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Soil fertility status of available nitrogen in soil through soil fertility mapping using GPS and GIS techniques of Bamhanidih village and block, Janjgir-Champa district of Chhattisgarh state

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Abstract
The present research is to evaluate soil fertility status of available nitrogen in soil by soil fertility mapping using GPS and GIS techniques of Bamhanidih village. In order to study the selected physic-chemical properties and available macro and micro-nutrients, a total of 221 surface soil samples (0-15cm) were randomly taken for this purpose. Soil fertility maps were adopted by using Kriging techniques of Geo-statistical interpolation methods. Soil fertility maps of study area will be conducted on 1:23,186 scale.

Keywords: soil fertility mapping, GPS, GIS

Introduction
Soil fertility is concerned with the inherent capacity of the soil to provide nutrients, in adequate amounts and in proper balance, for the growth of specified plants when other growth factors such as light, water and temperature, and the physical condition of the soil are favorable. Thus a fertile soil may or may not be abundant depending leading crops, marketing condition in addition to several further factors (i.e., excessive acidity or alkalinity, the presence of toxic substance, deprived physical properties or an excess or deficit of water. Now days fertility maps are used to show spatial distribution of nutrients in particular area with the help of GIS and GPS tools and software. Nitrogen is an essential constituent of metabolically active compounds such as amino acids, proteins, enzymes and some non-proteinous compounds. When nitrogen is a limiting factor, the rate and extent f protein synthesis are depressed and as a result plant growth is affected. (T.D. Biswas and S.K. Mukharjee, 2019) [1]

Material and methods Study Area
The study area lies in the village and block *Bamhanidih* of the district Janjgir-Champa, Chhattisgarh state. This village is situated at the bank of *Hasdev* River. This village lies almost at the centre of the district. It is located 35 km away from district headquarter *Janjgir* and 16 km away from *Champa* city. *Bamhanidih* block is one of the 9 blocks of Janjgir-Champa district and
Bamhanidih village is one of the 78 villages of the district. The geographical location of the study area is 21051' E latitude, 82058' longitude and 254 m above MSL with geographical area of 824.82 ha. The study area comes under the command area *Hasdev- Bango* irrigation project, some of the area is also irrigated by tube wells. The study area comes under *Chhattisgarh-Plains* agro-climatic zone of the state.

Climate and weather conditions
Generally hot, sub-humid and semi-arid climatic conditions prevailed in Bamhanidih village. Average rainfall overall region of research area is near about 1388 mm with rainfall intensity of 20.85 mm h-1. Rainfall occurs due to south west monsoon and is mostly concentrated in the months of June to September and very little amount occurred in the months from October to February. The hottest and coolest months are May and December respectively.

The maximum temperature in summer was found as high as 49 ^{0}C and the minimum temperature in winter was found as low as 10 ^{0}C.

Soil type

The soils of the study area, in general, are dominantly brown to slightly black in colour and locally called *Dorsa* soils which fall under the category of *Alfisols*. These soils were found to be moderately to slightly acidic in soil reaction. The mechanical composition of the soils indicated sufficiency of clay content and the texture is sandy loam.

Sample collection and laboratory analysis

Soil samples were collected from irrigated areas in the surface profile: 0-15 cm depth of soil. A screw style augur and a spade or *Khurpi* were used for sampling. Spade was used to make a "V" shaped cut up to the plough depth (upper layer: 0-15cm) and then a uniform 1-2 cm thick slice was taken out to remove any grass, stones, pebbles, or debris. For further planning, the collected soil sample was carefully mixed over a clean piece of polythene sheet and kept secured safely in packets labelled with field number, details of farmers and hamlets (*khars*) for further analysis. Soil samples are analyzed for available nitrogen by using method described by Subbiah and Asija, 1956 [4].

Result and Discussion

Available nitrogen

Nitrogen is essential for plant development, since it plays a fundamental role in energy metabolism and protein synthesis. These results indicated that the available N content of the soils ranged 211.9-288.5 kg ha-1 with a mean value of 247.2±25.41 kg ha-1. The per cent distribution of the samples under low range (150- 280 kg ha-1) and medium range (280-560 kg ha-1) is shown in the Table 1. The data revealed that 94.1% samples were under low range and only 5.9% samples were found in medium range Table 2.

Here it can be noted that most of the area of *Bamhanidih* village comes under N deficient category. It may be due to low OC content which is the main source of nitrogen (98%). It can also be due to the extensive leaching and runoff losses of various form of N from soils of low lying land (*Bahara* soils) with peculiar topography having gradient towards river (promoting surface and ground water flow) in the study area.

The results obtained in this study in respect of the available N were also found in line with the findings of Mandal *et al.*, (2018) [2]. They evaluated soils of Durg district and found that 98.82%collected samples were deficient in terms of available N. Results were further supported by the work of Maragatham *et al.*, (2014) [3] wherein soils of Salem district of Tamil Nadu were studied. The results showed that 92.5% and 7.5% area were in low and medium fertility range respectively.

Table 1: Salient properties of soil in the study area

S. No.	Parameters	Range	Average/ Mean	S.D.
1	pH	4.7-5.98	5.39	0.359
2	EC (dS m-1)	0.10-0.23	0.17	0.02
3	Organic carbon (%)	0.11-0.20	0.16	0.02
4	Nitrogen (kg ha-1)	211.9-288.5	247.2	25.41
5	Phosphorus (kg ha-1)	10.1-25	20.5	3.99
6	Potassium (kg ha-1)	202.5-293.7	255.3	36.27
7	Sulphur (kg ha-1)	10.1-33.9	24.3	5.94
8	Boron (mg kg-1)	0.20-1.80	0.64	0.29
9	Zinc (mg kg-1)	0.52-1.92	1.12	0.28
10	Iron (mg kg-1)	12.65-59.60	36.66	10.92
11	Manganese (mg kg-1)	13.24-31.25	19.88	4.19
12	Copper (mg kg-1)	0.10-2.07	1.03	0.45

Table 2: Distribution of soil samples under different Nitrogen ratings

Soil N (kg ha-1)			
Classes	**Range**	**No of Samples**	**% of samples tested**
Low	150-280	208	94.1
Medium	280-560	13	5.9

Soil Fertility map

Results also presented in Fig.1 that shows status and spatial distribution of available N content of the soils in *Bamhanidih* village. The legend of this figure shows low values (150- 280 kg ha-1) of N content represented by yellow colour and that of medium value (280-560 kg ha-1) of N content represented by red colour.

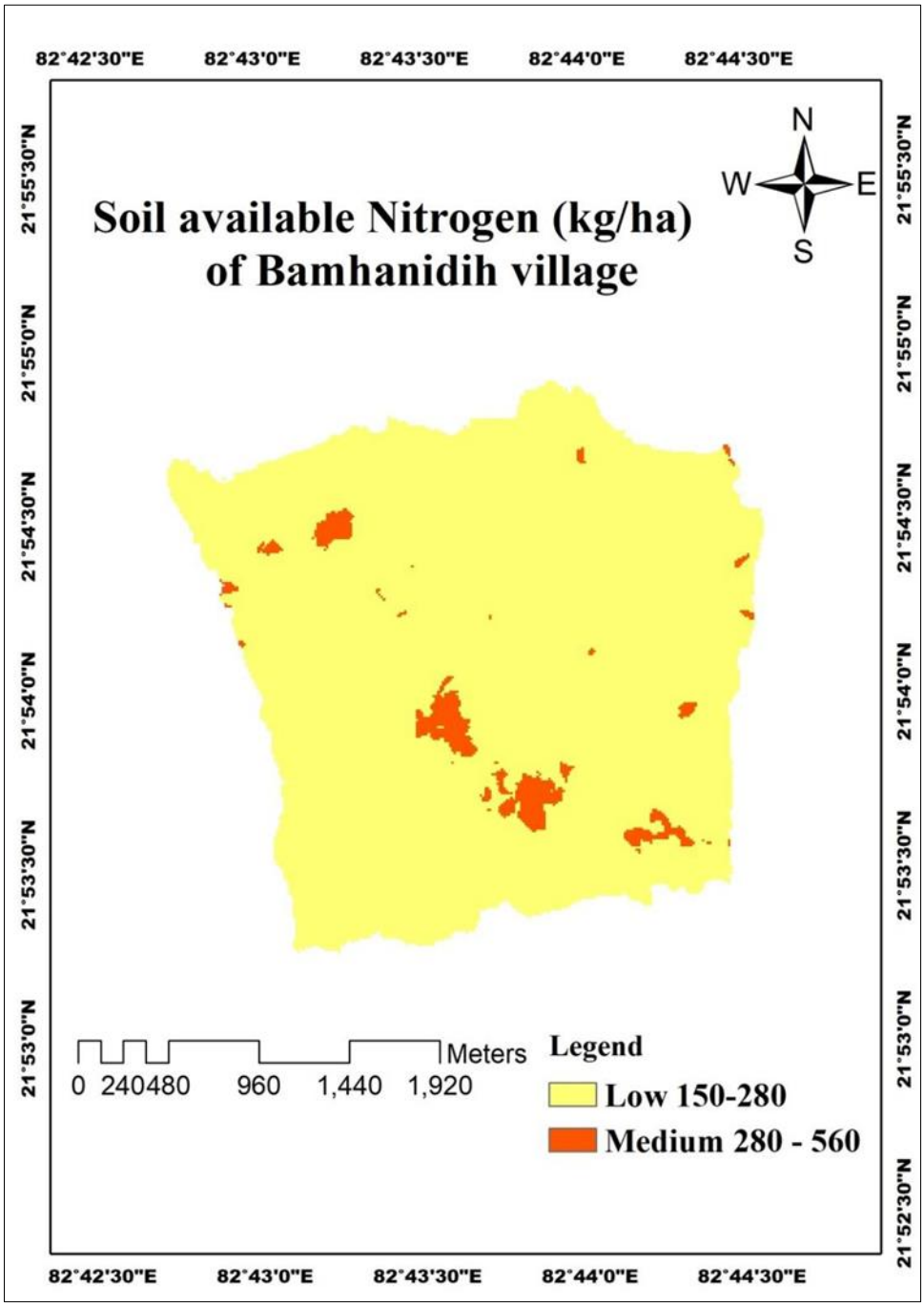

Fig 1: Spatial distribution of available N in soils of *Bamhanidih* village

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