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Analysis of physical properties of soil of Pandariya block, Kabirdham district, Chhattisgarh

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Abstract
27 Soil samples were collected at a depth of 0-15, 15-30 and 30-45 cm from 9 Village in Pandariya Block in Kabirdham District, Chhattisgarh India was carried out in year 2016-17. Soil samples were analysed for Soil colour soil texture, Bulk density Particle density Pore space solid space water retaining capacity. The Soil colour found in dry condition was, dark brown (10YR, 3/3), Brown (10YR, 4/3), Dark yellowish brown (10YR, 4/4) and Yellowish brown (10YR, 5/4). Soil colour found in wet condition was, very dark greyish brown (10YR, 3/2) and dark brown (10YR, 3/3). The sand, silt and clay percentage was varied from 57.34 to 65.25%, 8.43 to 17.38%, and 20.31 to 34.20% respectively. The two textural classes identified were sandy clay loam and sandy clay. The bulk density, particle density, pore space (%), solid space (%) and water retaining capacity found in varied from 1.11 to 1.33 Mg m^{-3}, 1.81 to 2.85 Mg m^{-3}, 31.25 to 58.83%, 41.17 to 68.75% and 52.33 to 70.55% respectively.

Keywords: Pandariya Block, Soil, Depth, Physical Properties

Introduction
Soil is the basic resource for agriculture and its proper management is essential to sustain agricultural production and maintain soil productivity. Soil testing is one of the best available tools, to ascertain the physical characteristics & nutrient status of a field so as to assess the fertilizer requirements for a crop or a cropping system or for knowing the reclamation requirements if the soil is saline or sodic in nature. Fertilizer application based on soil tests is the best available approach for harvesting the economically viable potential yields of crops by increasing input use efficiency and maintaining soil health (Singh and Brar, 2005) [9]. Soil test-based fertility management is an effective tool for increasing productivity of agricultural soils that have high degree of spatial variability resulting from the combined effects of physical, chemical or biological processes (Goovaerts, 1998) [5]. The production of rice crop is more in the Central part of India. Chhattisgarh is situated in the central part of India. The state of Chhattisgarh, with Raipur as its capital, came into existence on 1st November, 2000 by separation of 16 districts of Chhattisgarh region from Madhya Pradesh. At present 27 districts are there in Chhattisgarh. Chhattisgarh is situated between 17-23.70 N latitude and 80.40-83.380 E longitude in Central eastern part of India. The total geographical area of the state is 136.03 thousand sq. km.
Geographically, Chhattisgarh is divided into three distinct land areas viz.

- Chhattisgarh Plains,
- Bastar Plateau and
- Northern Hill Zones.

The state receives annual rainfall ranging from less than 1200 mm to greater than 1600 mm in different areas. The border of Chhattisgarh is touched by the states Uttar Pradesh in the North, Bihar in the North East, Orissa in the East, Andhra Pradesh in the South and South East, Maharashtra in South West and Madhya Pradesh in the West. Paddy is the main crop of the state and due to abundance of production of paddy Chhattisgarh was known as 'Rice Bowl of Central India.' A vast region of Chhattisgarh is covered by red & yellow soil. There are a number of types of soil found in Chhattisgarh area but there are four major types namely Kanhar, Matasi, Dorsa and Bhata, which cover major portion of the total land area. The red color of soil is generally related to unhydrated ferric oxide, and partially hydrated ions oxides. The yellow color in soil is also due to oxides of iron. The soils of the region are deficient in important mineral nutrients like nitrogen, phosphorous, lime and potash, which are concentrated in the lower parts of the soil layer. However, the tropical red and yellow soils or the red sandy soils of the region possess texture suitable for growing crops.

For the state as a whole, the predominant soil type is red and yellow loamy Soil. The percolation/water retention capacity, as well as the productive capacity of different soils, varies.
The following types of soils are found in Chhattisgarh (Tripathi and Bhardwaj, 2016) [11]:

- **Kanhar (clayey):** A low-lying deep bluish black soil with high moisture retention capacity. It is well suited for rabi crops, particularly wheat.
- **Matasi (sandy loamy):** This is a yellow sandy soil, with an admixture of clay. It has limited moisture retention capacity. Though used for paddy.
- **Dorsa (clay-loam):** This type of soil is intermediate in terms of soil moisture retention between kanhar and matasi. This is best described as loamy, and is a color between brown and yellow.
- **Bhata (laterite):** This soil is a coarse-textured, red sandy-gravelly soil, found on upland tops. It is deficient in minerals and other productivity enhancing nutrients.

Materials and methods

Site detail

Pandariya is a Block located in Kabeerdham district in Chhattisgarh. Placed in rural region of Chhattisgarh, it is one among the 4 blocks of Kabeerdham District. Pandariya is located at 22°14′N 81°25′E to 22.23°N 81.42°E.) normal rainfall is 1450.0 mm and average rainfall 1241.0 mm. The region generally experiences hot, sub humid climate, having average rainfall of 1157.1 mm. It has an average elevation of 348 m (1,142 ft).

Sampling and analysis

The 27 soil samples were collected with different depths (0-15cm, 15-30 cm, 15-30 cm) from 9Village- Baghraytola(V_1), Amarpur (V_2), Chhirpani(V_3), Jhingradongri(V_4), Kodwagoda (V_5), Vicharpur (V_6), Ravan manjholi(V_7), Gudha(V_8), Malkachhra(V_9). The soil colour was determined by Munsell soil colour chart as described in hand book of United State Department of America (USDA, 1994), The soil colour are best determined by the comparison with the Munsell colour chart (Annonymous, 1971) [2]. Soil texture refers to the relative percentage of sand silt and clay in soil. Soil texture analysis was done by Bouyoucos hydrometer method (Bouyoucos, 1927) [3]. Bulk density, particle density, pore space (%) and solid space (%) from 100 ml Graduated measuring cylinder method (Muthuaval, 1992). Water retaining capacity (%) was measured from 100 ml Graduated measuring cylinder method (Muthuaval, 1992).

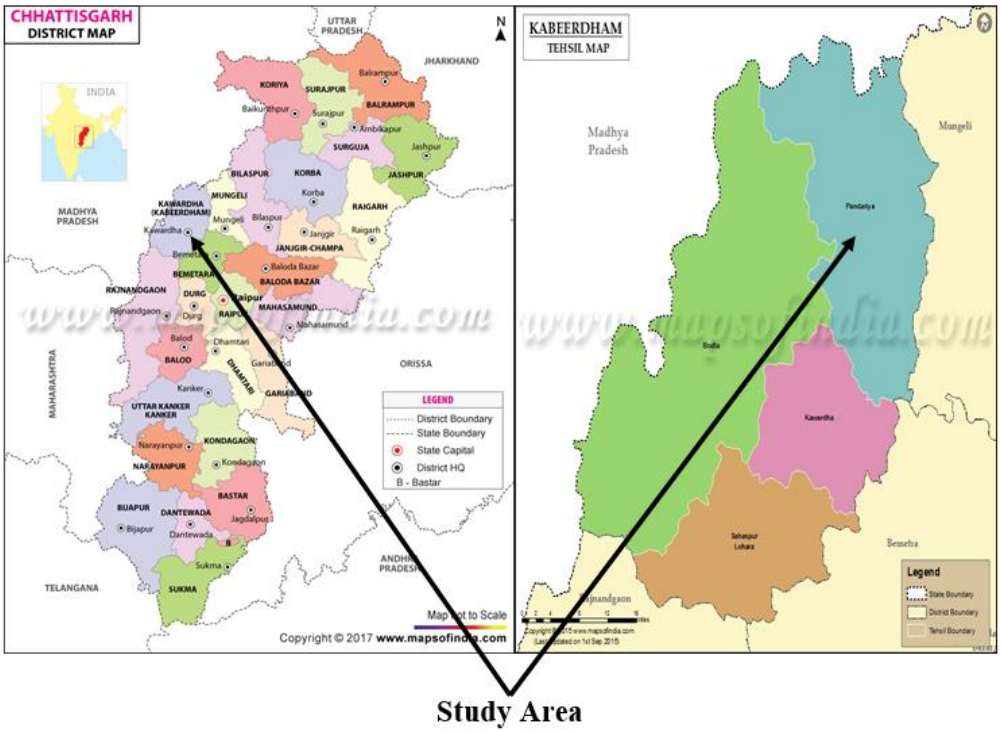

Fig 1: District and Block map of Kabeerdham District.

Table 1: Soils order, Local name and recent area under different Agro- climatic zone of Chhattisgarh.

Soil Orders	Local Name			Area (%)
	Chhattisgarh Plain (51%)	Baster Plateau (28%)	Northen Hills (21%)	
Entisols	Bhata	Tikara	Dadh	19.5
Inceptisols	Matasi	Matasi	Gader	14.8
Alfisols	Dorsa	Mal	Chawar	39.0
Vertisols	Kanhar	Gabhar	Gadar or Bahra	26.4
Mollisols*	-	-	-	0.3

*Soils of forest and grassland vegetation under subhumid to humid region of Baster and Jashpur

Source: Kumar *et al.*, 2015

Results and discussion

- **Soil colour:** Soil colour found in dry condition was, dark brown (10YR, 3/3), Brown (10YR, 4/3), Dark yellowish brown (10YR, 4/4) and Yellowish brown (10YR, 5/4). Soil colour found in wet condition, very dark greyish brown (10YR, 3/2) and dark brown (10YR, 3/3).
- **Soil texture:** The sand, silt and clay percentage was varied from 57.34 - 65.25%, 8.43 - 17.38%, and 20.31 - 34.20% respectively. The two textural classes identified were sandy clay loam and sandy clay.
- **Bulk density (Mg m^{-3}):** The bulk density was found in varied from 1.11- 1.33 Mg m^{-3} similarly results reported by (Chaudhari *et al.,* 2013) [4]. The lowest value of bulk density found in Amarpur (V_2) and Vicharpur (V_6) at depth (0-15 cm) 1.11 Mg m^{-3}. The highest bulk density was found in Kodwagodan (V_5) and Malkachhra (V_9) at depth (30-45 cm) 1.33 Mg m^{-3}.
- **Particle density (Mg m^{-3}):** The particle density was found in varied from 1.81-2.85 Mg m^{-3} similarly results reported by (Ahmadi and David, 2016) [1]. The highest particle density was found in Baghraitola (V_1) at depths (0-15 and 15-30 cm) and Jhingradongri (V_4) at depth (0-15 cm) 1.33 Mg m^{-3}.
- **Pore space (%):** The pore space (%) was found in varied from 31.25 - 58.83% similarly results reported by (Ahmadi and David, 2016) [1]. The lowest pore space (%) found in village Chhirpani (V_3) at depth (30-45 cm) 31.25%. The highest pore space (%) found in village Baghraitola (V_1) at depths (0 -15 and 15-30 cm) 58.83% and Chhirpani (V_3) at depth (0-15 cm) 58.83%.
- **Solid space (%):** The solid space (%) was found in varied from 41.17 – 68.75% similarly results reported by (Ahmadi and David, 2016) [1]. The lowest Pore space (%) found in villages Baghraitola (V_1) at depths (0 -15 and 15-30 cm) 41.17% and Chhirpani (V_3) at depth (0-15 cm) 41.17%. The highest pore space (%) found in village Chhirpani (V_3) at depth (30-45 cm) 68.75%.
- **Water retaining capacity (%):** The lowest value of water retaining capacity was found in villages Kodwagodan (V_5) at depth (30-45 cm) 52.33 %. The highest value of water retaining capacity was found in villages Jhingradongri (V_4) at depth (0-15 cm) 70.55%.

Table 2: Analysis results of chemical parameters of soil samples of Pandariya Block in Kabeerdham District, Chhattishgarh.

Village	Depth in cm	Bulk density (Mg m^{-3})	Particle density (Mg m^{-3})	Pore space (%)	Solid space (%)	Water retaining capacity (%)	Soil texture (%)	Textural classes name
Baghraytola (V_1)	0-15	1.17	2.85	58.83	41.17	68.35	Sand-62.31 Silt-17.54 Clay-20.15	Sandy clay loam
	15-30	1.17	2.85	58.83	41.17	65.11		
	30-45	1.17	2.22	47.05	52.95	60.23		
Amarpur (V_2)	0-15	1.11	2.22	50.00	50.00	69.52	Sand-62.23 Silt-16.65 Clay-21.12	Sandy clay loam
	15-30	1.17	2.22	47.05	52.95	68.12		
	30-45	1.25	2.22	43.75	56.25	66.33		
Chhirpani (V_3)	0-15	1.17	2.50	52.95	47.05	67.86	Sand-65.25 Silt-11.81 Clay-22.94	Sandy clay loam
	15-30	1.25	2.22	43.75	56.25	65.12		
	30-45	1.25	1.81	31.25	68.75	60.00		
Jhingra dongri (V_4)	0-15	1.17	2.85	58.83	41.17	70.55	Sand-61.37 Silt-10.79 Clay-27.84	Sandy clay loam
	15-30	1.25	2.22	43.75	56.25	69.30		
	30-45	1.25	2.00	37.50	62.50	62.33		
Kodwagodan (V_5)	0-15	1.25	2.22	43.75	56.25	67.12	Sand-65.13 Silt-8.89 Clay-25.98	Sandy clay loam
	15-30	1.25	2.00	37.50	62.50	59.11		
	30-45	1.33	2.00	33.34	66.66	52.33		
Vicharpur (V_6)	0-15	1.11	2.22	50.00	50.00	63.00	Sand-58.54 Silt-17.56 Clay-23.90	Sandy clay loam
	15-30	1.17	2.00	41.17	58.83	58.22		
	30-45	1.25	2.22	43.75	56.25	56.20		
Ravan manjholi (V_7)	0-15	1.17	2.00	50.00	50.00	65.20	Sand-59.33 Silt-9.64 Clay-31.03	Sandy clay
	15-30	1.17	2.00	41.17	58.83	63.00		
	30-45	1.17	1.81	35.29	64.71	59.00		
Gudha (V_8)	0-15	1.17	2.00	41.47	58.53	62.23	Sand-57.34 Silt-8.76 Clay-33.90	Sandy clay
	15-30	1.25	2.00	37.50	62.50	63.22		
	30-45	1.25	2.00	37.50	62.50	60.23		
Malkachhra (V_9)	0-15	1.17	2.50	52.95	47.05	66.22	Sand-58.20 Silt-9.87 Clay-31.93	Sandy clay
	15-30	1.25	2.22	43.75	56.25	63.01		
	30-45	1.33	2.00	33.34	66.66	59.24		

Conclusion

It can be concluded that the soil of Pandariya Block in Kabeerdham district of Chhattisgarh showed status according to (Table no. 2) two textural classes identified were sandy clay loam and sandy clay similarly results reported by (Chaudhari *et al.,* 2013) [4]. The solid space (%) found in varied from 41.17 – 68.75% similarly results reported by (Ahmadi and David, 2016) [1], the solid space (%) was found to be significant at different depths and village. The pore space (%) was found in varied from 31.25 - 58.83% similarly results reported by (Ahmadi and David, 2016) [1], the pore space (%) was found to be significant at different depths and village. The bulk density was found in varied from 1.11- 1.33 Mg m^{-3} similarly results reported by (Chaudhari *et al.,* 2013) [4], the bulk density was found to be significant at different depths and village. The particle density was found in varied from 1.81-2.85 Mg m^{-3} similarly results reported by (Ahmadi and David, 2016) [1], the particle density was found to be significant at different depths and villages. The value of water retaining capacity was found in ranges from 52.33 - 70.55% similarly results reported by (Sujatha *et al* 2016) [10], Water

retaining capacity was found to be significant at different village and depths.

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