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Village Level Soil Thematic Information System: A GIS Approach. Case study of selected villages in Ausgram Block, Burdwan District, West Bengal, India.

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Abstract:

Surface soil is important for all living things on the earth, either directly or indirectly human also depend on it. Agriculture purpose soil and soil fatality are very essential, so if any planner make any type of agricultural planning, soil and it properties study and analysis are very important. Ausgram block is one of main agriculture region in Burdwan district as well as West Bengal, but due to unscientific crop cultivation every year it getting failure; so present paper we taken soil and it properties is one of the parameter behind this problem. We have selected three villages from Ausgram block for the soil study purpose as a sample study, present soil thematic information study made through GIS approach and help of GPS. Present paper adopted a mathematical model (kriging) for the soil properties interpolation and soil thematic information system.

KEYWORDS:

GIS, Kriging, Soil Resource, Alternative agriculture.

1.INTRODUCTION:

All living things are dependent on the soil. To a great extent good soil is dependent on man and the way uses. Soil as a natural body supports land plants. Soil may be defined as a natural body development as a result of pedogenic process that takes place during and after the weathering of rocks and in which plants and other forms of life are able to grow. It forms a loose superficial mantle covering the earth's crust (Patil, Daji, Kadam, 2005). Soil is the natural medium for the growth of land plants. Soil is the collection of natural bodies occupying portion of the earth's surface that support plants and that have properties due to the integrated effect of climate and living matter, acting upon parent material, as conditioned by relief, over period of time (Soil Survey Manual, 1966).

Ausgram block is one of the good agriculture potential region in west Bengal but due to water stressed, soil phenomena and insufficient scientific awareness of local farmers not able to cultivate the crop every year successfully. Present paper only soil we taken for a consideration, it is main influencing factor of crop cultivation; so we have collected soil samples and analysised the soil properties for suitable and water stressed tolerance crop proposal.

Present soil study we have collected the soil samples such a way that they represented the whole study area. From a reputed soil laboratory, chemical properties of the soil samples were tested and analysed soil pH, EC mmhos/cm, OC (%), N kg/Ha, P2O5 kg./ha and K2O kg/ha for present study.

2. OBJECTIVE

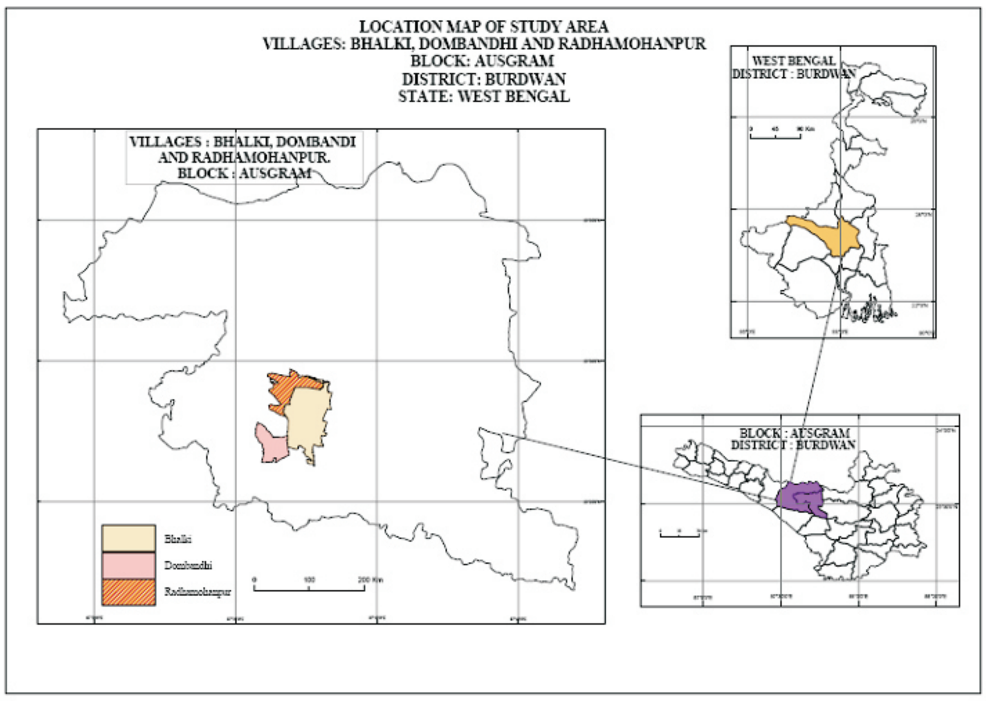
To create the soil thematic information system in village level, through GIS technology (Kriging method), for selected villages in Ausgram Block.

3. STUDY AREA

The study area Ausgram block I and II located in west-central part of Burdwan district, West Bengal (Figure: 1). The region is considered as water stressed region (Prakasam and Biswas, 2010). Average annual rainfall of the region is 1500mm and average annual temperature is 21.290C. Maximum rainfall occurs in the months of July (314mm) and the minimum occurs in the months of December (4.13 mm). Highest average temperature occurs in the months of June while the lowest occurs in the months of January. Topography of the Block is rugged. Highest relief of 70 m is found in the west-central part of the Block. Minimum relief of 32m is found in the east-central part of the Block. Generally the block is inclined form the west to east. Important rivers of the block are Kunur Nadi, and Ajay River, they are flowing from west to east. Total population of the blocks is 212921 (2001, Census of India) of which 43 per cent population belongs to Scheduled Caste category and 16 per cent belongs to Scheduled Tribe category 62 per cent of the total population of the blocks is literate.

In the present study we have selected three villages from Ausgram Block I and II (Bhalki, Dombandi and Radhamohanpur) located in south west part of Ausgram block (Figure:1).

Figure: 1 Study area



4. DATA BASE AND METHODOLOGY

For the present soil thematic information study we have been collected the soil samples from 41 different geographical locations (Table 1) with help of GPS and it analysised the properties to assess the fertility for all soil samples have been done. After collected the soil samples in different geographical location we have used the mathematical method for interpolate (Kriging method) the soil properties whole study area.

4.1 Interpolation

Spatial and spatio-temporal distributions of both physical and socioeconomic phenomena can be approximated by functions depending on geographical location in a multi-dimensional space, as multivariate scalar, vector, or tensor fields. While the soil phenomena are characterised by measured or digitised point data, often irregularly distributed in space, visualisation, analysis, and modelling within a GIS

Table: 1 Soil Samples and their Properties

Sl. No	Village Name	Geo-Location		pH	EC mmhos/ cm	OC %	N kg/ha	P^{2}O^5 kg/ha	K^{2}O kg/ha
		North	East						
1	Bhalki	23^{0}27.' 16.1"	87^{0}37' 12.6"	5.74	0.08	0.22	238.33	6.9	26.88
2	Bhalki	23^{0}27' 30"	87^{0}37' 44"	5.68	0.07	0.26	204.19	9.2	43.76
3	Bhalki	23^{0}28' 04"	87^{0}37' 50"	5.20	0.04	0.18	229.28	11.5	107.52
4	Bhalki	23^{0}28' 13"	87^{0}37' 56"	5.27	0.03	0.36	279.28	10.2	40.32
5	Bhalki	23^{0}26' 48.6"	87^{0}27' 31.8"	4.79	0.03	0.38	239.04	8.9	45.32
6	Bhalki	23^{0}27' 53"	87^{0}37' 49"	4.92	0.03	0.16	247.74	18.1	67.20
7	Bhalki	23^{0}27' 31.9"	87^{0}37' 15.6"	4.98	0.06	0.28	257.50	18.4	69.30
8	Bhalki	23^{0}28' 28"	87^{0}37' 42"	4.92	0.05	0.30	260.64	11.2	80.64
9	Bhalki	28^{0}28.3' 31.4"	87^{0}37' 40.7"	4.96	0.04	0.38	271.10	16.1	34.10
10	Bhalki	23^{0}28' 31.4"	87^{0}37' 40.7"	6.52	0.06	0.30	207.32	18.4	67.20
11	Bhalki	23^{0}28' 04"	87^{0}37' 50"	4.90	0.05	0.22	213.60	13.8	120.96
12	Bhalki	23^{0}28'47"	87^{0}37' 54"	4.71	0.03	0.30	223.00	7.6	53.20
13	Bhalki	23^{0}28' 31"	87^{0}31' 40.7"	5.05	0.03	0.18	224.05	6.6	36.20
14	Bhalki	23^{0}28' 20.7"	87^{0}37' 08.2"	5.25	0.03	0.20	213.24	12.3	80.64
15	Bhalki	23^{0}28' 25"	87^{0}37' 53"	5.32	0.05	0.30	246.30	14.3	44.13
16	Bhalki	23^{0}27' 16.1"	87^{0}37' 12.6"	5.58	0.06	0.34	251.22	8.2	107.52
17	Bhalki	23^{0}27' 20"	87^{0}37' 48"	6.90	0.08	0.40	228.92	78.2	94.08
18	Bhalki	23^{0}28' 25"	87^{0}37' 53"	5.63	0.04	0.38	266.90	11.5	107.52
19	Bhalki	23^{0}28' 40"	87^{0}37' 46"	5.53	0.05	0.40	256.87	12.3	35.10
20	Bhalki	23^{0}27' 27"	87^{0}37' 51"	5.30	0.04	0.26	228.92	69.9	255.34
21	Bhalki	23^{0}27' 57"	87^{0}37' 52"	4.75	0.02	0.10	181.88	15.6	94.08
22	Bhalki	23^{0}26' 39.9"	87^{0}37' 32.5"	4.80	0.05	0.38	295.48	11.5	39.10
23	Bhalki	23^{0}27' 12"	87^{0}37' 29"	4.78	0.06	0.34	238.68	64.4	28.88
24	Bhalki	23^{0}27' 47"	87^{0}38' 51"	6.26	0.09	0.78	453.00	46	519.84
25	Dombandi	23^{0}26' 34.7"	87^{0}36' 32.08"	4.89	0.02	0.16	232.06	17.6	53.76
26	Dombandi	23^{0}26' 46.04"	87^{0}35' 58.34"	4.31	0.04	0.30	261.40	9.2	65.20
27	Dombandi	23^{0}27' 43.6"	87^{0}35' 47.01"	4.50	0.04	0.32	247.74	18.4	29.88
28	Dombandi	23^{0}27' 43.6"	87^{0}35' 47.01"	4.32	0.02	0.22	250.88	10.5	53.76
29	Dombandi	23^{0}27' 09"	87^{0}36' 20.7"	4.71	0.01	0.36	250.88	15.6	27.88
30	Dombandi	23^{0}27' 43.6"	87^{0}35' 47.01"	4.56	0.02	0.14	168.99	16.9	161.28
31	Radhamohanpur	23^{0}28' 16.14"	87^{0}36' 38"	5.55	0.02	0.14	169.34	10.9	134.40
32	Radhamohanpur	23^{0}29' 12.06"	87^{0}37' 05.37"	5.70	0.07	0.40	244.60	16.8	147.84
33	Radhamohanpur	23^{0}28' 59.03"	87^{0}36' 14"	6.70	0.013	0.38	216.38	23.0	362.88
34	Radhamohanpur	23^{0}29' 33"	87^{0}36' 10.03"	4.92	0.07	0.50	244.60	27.6	108.52
35	Radhamohanpur	23^{0}29' 21.05"	87^{0}37' 11.03"	4.80	0.03	0.30	332.60	29.9	40.32
36	Radhamohanpur	23^{0}28' 23.22"	87^{0}37' 13.47"	4.49	0.05	0.36	235.20	11.5	40.33
37	Radhamohanpur	23^{0}29' 31.01"	87^{0}37' 11.03"	4.10	0.04	0.28	258.20	12.3	33.45
38	Radhamohanpur	23^{0}28' 52.03"	87^{0}36' 14"	4.43	0.01	0.28	210.88	14.6	41.41
39	Radhamohanpur	23^{0}29' 11"	87^{0}36' 54"	4.58	0.02	0.40	297.92	16.1	40.32
40	Radhamohanpur	23^{0}28' 23.22"	87^{0}37' 13.47"	4.45	0.01	0.48	300.19	9.2	31.44
41	Radhamohanpur	23^{0}29' 31.01"	87^{0}37' 11.03"	4.68	0.01	0.16	263.42	14.6	40.32

GIS usually based on a raster representation (Mitas, Mitasova, 1999). Present soil study has been made through Kriging interpolation method because it is the suitable statistical method for soil study.

4.1.1 Kriging

It is a powerful statistical interpolation method used for diverse applications such as physical sciences, geochemistry, and pollution modeling, Kriging assumes that the distance or direction between sample points reflects a spatial correlation that can be used to explain variation in the surface. It fits a function to a specified number of points or all points within a specified radius to determine the output value for each location. Kriging is most appropriate when a spatially correlated distance or directional bias in the data is known and is often used for applications in soil science and geology (Childs).

The predicted values are derived from the measure of relationship in samples using sophisticated weighted average technique. It uses a search radius that can be fixed or variable. The generated cell values can exceed value range of samples, and the surface does not pass through samples.

Kriging assumes that the spatial distribution of a geographical phenomenon can be modelled by a realisation of a random function and uses statistical techniques to analyse the data (drift, covariance) and statistical criteria (unbiasedness, minimum variance) for predictions. Kriging is the most successful for phenomena with a very strong random component or for estimation of statistical characteristics (uncertainty) (Mitas, Mitasova, 1999).

Present soil properties interpolation study made through the ordinary kriging method. It is simplest form of kriging and it uses dimensionless points to estimate other dimensionless points, it also the regionalized variable is assumed to be stationary. This ordinary kriging can be explain

$$z_e(p) = \sum w_i \cdot z(p_i)$$

In present study Z, at point p, Ze (p) to be calculated using a weighted average of the known soil locations.

This estimated soil value will most likely differ from the actual value at point p, Za(p), and this difference is called the estimation error:

$$\varepsilon_p = z_e(p) - z_a(p)$$

If their no drift exists and the weights used in the estimation sum to one, then the estimated value is said to be unbiased. The scatter of the estimates about the true value is termed the error or estimation variance of the soil properties.

$$\sigma_z^2 = \frac{\sum_{i=1}^{n}[z_e(p_i) - z_a(p_i)]_i^2}{n}$$

(Sources: Malaek, Younesi).

Using above formula we have interpolated the soil properties in entire study area and we have created the soil thematic information system and different thematic layers (Using GIS technology) in plat level in these villages. Every plat of the land boundary in cadastral level created from the village cadastral maps (1:4000), this data base generated through GIS technology.

5. RESULT AND DISCUSSION

The soil chemical properties include those that develop through the chemical activates within the soil mass (De and Sarkar, 1993). Soil chemical prosperities depend on soil chemical constituents, soil nutrients, composition and behavior of clay fraction, soil reaction, soil pH, base exchange, soil solution, humus, etc.

5.1 pH (Puissance de Hydrogen)

The pH value of the soil solution is expressed or evaluated as the negative logarithm of hydrogen ion concentration. It may be expressed in the following formula:

pH = Log 1/ (H+) = - Log (H+)

Soil pH is probably the most commonly measured soil chemical property. Since pH (the negative log of the hydrogen ion activity in solution) is an inverse or negative function, soil pH decreases as hydrogen ion or acidity increases in soil solution. The soil pH of 7 is considered neutral. Soil pH values greater than 7 signify alkaline conditions, whereas those with values less than 7 indicate acidic conditions. Soil pH typically ranges from 4 to 8.5, but can be as low as 2 in materials associated with pyrite oxidation and acid mine drainage.

Strong acid 4.0-5.0
Moderate acid 5.0-6.0
Slight acid 6.0-7.0
Neutral -7.0
Slight alkaline 7.0-8.0
Moderate alkaline 8.0-9.0
(De and Sarkar, 1993)

Soil pH or reaction has important influences on plant growth and microorganisms for its direct effect on hydrogen ion concentration as well as for its indirect effect on nutrient availability and the presence of toxic ions.

Neutral soils are ideal for the growth of most plants. Many plants fail to grow properly both in acid and in alkaline soil. Nature and concentration of soil solution, type of colloidal materials and the nature of exchangeable cations are important factors which influence soil reaction in its activity. Climate, physiography and parent material play important role in determining the soil reaction (De and Sarkar, 1993).

Soil pH has a profound influence on plant growth. Soil pH affects the quantity, activity and types of micro organisms in soils which in turn influence decomposition of crop residues, manures, sludges and other organics. It also affects other nutrient transformations and the solubility or plant availability of many plant essential nutrients. Phosphorus, for example, is mostly available in slightly acid to slightly alkaline soils, while all essential micronutrients, except molybdenum, become more available with decreasing pH. Aluminum, manganese and even iron can become sufficiently soluble at pH < 5.5 to become toxic to plants. Bacteria which are important mediators of numerous nutrient transformation mechanisms in soils generally tend to be most active in slightly acid to alkaline conditions.

Figure: 2 Puissance Hydrogen (pH)

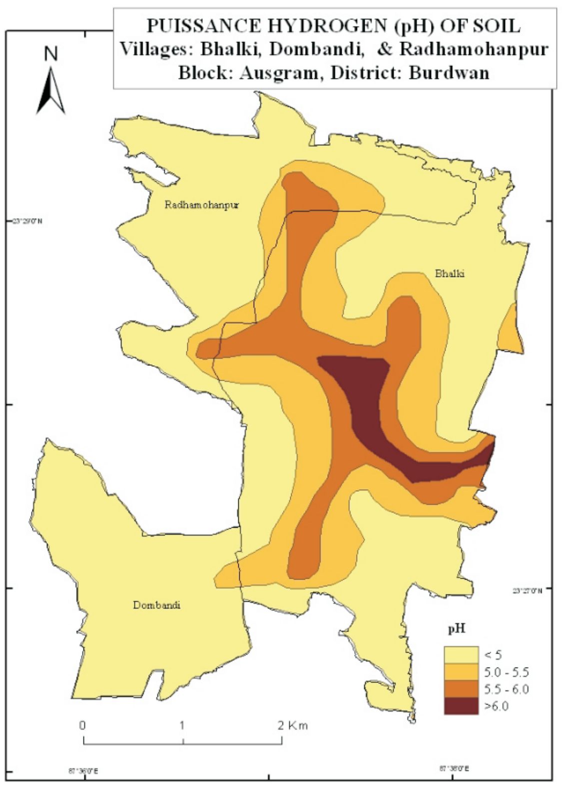


Figure: 3 Electric Conductivity (EC)

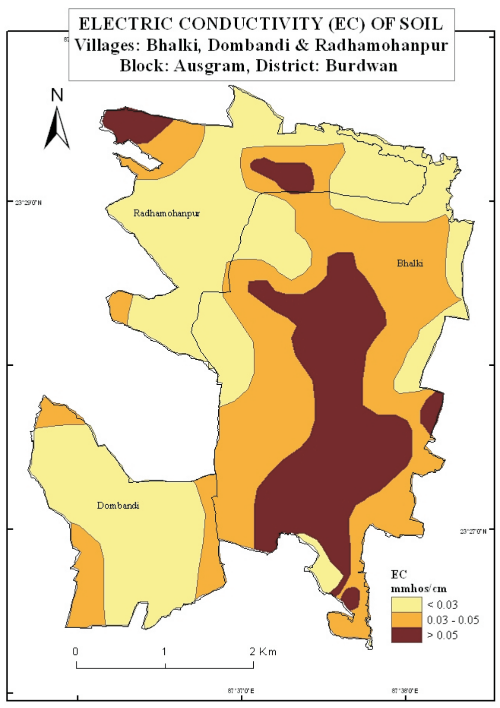


Figure: 4 Organic Carbons (OC)

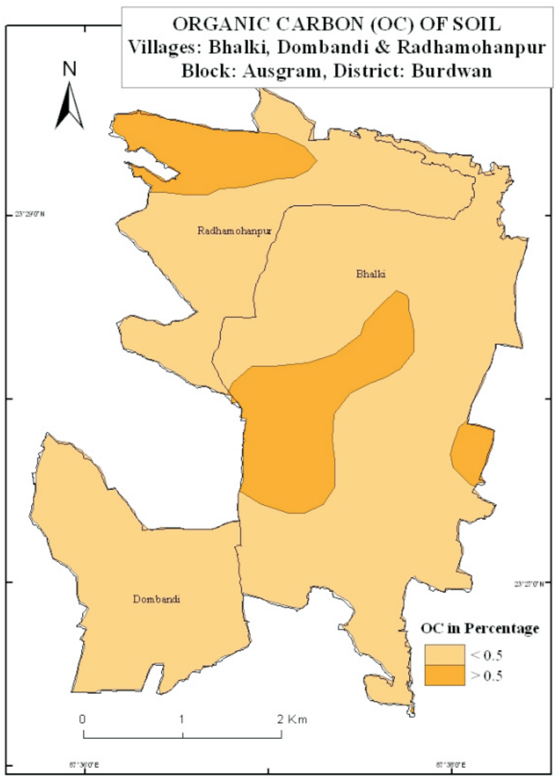


Figure: 5Nitrogen (N)

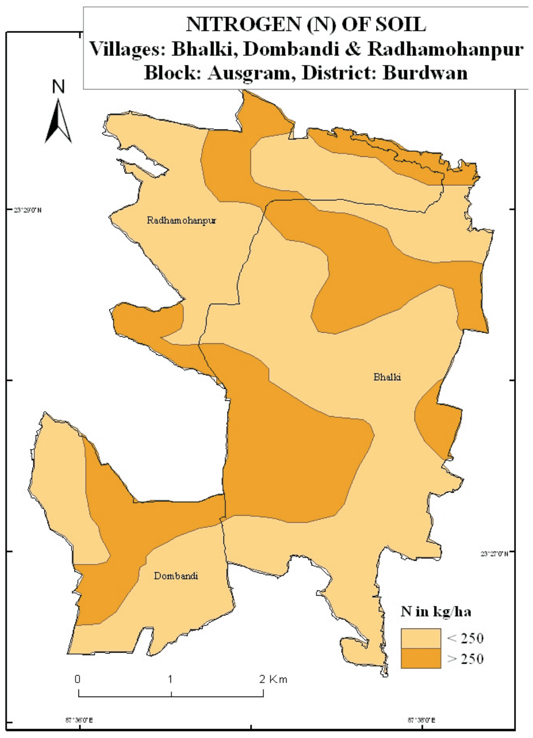


Figure: 6 Phosphorous (P2O5)

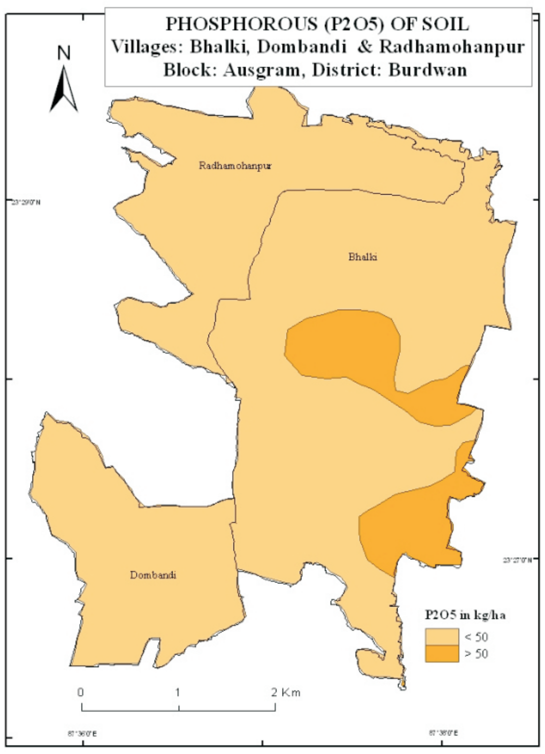
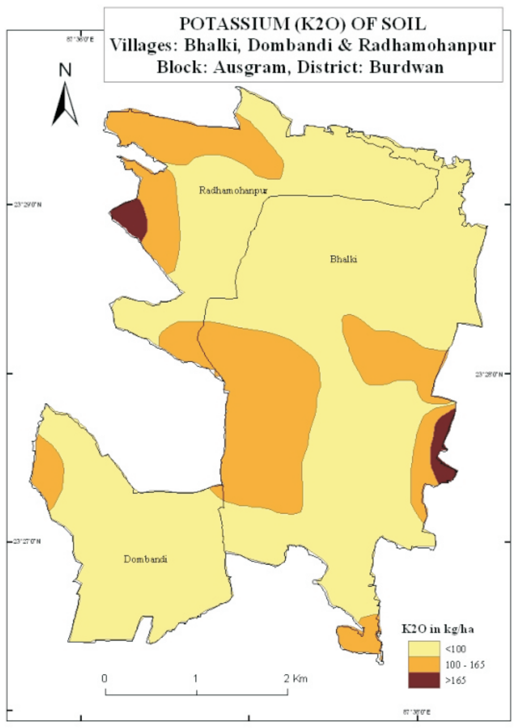


Figure: 7 Potassium (K2O)



Source: Intensive Field Study

Table : 2 pH (puissance de Hydrogen)

pH (puissance de Hydrogen)		
Class	Area in Hectare	Area in %
<5	1066.00	64.21
5.0-5.5	350.90	20.50
5.5-6.0	194.40	11.80
>6.0	52.70	3.49
Total	**1664.00**	**100.00**

Source: Author's Calculation

Soil pH map of the study area (Figure: 2) shows that soils of the entire area belongs to acidic conditions (pH value <7). Maximum soil pH value (6.9) is found in the central part of the area and minimum soil pH value (4.1) is found in northeast parts of the study area. The pH of the region has been divided into four soil pH zones i.e. <5, 5.0 – 5.5, 5.5 - 6.0 and > 6 pH values. First zone (<5) is distributes in almost all the directions of the study area, north, north east, south east, south, south west, west and north west parts of study area and it covers 64 % of total area. Second zone (5.0 – 5.5) is distributed over the central, north central, west central, south central and eastern parts of the study area and it covers 20% of total area. Third zone (5.5 – 6.0) is distributed over the central, north central, west central, south central and east parts of the study area and it covers 12% of total area. Last zone (>6.0) is distributed over the central and east central parts of the study area and it covers 3% of total study area (Figure: 2 & Table: 2).

5. 2 Electrical Conductivity (EC)

Soil Electrical Conductivity (EC) is a measurement that integrates many soil properties affecting crop productivity. It influences the water content, soil texture, soil organic matter, depth to clay-pans, salinity, exchangeable calcium (Ca) and magnesium (Mg). Electrical conductivity is the ability of a material to transmit (conduct) an electrical current and is commonly expressed in units of millisiemens per meter (mS/m). Soil EC measurements may also be reported in units of decisiemens per meter (dS/m), which is equal to the reading in mS/m divided by 100. Soils with water-filled pore spaces that are connected directly with neighbouring soil pores tend to conduct electricity more readily. Soils with high clay content have numerous, small water-filled pores that are quite continuous and usually conduct electricity better than sandy soils. Curiously, compaction will normally increase soil EC. Dry soils are much lower in conductivity than moist soils. Increasing concentration of electrolytes (salts) in soil water will dramatically increase soil EC.

Table: 3 Electrical Conductivity

Electrical conductivity (EC) in mmhos/cm		
Class	Area in Hectare	Area in %
<0.03	726.40	43.65
0.03-0.05	589.70	35.44
>0.05	347.90	20.91
Total	**1664.00**	**100.00**

Source: Author's Calculation

From the soil Electric Conductivity (EC) map (Figure: 3) of the villages, maximum EC value (0.09mmhos/cm) is found over the eastern part and minimum EC value is found over the south west, west, north west and northern parts of the study area. The current soil electric conductivity map has been divided into three zones i.e. <0.03, 0.03 – 0.05 and >0.05. First zone (<0.03) is distributed over the south west, west, north west, north and north east parts of the study area and it covers about 44% of total area. Second zone (0.03 – 0.05) is distributed over the south west, west, north west, east, south east and central parts of the study area and it covers 35% of total area. Last zone (>0.05) is distributed over the central, south, east, central north and north western parts of the study area and it covers 21% of total study area (Figure: 3 & Table: 3).

5.3 Organic Carbon (OC)

The presence of decomposing organic matter in soil is indicative of the fact that the synthetic processes are already active in the soil and the biochemical activities which supplement the chemical activities have also started. The plants and animals (both macro and micro) grow on weathered materials and the organic residues left behind decay with time and become an integral part of the soil. The main source of soil organic matter in plant tissues and animals are the subsidiary source of soil organic matter. Earthworms, centipedes, ants etc. also play an important role in the translocation of plant residues. Gravity and water infiltration bring carbon molecules down through the soil profile, making them available for consumption. However, some forms of carbon decompose more easily than others. "Older" carbon in the soil profile is much more resistant to decomposition and remains stored in the soil. Soil organic matter directly benefits the soil microbial community and indirectly influences all other organisms, particularly plants. Nutrients tied up in organic matter are not readily available to plants. Rather, microbes must first begin the decomposition process and obtain energy from organic carbon. As the organic matter is broken down, nutrients such as nitrogen and phosphorus are released into the soil and are then available for uptake by plants.

The soil Organic Carbon (OC) map (Figure : 4) of the study area shows maximum Organic Carbon (0.5%) is available in the north west and western parts and minimum Organic Carbon value (0.1%) is available in eastern part of the study area. The Organic Carbon concentration of the region is divided into two zones i.e. <0.5% and >0.5. First zone (<0.5%) is distributed over the north, north east, east, south east, south, south west and northern parts of the study area and it covers 83% of total area. Second zone (>0.5%) is distributed over the north west, west and central east parts of the study area and it covers 17% of total area (Figure: 4 & Table: 4).

Table: 4 Organic Carbon (OC)

Organic Carbon (OC) in percentage		
Class	**Area in Hectare**	**Area in %**
<0.5	1379.3	82.87
>0.5	284.7	17.13
Total	**1664.00**	**100.00**

Source: Author's Calculation

5.4 Nitrogen (N)

Nitrogen is a major structural constituent of the cell, Nitrogen plays an important role in plant metabolism. When the nitrogen supply is the limiting factor, both the role and extent of protein synthesis are depressed. Excessive amounts of nitrogen are also harmful. High amount of nitrogen produces succulence in plants and enhance their sensitivity to water and temperature stress. High nitrogen in plants also becomes susceptible to lodging, pathogens and pests.

Nitrogen is the nutrient required by plants in the greatest quantity. The nitrogen concentration of plants ranges from about 0.5 to 5% on dry weight basis. Since most of the plants have rather high nitrogen requirement and most soils can't supply sufficient nitrogen to meet this demand, nitrogen normally be supplemented through organic or inorganic fertilizer sources. The ultimate source of all nitrogen in soils is the atmosphere. Nitrogen as N_2 is not directly available for uptake by most plants. Legumes in symbiosis with particular species of the bacterial genus, Rhizobium, transforms gaseous N_2 to plant available form, with capacities to fix N_2 ranging from about 40 to greater than 300 lbs N/acre/year. Nitrogen is an essential ingredient for the production of sufficient food for an expanding world population. Proper nitrogen management can decrease the potential for negative environmental impacts.

Nitrogen status map (Figure: 5) of the study area shows that the maximum amount of nitrogen (N) is available in the eastern part (453 kg/ha) of the study area and the minimum is available in the western part (168.99 kg/ha). We classified the soil nitrogen map into two zones i.e. <250 kg/ha and >250 kg/ha. The first zone (<250 kg/ha) is distributed over the south, south east, central, north west and north eastern parts of the study area and it covers 63% of total area. Second zone (<250) is distributed over the west, south west, east, central, north east and north eastern parts of the study area and it covers 37% of total area (Figure: 5 & Table: 5).

Table: 5 Nitrogen Status in Soil

Nitrogen Status in Soil, kg/ha		
Class	**Area in Hectare**	**Area in %**
<250	1050.3	63.12
>250	613.7	36.88
Total	**1664.00**	**100.00**

Source: Author's Calculation

5.5 Phosphorus (P)

Its role in energy transformations and metabolic process of plants is very important. It also involved in the activation of a number of enzymes participating in the dark reactions in photosynthesis.

Phosphorus in soil organic matter accounts for about 20 to 65% of the total phosphorus found in soils. Therefore, phosphorus mineralization from soil organic matter is an important source of available phosphorus for plant growth. Phosphorous ranks second to nitrogen as a limiting nutrient for plant growth. Although plant available forms of this element are anionic, phosphorus is immobile in soils with appreciable colloid content because it tends to be tightly bound to these tiny particles. Phosphorus may also form water insoluble compounds such as insoluble calcium phosphates in alkaline soils and insoluble iron and aluminium phosphates in acid soils. The concentration of phosphorus in soil solution is normally much less than one part per million (ppm), even in fertilized soils, and often is only hundredths of a ppm in unfertilized soils. Phosphorus fertilizers are normally produced through acidification of the mineral, apatite, found in high concentrations in some sedimentary deposits. Organic phosphorus sources, such as manure, may also be used. Manures, however, usually contain relatively large quantities of phosphorus relative to nitrogen. Care must be taken with manure additions so that excess phosphorus doesn't result in deficiencies of other nutrients, such as zinc or contribute to soluble phosphorus in runoff waters. Soluble phosphorus can be lost in surface runoff waters, but is usually found adsorbed to soil particles transported by erosion. Phosphorus in runoff has been implicated in eutrophication (excessive algal growth) of lakes and streams. Plants need phosphorous for strong root growth; fruit, stem and seed development; disease resistance; and general plant vigour. Phosphorous availability depends on warm soil temperatures, pH range and the levels of other nutrients, such as calcium and potassium in the soil.

Phosphorous (P) status map (Figure: 6) shows that the maximum soil Phosphorous value (108.10 kg/ha) is found in the eastern part of study area and the minimum soil Phosphorous value (6.6 kg/ha) is found in the central part of the study area. The distribution of the soil Phosphorous is divided into two zones i.e. <50 kg/ha and >50kg/ha. The first zone (<50kg/ha) is distributed over the entire study area except some parts in eastern side and it covers about 90% of total area. Second zone (>50kg/ha) is distributed over the central to eastern and south eastern parts of the study area and it covers 10% of total study area (Figure: 6 & Table: 6).

Table: 6 Phosphorous Statuses

Phosphorous Statuses in kg/ha		
Class	**Area in Hectare**	**Area in %**
<50	1492.00	89.66
>50	172.00	10.34
Total	**1664.00**	**100.00**

Source: Author's Calculation

5.6 Potassium (K)

Potassium deficiency is known to produce water imbalance in plants. Potassium salts have a great buffering action and their various enzyme systems. Potassium is known to increase the resistance of plant to the stress of moisture, to heat and to diseases caused by pathogenic fungi, nematodes and other microorganisms. In cereals, potassium improves the proper development of mechanical tissues in the straw, making them less susceptible to loading. In fruit trees, potassium improves the colour, flavor and the size of the fruits.

Potassium (K) is essential for vigorous growth, disease resistance, fruit and vegetable flavour and development. Potassium is required by plants in amounts second only to nitrogen. Unlike nitrogen and phosphorus, potassium is not organically combined in soil organic matter. Different potassium-containing minerals, such as micas and feldspars are the principal sources of potassium in soils. Clay-sized micas weather more rapidly to release potassium than feldspars because of their much greater surface area. Soils that contain considerable micaceous clay may be able to supply a crop's entire potassium requirement without fertilization. Phosphorus is a component of the complex nucleic acid structure of plants, which regulates protein synthesis. Phosphorus is important in cell division and development of new tissue. Phosphorus is also associated with complex energy transformations in the plant.

Potassium (K) distribution map (Figure: 7 & Table: 7) shows that the maximum concentration of the K is (519.84 kg/ha) available in the eastern part and the minimum value is (26.88 kg/ha) available in the southern part of the study area. We have divided the potassium map into three zones i.e. <100 kg/ha, 100 - 165 kg/ha and >165kg/ha. The first zone (<100 kg/ha) is distributed over almost the entire study area like south, south west, south east, east, north east, north and central parts of the study area and it covers 74% of total area. Second zone (100 - 165kg/ha) is distributed over the central west, north west and south east, east central parts of the study area and it covers 25% of total area. Third zone (>165kg/ha) is distributed in central east, north west parts of study area and it covers one per cent of total area.

Table: 7 Potassium Status

Potassium Status in Kg/ha		
Class	**Area in Hectare**	**Area in %**
<100	1231	73.95
100-165	410.7	24.65
>165	22.3	1.40
Total	**1664.00**	**100.00**

Source: Author's Calculation

6. SUMMARY AND CONCLUSION

From the above discussion it has been clear that the entire region and the selected villages are having inferior quality of soil. The unavailability of the water resource worsens the situation. The field investigation revealed that most of the farmers cultivate the land on a sustainable basis only once in a year. Day by day the situation is becoming grim. An urgent need is there to plan for some soil; treatment using natural and chemical fertilizers, it can increase the soil quality although alternative agricultural system for the poor farmers so that they can cultivate some crops with the available the soil properties and resources and at the same time can earn some more income.

Above study GIS technology have been used properly for the interpolating the soil properties in scientific way (Kriging method), this methodology can be used any type of physical and chemical applications.

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