 foot.

So the same problem has resulted. In the same way, the depth of quarrying land is deeper from 1 foot to 2 feet, 2 feet to 3 feet, 3 feet to 4 feet and on words. It is very alarming that the quarrying is repeatedly increasing. It is treated as an ulcer or septic wound.

Photo Plate-3: Depth of quarrying of land its impact

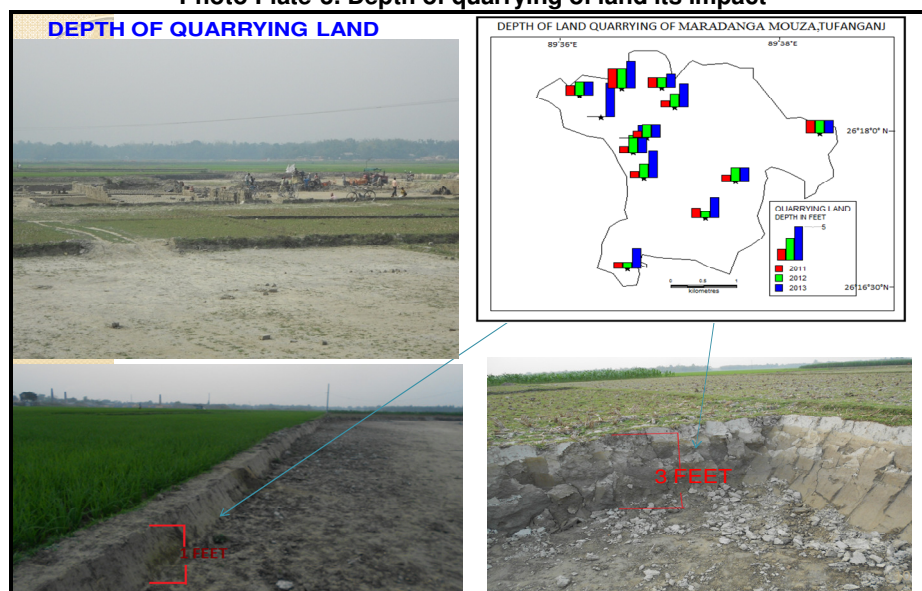
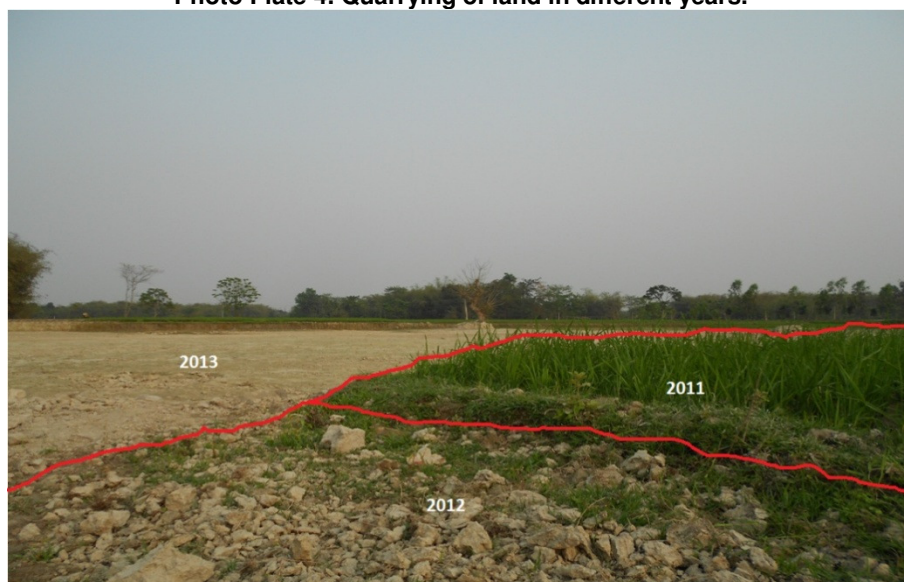


Photo Plate 4: Quarrying of land in different years.



3. Soil becomes unfertile: Agricultural land becomes barren and unfertile due to soil quarrying [4]. These factors changed the fertility status of the soils in the areas where quarrying is going on. The topsoil layers (9-12 inches) have all the tangible nutrient like organic compounds phosphorous, potash and innumerable intangible macro and micronutrients. These are decayed due to soil quarrying. The cultivation on un-quarried land requires a small amount of chemical

fertilizer and productivity is higher whereas in the quarried land the consumption of fertilizers is higher and the productivity is low.

4. The decrease of productivity of crops: The cultivation on un-quarried land requires less fertilizer and productivity is higher whereas, on quarried land, the consumption of fertilizers is higher and the yield of the crop is low.

Table 4: Changing Scenario of Crop Production in Tufanganj Block-1.

Year		Aus	Aman	Boro	Jute	Wheat	Potato	Oil Seed	Total
2010	Area in Hectare	62.7	165.6	46.1	70.5	18	12.8	38.4	414.1
	Production (Ton)	106.1	244	137.1	880.3	18	238.2	17.8	1641.5
2012	Area in Hectare	7.71	190.62	57.77	62.59	9.3	16.36	33.4	377.75
	Production (Ton)	7.9	391.42	163.56	490.08	16.4	316.07	11.44	1396.87
2015	Area in Hectare	21.94	166.92	64.51	46.23	8.91	17.89	11.04	337.44
	Production (Ton)	28.25	232.47	161.09	419.77	21.51	393.64	2.93	1259.66

Source: Field Survey, 2015-16.

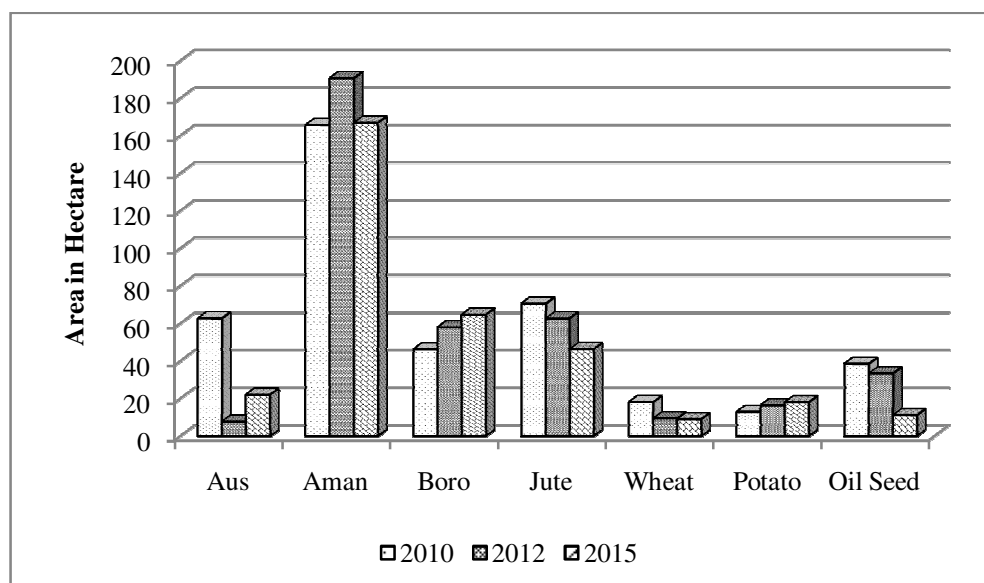


Fig. 4. Changing Scenario of Crop Production in Tufanganj Block-1.

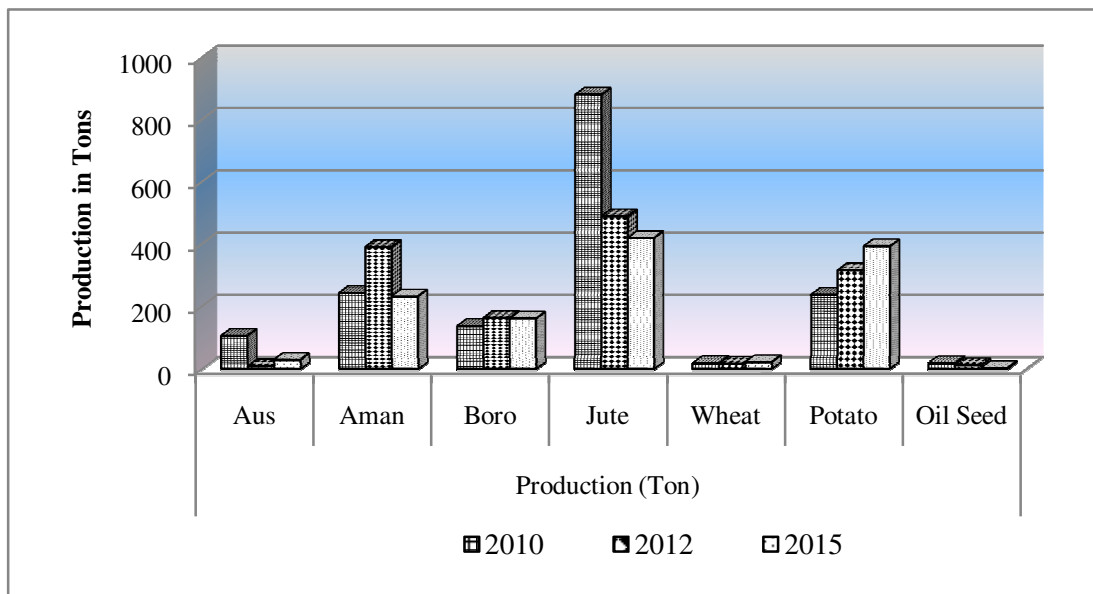


Fig. 5. Production of Crops in Different Years.

Table 5: Yield Rate (Kg/Bigha) among different types of Crops.

Crops	Un-quarried land	Adjacent of quarried land	Quarried land
Mustard	300	250	200
Maize	1000	850	800
Boro	850	700	650
Amon	700	600	500

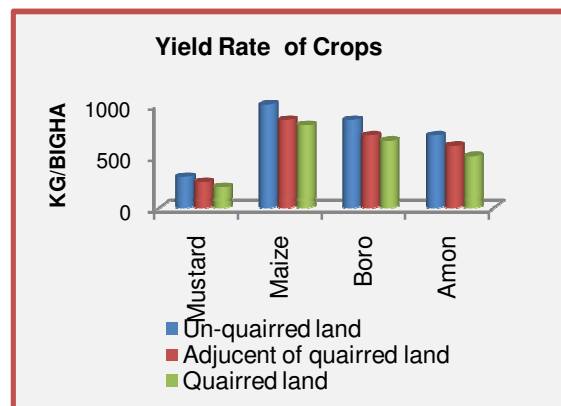


Fig. 6. Yield Rate of Crops.

Photo Plate-5: Shifting of Crops.

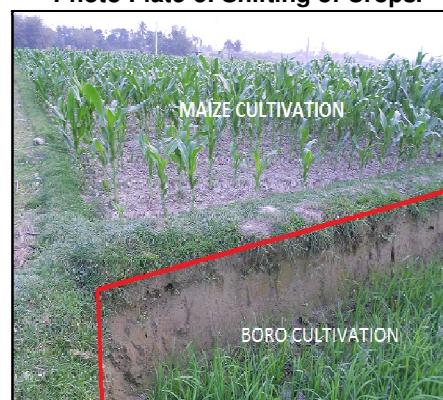
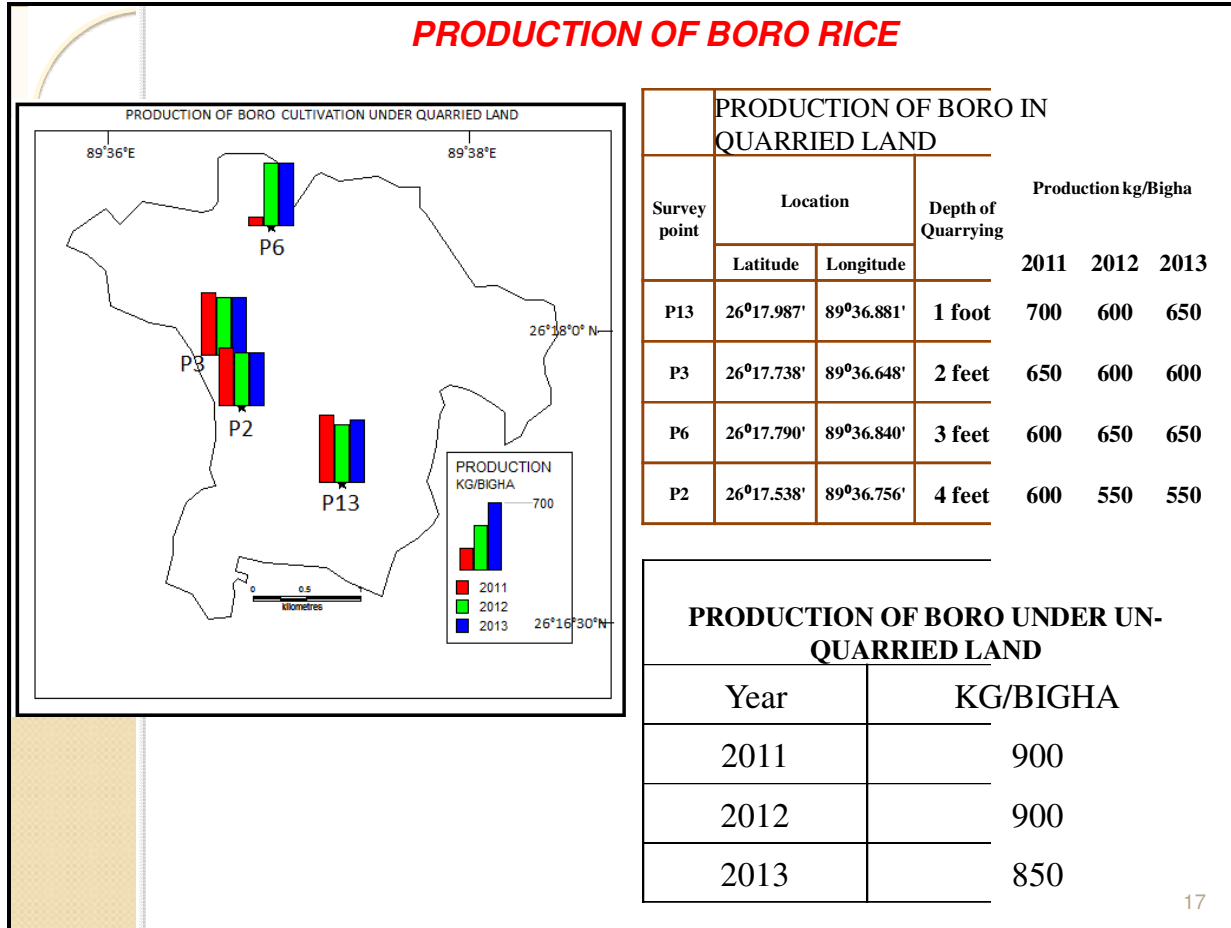


Photo Plate-6: Production of Boro Rice.



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5. The problem of Irrigation: The un-quarried land becomes higher in elevation and hence, difficult for irrigation. During the time of cultivation, the major portion

of that irrigated water is being drained away towards the lower land. So the requirement of water in the higher land becomes much more than the quarried low land.

Photo Plate-7: Problem of Irrigation on the higher land.



6. Problem of Water Logging: From the field survey, it reveals that water logging in the quarried land is a common problem in the brick kiln area. Water logging is defined as the flooding of land by rainwater [4]. It occurs through water accumulation in the low-lying lands. Water logging is not only in the rainy season but also occasionally take place in the other season. If the land is cultivated, the crop can be spoiled when drowned by the excessive water. Consequently, cultivation of the quarried lands can be the much more risky enterprise.

Photo Plate-8: Irrigation Canal.



In many cases, the risk of water logging prevents the land from being cultivated. Inundation of agricultural land is common during the rainy season. Thus, it is difficult to practice the crops because of water logging. After studying the area it is found that Amon is not suitable in the area where the depth of quarried land > 4-5 feet. Moreover, the water logging throughout the year creates some environmental problems as these are the breeding place of mosquitoes and the ecology of the area has been disrupted [7]. The long-term water logging contaminates the underground water.

Photo Plate-9 & 10: Problem of Water Logging.



VI. CONCLUSION

In Conclusion, it may be said that land degradation remains an important global agenda in the 21st century because of its adverse impact on agronomic productivity the environment, and its effect on food security and the quality of life. It is fact that in India quarried and mined should be reclaimed for agriculture by suitably excavating, replacing the topsoil and subsoil. From the study it is observed that the quarrying of topsoil creates several environmental issues which include

(a) Quarrying of the topsoil from the agricultural field leads to the loss of major soil nutrients and land becomes infertile [8].

(b) The productivity of the soil has decreased and the production of crops diminished [9].

(c) Decreased agricultural production in the study area compels the farmer to migrate to the brick kiln and they shift their occupation.

(d) Continuous excavation of the agricultural land degrades the un-quarried land as the farmer of the unquarried land tries to level their land as compared to the quarried land.

(e) Quarrying of silt and sand from the nearby riverbed leads to erosion of embankments of the river [10]. The river engulfs the agricultural land.

The excessive and rampant topsoil quarry should be banned. For this purpose technology transfer should be the urgent need for making the bricks. Fertile topsoil should be replaced by Fly-Ash-Lime-Gypsum (FALG) bricks for making the bricks. It serves two basic purposes – it helps to preserve the topsoil on one hand and manage the ash to protect the environment on the other.

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