IMPACTS OF BRICK UNITS ON GEO-ENVIRONMENT ALONGSIDE THE PRAVARA RIVER, WEST MAHARASHTRA, INDIA USING STATISTICAL TECHNIQUES

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ABSTRACT

An attempt has been made to identify instream brick units and its Geo-environmental impacts on the Pravara river. The main aim of this research work is to analyse Geo-environmental impacts on the Pravara River water, for which water samples from 10 sampling stations within tehsil have been collected during 1st week of Jun 2021. Physico-chemical parameters have been analyzed by standard method. The Field observations reveal that enhancement in population has been observed every year and with population growth brick kilns also increased. It is easy source of money earning specially for rural economy. Many brick kilns are instream for easy availability of soil and water but it declined water quality. Study reveals that in the study area due to instream brick units Water quality has been deteoriated at Kokanevadi, Kasara Dumala (WQI-78.3) and Umbari. Results also shows that at Sangamner, Kokanevadi and Kasara Dumala water is not fit for drinking purpose. To analyze Physio-chemical characteristics of water is the main aim of the research with remedial measures to mitigate the deterioration and related consequences in future.

Keywords: Pravara River, brick kilns, Geo-environmental impacts, physico-chemical analysis

INTRODUCTION-

River plays an essential role in human life. Rivers nourishes every living organisms on the earth so they are also known as arteries of our planet. Rivers are the most important life

supporting systems of the nature. (Sreebha S., 2008). River water is a basic natural resource (Kharake A. & Raut, 2021) for human beings because they are important carriers of water and nutrients (Kharake A. & Raut, 2020). Rivers also provides its valuable deposits like sand and clay (Kharake A. & Unde Maya, 2018) to the respected area. Many human activities like brick making, sand excavations, construction of bridges, vegetation destruction, and diversion of channel, agricultural depends on the river water resource and deposited materials.

Brick industry is material provider industry to the construction sector. It is also one of the important cottage industry which provides employment to rural and unskilled population (Kumbhar A, 2007). Rivers acts a vital role in brick making industries because it is source of essential raw material like sand, clay and water. Brick industries always try to find location at a place where major raw materials like soil and water are available (Sanat Das, 2018) nearest and transportation charges are minimum. Inherently location near river is conducive for brick industries. For least transport cost of water and clay maximum brick units mostly situated in and along the river (Murmu *et al*, 2018). Sangamner tehsil in Ahmednagar District is one of the developed tehsil and well known for co-operatives industries. It is also famous as an educational

hub. It is also having concentration of sugar mills and allied industries which provide employment for skilled and unskilled labours of nearby villages, it leads population growth and with population growth construction sector also has been increased and to meet the need of construction sector brick kilns have been developed in small villages especially along river. The rapid increase in the bick kilns has given rise up the environmental concerns (Jamatia A. *et al*, 2006).Brick kiln are based of rural economy but instream and along brick kiln effects on river water quality and river environment. Brick industries is a significant economic activity in the area but it also indiscriminate cutting of topsoil (Sanat Das, 2018), other environmental costs of the brick kilns are reduction in soil fertility, reduced visibility, drying the ground water sources (Suman Kumar Periyar, 2006) etc. It is also results in emission of particulate matter which has an adverse effects on the health of the worker (Rizwana Khan and Harish Vyas, 2008) and vegetation around kilns (Jamatia A. *et al*, 2006) and land becomes noncultivable due to the firing process of the bricks, solid waste material (Kadam A, 2008). The other environmental threat like disturbance of natural flow, deterioration of the water quality.

Taking this view in account Pravara River in Sangamner Tehsil has been

selected for further research. Pravara River is an important drainage pattern of Sangamner tehsil. River Pravara has proved as a boon for tehsil for drinking, irrigation and industrial and tourism purpose. Many human activities along river badly affects on quality of the water as well as Geo-environmental effects in the area specially brick kilns. To understand inappropriate locality of brick kilns and its impact on water quality of Pravara River is the main objective of the paper, Furture research will helpful to minimize such interventions in future and also enhanced water quality .

Study Area-

Pravara River is an important drainage pattern of Ahmednagar district. The northern part of district is drained by Pravara. For further study Pravara river in Sangamner Tehsil has been selected. The total length of River is about 230 Km the River Pravara rises at an elevation of 1080 meters near Ratanvadi village in Akole Tehsil. Sangamner Tehsil is the one of the developed Tehsil in the district which located about 58 km. downstream from the origin of Pravara River. Sangamner city in tehsil is situated on the confluence (*sangam*) of river Pravara, Mahlungi and river Nataki that's why city got its name Sangamner. Sangamner Tehsil is located at 19°57'north and 72° 22'east. Sangamner Tehsil has an average elevation of 549 meters from mean sea level. After 1967 establishment of co-operative sugar mill at Sangamner, the agriculture in the area has witnessed rapid changes. Sugarcane has become dominant commercial crop in the area. River Pravara is a major irrigation source for the agriculture.
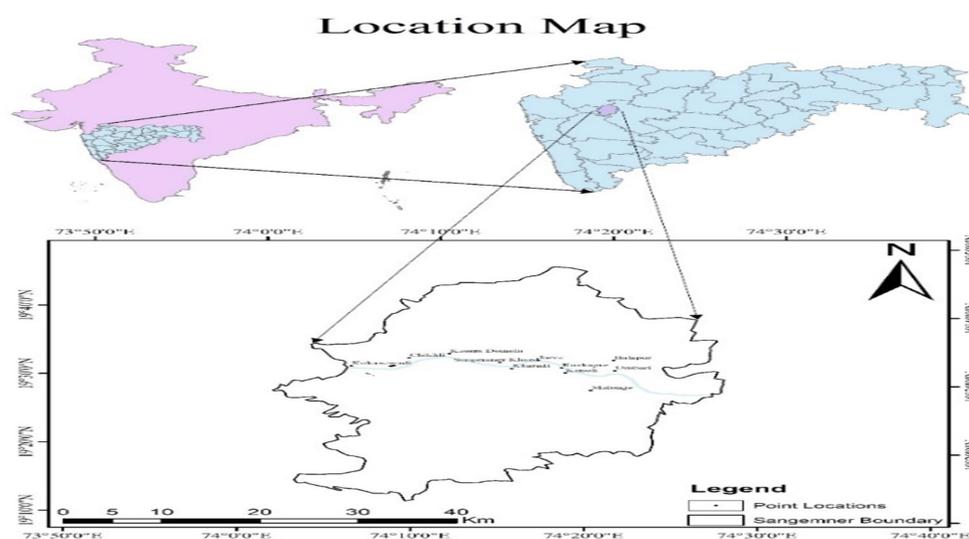

Figure No. 1: Location map of the study area

MATERIAL AND METHODS-

Study include systematic observation of entire channel through SOI Topographical maps (47/I/1,2,3,6,7,10,11,14,15 and 47/E/10,11,12,13,14,15, on 1:50000 scale). It can help to understand the morphology, physiography and general observation of the study area. Field observation also has been done for understanding instream brick kilns sites. For furture study 10 sampling stations within Sangamner Tehsil have been selected. Selection of sampling stations is based on instream brick kiln, so sites along Pravara River namely Kokanewadi, Chikhali, Kasara Dumala, Sangamner Khurd, Khardi, Jorve, Kanoli, Kankapur, Umbari Balapur and Malunje have been selected. All these sites have instream and along brick kilns. Various Physio-chemical parameters like pH, conductivity, Total dissolved solids (TDS), Dissolved oxygen (DO), ORP and salts were analyzed for the evaluate the impact of instream brick kilns on water quality. for water quality analysis water samples have been collected from the surface water along river during Jun 2021. Temperature and pH of samples have been measured at in the field during collection. The water samples were analyzed at Water Quality Laboratory level- II, Nashik under Hydrology Project, Water resources department, Government of Maharashtra. The analysis was carried out in the laboratory as per BIS standard methods. The Karl Pearson correlation matrix has been established for examine relationship between the water quality parameters for that an average value of individual parameter was calculated for different sites with the help of Microsoft Excel worksheet. It all information summarize and analyzed with the help of graphs. WQI was also calculated for investigation of water quality. The data was analyze for water quality status and for that water quality index was determined by the formula developed by NSF (National Sanitation Foundation) and modified by CPCB (Central Pollution Control Board) **(Table 1)**. Determining the Water Quality Index, the water quality is described for easy understanding and interpretation. The classification and the description of the water quality Index [17] are given in **Table 3** which depicts the water quality in simple and easy way. It all information summarize and analyzed with the help of graphs.

$$WQI = \sum_{i=1}^{P} W_i l_i$$

Where;

I$_i$= sub index for water quality parameter

W$_i$= weight (in terms of importance) associated with water quality parameter

P= number of water quality parameters

Table No.1 Water Quality classification and best designated use

Sr. No.	WQI	Class by CPCB	Remarks	Color Code
1	63-100	A	Non Polluted	
2	50-63	B	Non Polluted	
3	38-50	C	Polluted	
4	38 and less	D,E	Heavily Polluted	

RESULT AND DISCUSSION-

I.   Temporal Growth of the Brick Units-

The brick making industry is wide spread industry in the study area and It is closely associated with the growth of population. It has been seen that growth of population leads to increased demand of bricks, ultimately results in growth and development of industries. Study area also experienced increased in brick units due to increase demand of bricks. **Table No. 2** shows the numbers of brick units in the study area from 2010 to 2020. It has been observed that from 2010 numbers of brick units increasing year by year.

II.   Area of Brick Fields-

About 86% brick units have been situated along river bank some are in stream. It has been observed that according to river stages brick units have been changed because deposited soil of river is important raw material of the brick units, so to avoid transportation cost of soil they are situated in the deposited field specially at mature stage of the river. In the study area 85% brick units have been situated in mature stage of river specially.

III.   Impact on the water Quality-

Physicochemical parameters of the water are important in identifying the type, quality and nature of the water [Egbueri *et al* 2019]. The physicochemical characteristics of the water of the study sites are presented in the **Table No. 3**. The water samples at various stations were tested for various parameters like temperature, pH, Conductivity, TDS, ORP, DO, Salts etc.

Table No.2: Temporal Growth of the Brick Units

Year	Numbers of brick units in the study area
2010	427
2011	434
2012	448
2013	456
2014	479
2015	482
2016	486
2017	487
2018	491
2019	496
2020	497

Figure No.2 Temporal Growth of the Brick Units

Figure No.3. Area of Brick Fields (In %)

INDEX
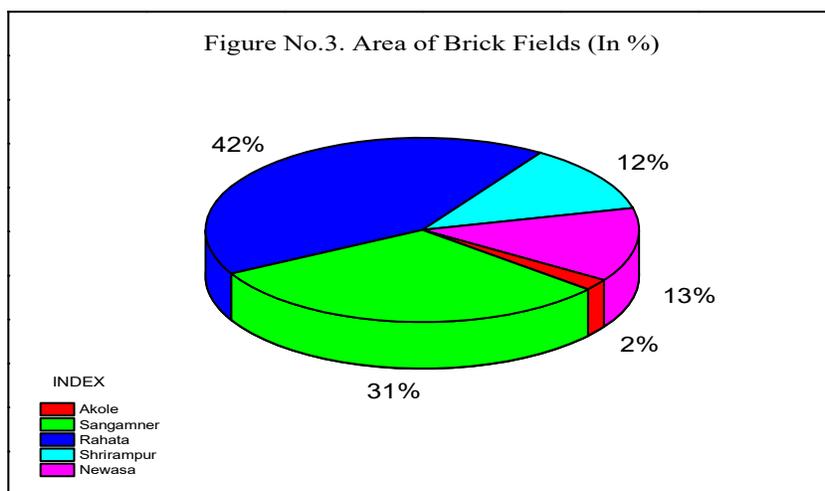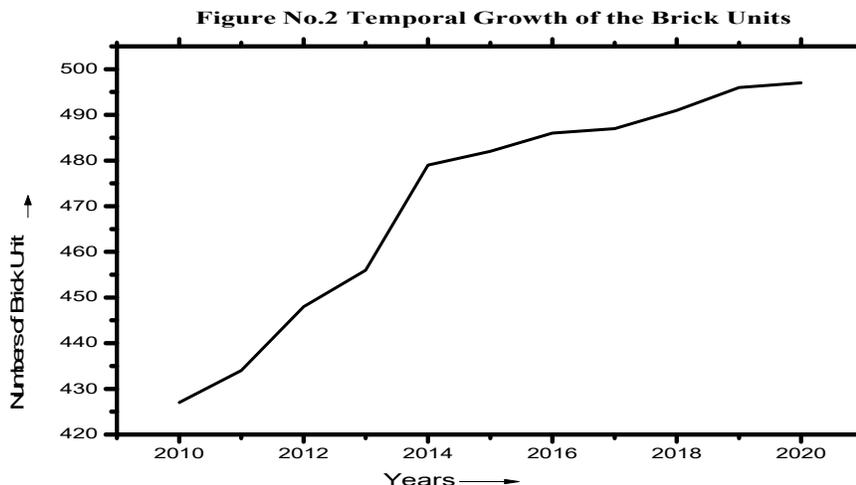- Akole
- Sangamner
- Rahata
- Shrirampur
- Newasa

Table No. 3: The Parameters of the Pravara River

Sr No	Sampling station	Temperature (°C)	pH	Conductivity (µS)	TDS (ppm)	ORP (mV)	DO (mg/l)	Salt (ppm)	WQI
1	Kokanewadi	22.5	5.52	469	309	35.1	4.3	234	39.8
2	Chikhali	19.4	6.29	387	256	-18.8	4.7	194	53.2
3	Kasara Dumala	20.9	5.42	499	260	43	2.7	199	45.9
4	Sangamner Khurd	22.6	5.48	478	311	39.5	5.3	235	33.32
5	Khardi	19.5	6.9	415	270	-46.5	4.2	207	68.91
6	Jorve	22.5	5.49	480	312	40	5.4	236	34.1
7	Kanoli	19.5	6.42	402	266	-18.2	2.3	202	68.06
8	Kankapur	19.4	6.57	390	257	-26	2.4	195	71.23
9	Umbari Balapur	21	5.51	442	292	10	2.6	222	48.22
10	Malunje	19.8	6.43	442	256	-18.8	4.69	194	55.42

(Required desirable limits- As per standards prescribed For Drinking Water by Bureau of Indian Standards, 2002 (BIS) limits, 2012)

pH - It is one of important parameter in analysing quality of water It is amount of hydrogen ion concentration It provides information about acidity or basicity of water pH can be affected by chemicals in the water, therefore pH is an important indicator of water that is changing chemically. pH is expressed in "logarithmic units". Hence each number represents a 10-fold change in the acidity or basicity of the water. Water with a pH of 4 is ten times more acidic than water having a pH of 5. The pH of the drinking water of the study area was within the permissible limits (6.5-8.5) of WHO (2011).

Conductivity -Conductivity is the ability of a solution, a metal or a gas i .e all materials - to pass an electric current. Conductivity measures the amount of total dissolved salts (TDS) or the total amount of dissolved ions in the water. The more ions that are present, the higher the conductivity of water Pure water is not a good conductor of electric current rather's a good insulator. According to WHO standards, EC value should not exceeded 400 µS/cm (Meride *et al*., 2016). The conductivity values of water at various stations is in permissible limits

Total Dissolved solids- Total dissolved solids (TDS) is used to determine the inorganic salts and small amounts of organic matter present in water. The major constituents present in water are calcium, magnesium, sodium, and potassium cations and carbonate, hydrogencarbonate, chloride, sulfate, and nitrate anions Water with high values of TDS around 1000 ppm is not fit for human consumption (Pandey *et al*., 2020) High levels of TDS are caused due to the presence of potassium, chloride and sodium and toxic ions in larger amounts. It is also undesirable to drink and it may have salty, metallic or bitter taste(Ali Al-Alawi *et al.,* 2014) The value of TDS at sampling stations is well within permissible limit

ORP- ORP (Oxidation Reduction Potential) is a measure of the oxidising or reducing potential of a water body The ORP values are like pH values used to determine water quality. ORP values indicate a systems relative state for gaining or losing electrons. In healthy waters, ORP should read high between 300 and 500 millivolts (Abdel-Meguid *et al* 2018). The ORP values of sampling stations indicate that water there is not healthy this may due to waste addded in water by brick klins Most of klins dump ashes of coal, waste of bricks unscientifically beside the brick kiln on the agricultural land and the river bank

DO- Dissolved oxygen determines level of free, non-compound oxygen present in water. It is actually the amount of oxygen available to living aquatic organisms. It is an important parameter in assessing water quality because of

its influence on the organisms living within a water-body Sun *et al* (2016). Healthy water should generally have dissolved oxygen concentrations above 6.5-8 mg/L, Oak *et al* (2020). DO at various sampling sites averages between 1.6 -4.7. This is due to anthropogenic activities during brick making.

Total Salts- Salts in water range from 194-222 ppm which makes water unsafe for drinking purpose. The above table shows that amount of salts at various stations range from 194 ppm to 235 ppm which is slightly above limit. The above physico-chemical parameters show that brick industries have a significant impact on the water quality of the river There higher concentration of brick klins at Kokanewadi, Kasara Dumala, Malunje, Jorve, Sangamner Khurd. Most industries dump their waste material on the river bank which causes is a higher risk of pollution of the river water.

Correlation-

Simple correlation coefficient (R^2) is used to shows the degree of linear correlation between any two parameters for water quality measurement. In the present analysis following classifications were used.

Statistical Analysis- The Karl Pearson matrix has been established for examining relationship between two parameters of sample. The value of coefficient 0.7 and above is considered as strong positive corelation. It has been found that there is strong positive relation O.R.P and EC, D.O and

EC Salts and TDS values TDS and EC value show moderatly positive correlation.

WQI-

Water Quality Index (WQI) is most effective method of measuring water quality. It provides a single value expressing the average quality of water at a time, based on analytical values of physico-chemical parameters. The index was first developed by Horton in 1965 to measure water quality by using 10 most regularly used water parameters. The method was subsequently modified by different experts. These indices used water quality parameters which vary by number and types. The weights in each parameter are based on its respective standards, and the assigned weight indicates the parameter's significance and impacts on the index.

$R^2=1$	=	**Perfectly correlated**
$\pm 0.9< R^2$	=	**Very strongly correlated**
$\pm 0.7<R^2$	=	**Strongly correlated**
$\pm 0.5<R^2$	=	**Moderately correlated**
$R^2<\pm 0.5$	=	**Poorly correlated**

Table 4: Statistical Summary Of Physico-Chemical Parameters

	Temperature	pH	EC	TDS	ORP	DO	Salt
Max	21	78.3	442	292	10	4.7	222
Min	18.9	5.51	387	256	-46.5	1.6	194
Mean	19.8	13.635	414.2	269.7	-22.12	3.209	204.6
Sum	198	136.35	4142	2697	-221.2	32.09	2046

Table No. 5: Karl Pearson Correlation Matrix For Water Samples Of Pravara River Water In Pravara River

Parameters	pH	EC	TDS	ORP	DO	Salt	
pH	1.0						
EC	0.41	1.0					
TDS	0.31	0.56	1.0				
ORP	-0.24	0.83	0.31	1.0			
DO	-0.42	0.89	-0.03	0.01	1.0		
Salt	0.33	0.57	0.99	0.27	-0.71	1.0	

(Computed by Researchers)

Table No. 6. WQI rating of various sampling sites of Pravara River

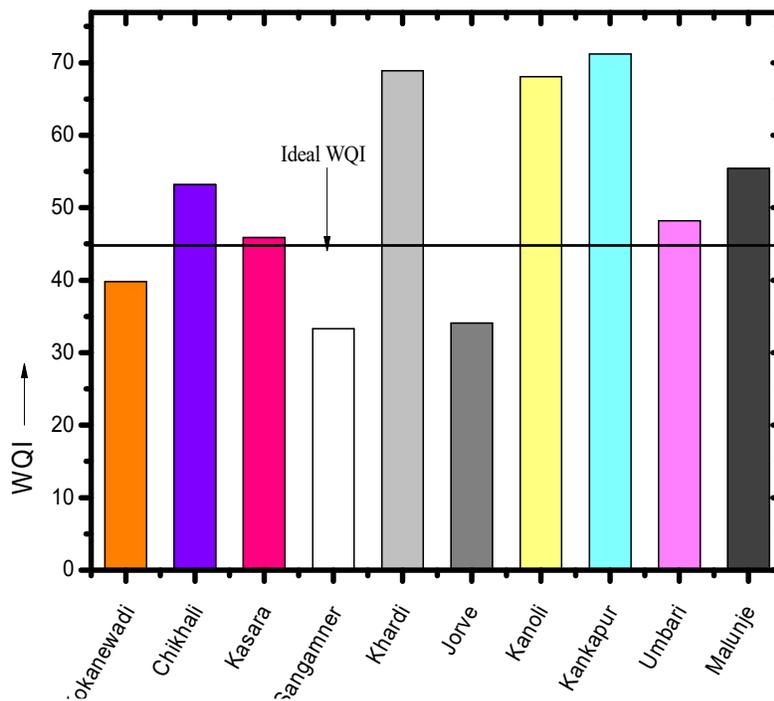| Sr. No.	Sampling station	WQI	Color Code
1	Kokanewadi	74.35	
2	Chikhali	53.20	
3	Kasara Dumala	78.3	
4	Sangamner Khurd	71.2	
5	Khardi	68.91	
6	Jorve	71.96	
7	Kanoli	68.06	
8	Kankapur	71.23	
9	Umbari Balapur	48.22	
10	Malunje	55.42	

Figure No. 4: WQI of Selected Sites

Deterioration of land-

Another effect of brick industries on environment is deterioration of land Due industrlisation and urbanization brick industries are flourishing in developing countries Ahuti *et al* (2019) .Generally brick kilns are set up on fertile land near river bank Saha *et al* (2016) Brick-klin owners use the soils from fertile agricultural land on the river banks also, mud from river banks and also ashes of coal for making bricks, waste of bricks is dumped unscientifically beside the brick kiln on the agricultural land and the river bank Das (2019). It results in the extensive soil erosion at the bank and land degradation which is environmentally unsustainable. Filipová *et al* (2017)

DISCUSSION- From above observations it can be seen that most of the brick industries located beside the river bank due to a constant supply of raw materials of brick, like mud, sand, and water. The study of water sample shows that the standard of the water is deteriorating close to brick field because of indiscriminate activities of brick kiln industry In addition to this brick industries have effect on air. The coal is used for firing of bricks burning of which adds particulate matter in air In study area low cost waste material is used for primary source of fuel .The design of klins is not scientific also use of low cost fuel results

in incomplete combustion produce lot of ash .harmful gases like sulpher dioxide, Carbon dioxide, NOx, CO .In additionto these particulate matter which contains toxic metals and volatile organic compounds is let off in the air. In addition to this raw material i.e soil which taken from river bank or from fields near river bank causes land degradation as well as land degration. Further this land degradation results in economic loss

CONCLUSION-

From above observations it can be seen that most of the brick industries allocated beside the river bank due to a constant supply of raw materials of brick, like mud, sand, and water. They use coal for burning bricks which affect air ,water and soil at and around river bank The study of water sample shows that the standard of the water is deteriorating close to brickfield because of indiscriminate activities of brick kiln industry. With the infrastructure development, the brick-making industry is increasing along river In the overall study, it is observed that the indiscriminate and unscientific manufacturing leads to different geo-environmental problems such as land degradation, water pollution Ashes of coal and waste of bricks are dumped unscientifically near the brickfield on the agricultural land and beside the river bank, which is causing higher risk of pollution of the river water

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