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Evaluation of Soil Fertility Status of Palari Block under Baloda Bazar District of Chhattisgarh

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Abstract
A Study was undertaken to evaluate the fertility status of Palari block, Baloda Bazar district, Chhattisgarh covering 18 villages during 2016-2017. The systematic collection of samples was carried out in geo–referenced surface (0-0.15m) soils samples from 970 sites representing *Inceptisols, Alfisols* and *Vertisols* using Global Positioning System and mapped on 1:4000 Scale. The soil samples were analyzed for pH, EC, OC, N, P and K for delineation of the fertility status in relation to salient physico-chemical characteristics.

Keywords: *Inceptisols, Alfisols, Vertisols* and physico-chemical

Introduction
Soil fertility is the status or the inherent capacity of the soil to supply nutrients to plants in adequate amounts and in suitable proportions. Soil productivity is the capacity of the soil to produce crops with specific system of management and is expressed in terms of yields. Soil fertility and productivity are the key pillars for food production and soil quality is of equal significance in the background of soil degradation caused by many factors. Crop growth is influenced by aerial and soil environment. Suitable environment is necessary for better germination, growth and yield of crops. The higher nutrient availability is favorable when soil has higher water holding capacity, proper aeration and less soil strength or mechanical resistance. All productive soils may be fertile but all fertile soils need not be productive which may be due to problems like water logging, saline or alkaline conditions, adverse climate *etc*. Under these conditions, crop growth is restricted though the soil has sufficient amounts of nutrients. Hence soil fertility status may be defined in a modified way as “the capacity of the soil to produce crops economically and maintain the soil’s health without deterioration”. Again, under irrigation, soil and water compatibility is very important and otherwise the applied irrigation water may adversely affect the chemical and physical properties of the soil. Hence, determining the suitability of land for irrigation requires a thorough evaluation of the soil properties, the topography of the land within the field and the quality of water to be used for irrigation. Soil fertility, compatibility and erodability are the elements of soil quality and among them the decline in soil fertility problem endangers the maximum growth in productivity.

Material Method
Location and climate
Palari block is situated in Baloda Bazar district of Chhattisgarh state lying between 21.53° N latitude, 82.16° E longitude with an altitude of 270 m above the mean sea level. The location of study area is shown in the map of the Chhattisgarh state (Fig.).There are about 18 villages which includes for evaluation of soil fertility status in Palari block.

Soil characteristics
The survey area comes under the soil orders of *Alfisols, Inceptisols* and *Vertisols*. These soils are locally known as Dorsa, Matasi and Kanhar respectively. The *Alfisols* occur on midland situation, are deep and hence have good water holding capacity, roughly twice as that of *Inceptisols.* Most Alfisols fields are bunded and leveled. Impact of drought is relatively less in this situation. The *Inceptisols* is light-textured (gravelly and sandy), upland-unbunded, low water holding capacity, low fertility, excessive soil erosion type of soil. While *Vertisols* is

clayey in texture, dark brown to black in colour, neutral to alkaline in reaction due to presence of lime concretion and is deep (1-1.5 m). The structure varied from coarse angular blocky to massive and cloddy. Soil is represented as typical fine *Smetices, Hyperthermic* and *Typic Haplustert.*

Soil Sample Collection and Preparation

For evaluation of the soil fertility status of Palari block, a systematic survey was carried out. Surface (0-15cm depth) soil samples were collected from the different village of Palari block using GPS (Global Positioning System) marked. The sampling points have taken from the cadastral map of different villages by locating in such a way that from each 10 ha area may represent one grid based soil sample.

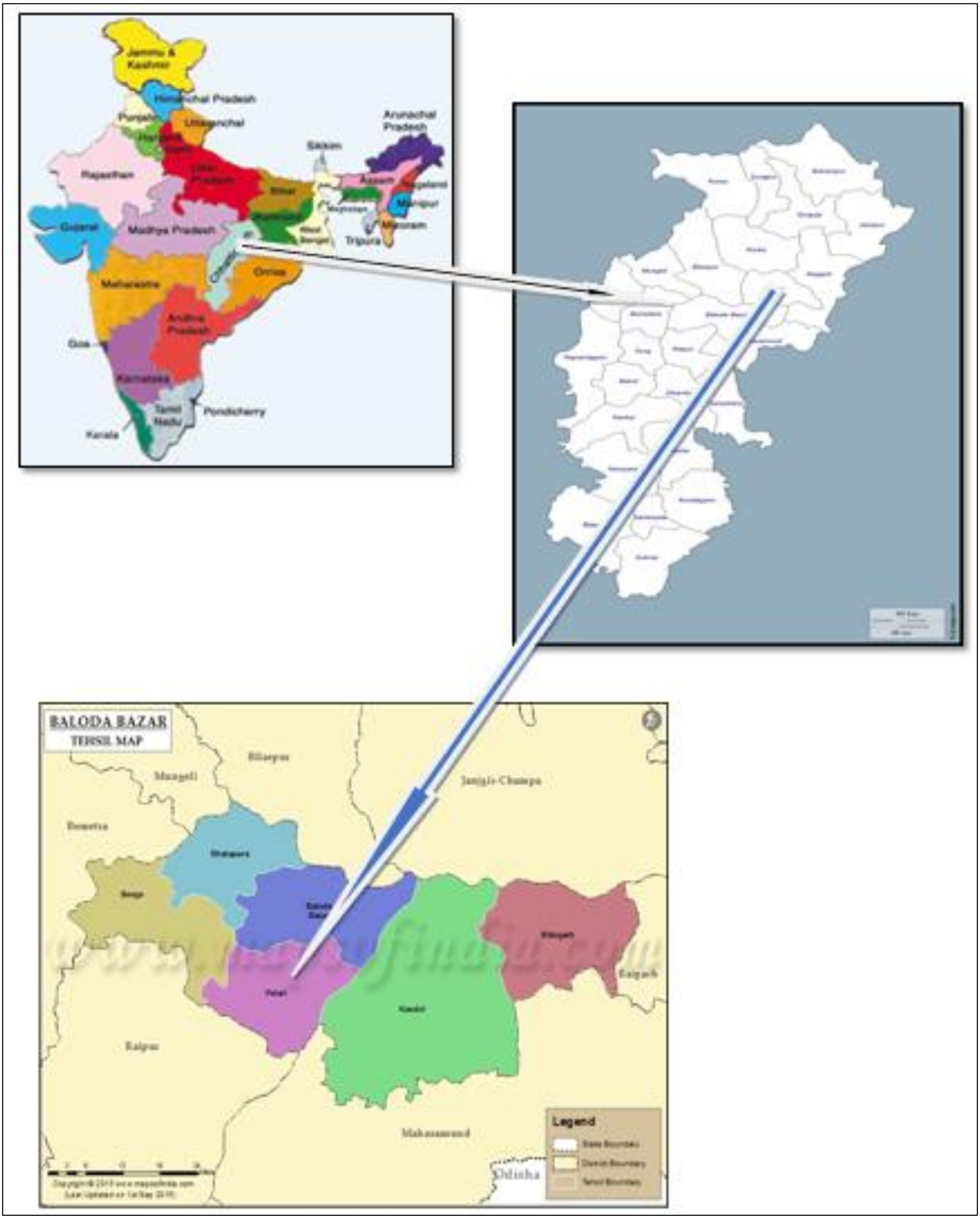

Fig: map of the study area Palari block

Determination of soil pH

It was measured by glass electrode pH meter in 1:2.5 soil water suspensions after stirring for 30 minutes as described by Piper (1967) [5]. The electrode potential developed due to H^+ ions is measured by pH meter using two half cells namely reference electrode and glass electrode. The electrode potential is directly related to the H^+ ions concentration of the medium.

Determination of Electrical conductivity in soil

The soil samples used for pH determination were allowed to settle down the soil particles for 24 hours. The conductivity of supernatant liquid was determined by Solubridge as described by Black (1965) [1]. The soluble salts in soils are determined by electrical conductivity method. Solution offers some resistance to passage of electric current through them, depending upon the salt content. Higher the salt content, lower is the resistance to flow of salt concentration. EC which is reciprocal of resistance, thus, increases with increases in salt concentration.

Determination of Organic carbon (OC) in soil

It was estimated by Walkley and Black's (1934) rapid titration method as described by Jackson (1967) [3]. In this method, organic matter is oxidized with chromic acid (potassium dichromate + sulphuric acid). The unconsumed potassium dichromate is back titrated against ferrous sulphate or ferrous ammonium sulphate.

Estimation of available nitrogen in soil

Available nitrogen in soil was determined by alkaline potassium permanganate method as described by Subbiah and Asija (1956) [8]. The procedure involves distilling the soil with alkaline potassium permanganate solution and absorbs the ammonia liberated in boric acid which is then titrated with Standard sulphuric acid/sulphamic acid.

Estimation of available phosphorus in soil

Available phosphorus was estimated by the ascorbic acid method as described by Olsen, (1954) [4]. In this method, 2.5 gm soil sample was taken and extracted with 0.5 M sodium bicarbonate at pH 8.5. After extraction from the soil, phosphate in the extract is measured by the reaction of phosphate with ammonium molybdate in an acid medium to form molybdophosphoric acid which is then reduced to a blue coloured complex through reaction with ascorbic acid. Absorbance readings were taken at an 882 nm wavelength using a double beam spectrophotometer. A standard curve constructed from absorbance readings of standards is used to deduce phosphate concentration of sample.

Estimation of available potassium in soil

Available potassium was extracted from the 5 gm soil with the help of suitable extractant neutral normal ammonium acetate by shaking, followed by filtration or centrifugation and K is determined in the extract using flame photometer as described by Jackson (1967). The photometer analysis is based on the measurement of the intensity of characteristic line emission given by the element to be determined.

Results and Discussion

Soil physico-chemical properties of the study area

Soil Physico- chemical Properties are shown on the table. 1. The pH ranged from 5.5 to 8.1, 6.0 to 7.9 and 5.7 to 8.1 in *Inceptisols, Alfisols* and *Vertisols,* respectively. The electrical conductivity (EC) varied from 0.08 to 0.63 dS m^{-1} with a mean value of 0.2 dS m^{-1} at 25^0C of the Palari block. Organic carbon status of soils of Palari block is presented in (table 1) revealed that most of the soils are having low to medium status of organic carbon. It ranged from 0.22% to 0.80% with a mean value of 0.48% in *Inceptisols, Alfisols* and *Vertisols* of Palari block.

Available Nitrogen status

The available N content (Table 2) of *Inceptisols, Alfisols* and *Vertisols* varied from 77 to 282 kg ha^{-1} with an average value of 168 kg ha^{-1}. The available N content ranges from 102 to 277 kg ha^{-1}, 102 to 277 kg ha^{-1} and 77 to 282 kg ha^{-1} with mean values of 157, 234 and 172 kg ha^{-1} in *Inceptisols, Alfisols* and *Vertisols* respectively. The soil samples *i.e.* 100%, 100% and 99.70% were found as low available N content in *Inceptisols, Alfisols* and *Vertisols* respectively. The soils of Palari block fell under low status (<280 kg ha^{-1}) in available N content. In general, out of 970 samples, 99.80% fell under low status and 0.20% samples were categorized under medium N status (Table 2.). In this way, almost all the soil samples tested for available N were found to be deficient in N. These results are also in agreement with the findings of Jatav (2010) [2] in the soils of *Inceptisols* order of Baloda block of Janjgir-Champa district of Chhattisgarh and Shukla (2011) [7] in the *Inceptisols, Alfisols* and *Vertisols* groups of Pamgarh block in Janjgir-Champa district (C.G.).

Available P status

The ratings for available phosphorus status are presented in the (table 3). The overall available P of the study area was noted from 1.34 to 26.61 kg ha^{-1} with a mean value of 13.8 kg ha^{-1} (Table 3.). Further, in *Inceptisols, Alfisols* and *Vertisols* it varied from 3.9 to 26.5kg ha^{-1}, 6.9 to 22.3 kg ha^{-1} and 1.3 to 26.6 kg ha^{-1} with an average value of 14.1, 14.6 and 13.7 kg ha^{-1} respectively. The range is quite large which might be due to variation in soil properties *viz.,* pH, organic matter content, texture and various soil management and agronomic practices. Considering the soil test rating for available phosphorus (<12.5 kg ha^{-1}as low, 12.5-25 kg ha^{-1} as medium and >25 kg ha^{-1}as high) majority of the soils fell under medium status. Nearly, 57.42% *(Inceptisols*), 58.83% (*Alfisols*) and 51.23% (*Vertisols*) soil samples were observed under medium status in available phosphorus. The 41.92%, 41.17% and 47.39% samples of study area were categorized under low available P content in *Inceptisols, Alfisols* and *Vertisols,* respectively. Phosphorus is present in soil as solid phase with varying degree of solubility. When water soluble P is added to the soil, it is converted very quickly to insoluble solid phase by reacting with soil constituents. These may include calcium Cate (Olsen, 1953), Fe and Al oxides (Dean and Rubins, 1947 and Chu *et al*. 1962) and partly organic matter. These reactions affect the availability of P and as a result of these reactions, a very small amount of total P is present in soil solution at any time reflected by soil testing. However, a low to medium range of soil available P under study area may be mostly affected by past fertilization, pH, organic matter content, texture various soil management and agronomic practices Verma *et al*. (2005) [9], Jatav (2010) [2], Shukla (2011) [7].

Available K status

The available K content in study area soil ranged from 113 to 567 kg ha^{-1} with an average value 238 kg ha^{-1}(Table 4). The available K ranged from 115 to 555 kg ha^{-1}, 145 to 549 kg ha-

^{1} and 113 to 567 kg ha^{-1} with an average 243, 245 and 235 kg ha^{-1} in *Inceptisols*, *Alfisols* and *Vertisols*, respectively of the study area Palari block. Considering the soils having <135 kg ha^{-1} as low, 135-335 kg ha^{-1} as medium and >335 kg ha^{-1} as high in available potassium contents. The data presented in (table 4.) revealed that 6.28% samples had low and 81.03% had medium, whereas 12.69% samples had high in available K content of the study area. Distribution of the samples with respect to available K indicated (Table 4) that in *Inceptisols* about 12.54% samples had high, 81.52% medium and only 5.94% had low available K content. In *Alfisols*, about 88.23% samples were found in medium and 11.77% samples were found in high K content, whereas in *Vertisols* 80.62% samples found in medium, 12.77% in high and only 6.61% samples recorded as low K content.

These results confirmed the finding as reported by Jatav (2010) in the soils of *Inceptisols* group of Baloda block of Janjgir-Champa district of Chhattisgarh and Shukla (2011) in the *Inceptisols*, *Alfisols* and *Vertisols* orders of Pamgarh block in Janjgir-Champa district (C.G.). Adequate (medium or high) available K in these soils may be attributed to the prevalence of potassium-rich minerals like *Illite* and *Feldspars* (Sharma *et al*., 2008) [6].

Table 1: Soil physico-chemical properties of the study area

Soil Characteristics	Range	Mean	S.D
pH(Soil:water,1:2.5)	5.5 - 8.1	7.3	± 0.58
E.C.(dSm^{-1})	0.08 -0.63	0.20	± 0.09
O.C. (%)	0.22 – 0.80	0.48	± 0.17
Available N (kg ha^{-1})	77 – 282	153	± 58.05
Available P (kg ha^{-1})	1.34 – 26.61	13.8	± 5.25
Available K (kg ha^{-1})	113 – 567	238	± 90.57
Available S (kg ha^{-1})	3.64 – 33.88	14.0	± 6.50
Available B (mg kg^{-1})	0.70 – 3.40	1.75	± 0.54
Available Fe (mg kg^{-1})	6.14 – 45.52	25.67	± 6.86
Available Mn (mg kg^{-1})	2.54 – 41.72	24.39	± 8.12
Available Cu (mg kg^{-1})	0.20 – 5.06	1.51	± 0.86
Available Zn (mg kg^{-1})	0.20 – 2.94	0.78	± 0.49

Table 2: Distribution of available nitrogen status in the soils of Palari block

Available N(kg ha^{-1})	Inceptisols		Alfisols		Vertisols		Total (%)
	No. of samples	% Samples	No. of samples	% Samples	No. of samples	% Samples	
Low (<280)	303	100	17	100	648	99.70	99.80
Medium (280-560)	0	0	0	0	2	0.30	0.20
High (>560)	0	0	0	0	0	0	0
Total	303		17		650		100%

Table 3: Distribution of available phosphorus status in the soils of Palari block

Available P(kg ha^{-1})	Inceptisols		Alfisols		Vertisols		Total (%)
	No. of samples	% Samples	No. of samples	% Samples	No. of samples	% Samples	
Low (<12.5)	127	41.92	7	41.17	308	47.39	45.57
Medium (12.5-25)	174	57.42	10	58.83	333	51.23	53.30
High (>25)	2	0.66	0	0	9	1.38	1.13
Total	303		17		650		100%

Table 4: Distribution of available potassium status in the soils of Palari block

Available P(kg ha^{-1})	Inceptisols		Alfisols		Vertisols		Total (%)
	No. of samples	% Samples	No. of samples	% Samples	No. of samples	% Samples	
Low (<12.5)	18	5.94	0	0	43	6.61	6.28
Medium (12.5-25)	247	81.52	15	88.23	524	80.62	81.03
High (>25)	38	12.54	2	11.77	83	12.77	12.69
Total	303		17		650		100%

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