STUDIES ON FERTILITY STATUS OF CENTRAL TAHSILS OF PARBHANI DISTRICT (MANWAT, PARBHANI AND PURNA)

BY

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B.Sc. (Agri.)

DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

COLLEGE OF AGRICULTURE, PARBHANI

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PARBHANI 431402 (M.S.), INDIA

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DISSERTATION

Submitted to the
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani
in partial fulfilment of the
requirement for the degree of

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DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY
COLLEGE OF AGRICULTURE, PARBHANI
VASANTRAO NAIK MARATHWADA KRISHI VIDYAPEETH,
PARBHANI - 431402 (M.S.), INDIA.

2014

CANDIDATE'S DECLARATION

I hereby declare that this dissertation

Or part thereof has not been

Previously submitted by me

For a degree of any

University or

Institute

Place: PARBHANI
Date: 31 /05 /2014

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CERTIFICATE – I

This is to certify that the dissertation entitled **"STUDIES ON FERTILITY STATUS OF CENTRAL TAHSILS OF PARBHANI DISTRICT (MANWAT, PARBHANI AND PURNA)"** submitted by **GOPAL SANGRAM SUNEWAD** to the Vasantrao Naik Marathwada Krishi VIdyapeeth, Parbhani in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (Agriculture)** in the subject of **Soil Science and Agricultural Chemistry,** is record of original and bonafided research work carried out by him under my guidance and supervision. It is of sufficiently high standard to warrant its presentation for the award of the said degree.

I also certify that the dissertation or part thereof has not been previously submitted by him for a degree of any university.

Place**:** PARBHANI
Date: 31/05/ 2014

(Dr. H. K. Kausadikar)
Research Guide and Chairman

CERTIFICATE – II

This is to certify that the dissertation entitled **"STUDIES ON FERTILITY STATUS OF CENTRAL TAHSILS OF PARBHANI DISTRICT (MANWAT, PARBHANI AND PURNA)"** submitted by **GOPAL SANGRAM SUNEWAD** to the Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE (Agriculture)** in the subject of **Soil Science and Agricultural Chemistry** has been approved by the student's advisory committee after viva-voce examination in collaboration with the external examiner

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2014

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Place : Parbhani. **(SUNEWAD G. S.)**
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ABBREVIATIONS

%	-	Per cent
ha.	-	Hectare
cm.	-	Centimeter
mm.	-	Millimeter
et al.	-	(*Et alia*) others
Fig.	-	Figure
sq. km	-	Square kilometer
i.e.	-	*Id est,* that is
dSm^{-1}	-	Decisimon per meter
$g\ kg^{-1}$	-	Gram per kilogram
$kg\ ha^{-1}$	-	Kilogram per hectar
$mg\ kg^{-1}$	-	Milligram per kilogram
No.	-	number (s)
^{o}C	-	degree celcious
ppm	-	Parts per million
M ha	-	Million hectare
DTPA	-	Diethylene triamine penta acetic acid
Temp	-	Temperature
viz.,	-	(Vide licet) namely
Max.	-	maximum
Min.	-	minimum
NIV	-	Nutrient index value
Agri.	-	agriculture

Univ.	-	university
pH	-	Puissance de hydrogen
EC	-	Electrical conductivity
O.C	-	Organic carbon
$CaCO_3$	-	Calcium carbonate
N	-	Nitrogen
P	-	Phosphorus
K	-	Potassium
Ca	-	Calcium
Mg	-	Magnesium
S	-	Sulpur
Fe	-	Iron
Mn	-	Manganese
Zn	-	Zinc
Cu	-	Copper
S	-	Samples
V		Village

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Research Title: "**Studies on Fertility Status of Central tahsils of Parbhani District (Manwat, Parbhani and Purna)"**

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ABSTRACT

The present investigation entitled "Studies on Fertility Status of Central tahsils of Parbhani district (Manwat, Parbhani and Purna)." was carried out during 2012-13 at department of Soil Science and Agril. Chemistry, VNMKV, Parbhani.This region comes under semi arid tropics. Total 225 soil samples (75 from each thasil) were collected from central tahsils viz., Manwat, Parbhani and Purna of Parbhani district. These soil samples were analyzed for physical, chemical properties and fertility status of soil by using standard procedures. Regarding chemical properties, pH value of soils of Manwat tahsil varied from 7.10 to 7.9 with mean value of 7.47, Parbhani tahsil soil pH ranged from 7.10 to 8.40 with mean value of 7.83 and Purna tahsil soil pH was ranged from 7.45 to 7.90 with mean value 7.54. These soils are categorized as normal to alkaline in nature. Thus, soils of Central tahsils of Parbhani district are netural to moderately alkaline in soil reaction. The Electrical conductivity of soils of Manwat tahsil ranged from 0.32 to 0.69 with a mean value 0.52 dSm^{-1}, Parbhani tahsil ranged from 0.30 to 0.58 with a mean value 0.48 dSm^{-1} and Purna tahsil ranged from 0.18 to 0.65 with a mean value 0.40 dSm^{-1}. Thus, the EC of Soils of Central tahsils of Parbhani district is in safe of limit salinity for plant growth. The value of organic carbon content of soils of Manwat tahsil was varied from 0.32 to 0.69 per cent with average value 0.52, Parbhani tahsil soil from 0.05 to 1.05 with average value of 0.50 per cent and Purna tahsil soils from 0.10 to 0.90 with average value of 0.35 per cent. Thus, the organic carbon content of Central tahsils of Parbhani district ranged from low to medium. The calcium carbonate content of

Manwat tahsil soils was varied from 5.0 to 10.5 with average value of 7.69 per cent, Parbhani tahsil soils were varied from 5.0 to 10 per cent with average value of 6.89 per cent and Purna tahsil soils were varied from 4.4 to 10 per cent with an average value 7.5 per cent. Thus, the Central tahsils of Parbhani district soils are non-calcareous to calcareous in nature.

According to the concept of "soil nutrient index", the availability of soil available N (1.03), and P (1.54), nutrients are in low range, where as, The secondary nutrient S is deficiency in 100 percentage soils and DTPA-Fe, 36, DTPA Mn, 21.3, DTPA Zn, 91.5, soils of central tahsils of Parbhani district. High in available K (2.98). Thus, deficiencies of nitrogen, sulfur and zinc are soil nutritional constraints of Central tahsils (Manwat, Parbhani and Purna) of Parbhani district. Further, the organic carbon content showed positive and significant corr elation with available Nitrogen, Phosphorus, Sulphur as well as micronutrients. The calci um carbonate content showed negative correlation with available P and DTPA Zn.

The soil site suitability characteristics of Manwat, Parbhani and Purna tahsils of Parbhani district showed that these soils are highly suitable for growing soybean and moderately suitable for growing cotton crop.

(G.S. Sunewad)	**(Dr.H.K. Kausadikar)**	**(Dr.V.D. Patil)**
Student	**Research Guide**	**Head**

Chapter- I

INTRODUCTION

Before green revolution the problem of major and micronutrient deficiency was not an impediment in crop production in India due to substance farming with local crop varieties with low production potential and inadvertent applications of plant nutrients through organic manures. After the late sixties green revolution change the scenario of Indian Agriculture, introduction of fertilizer responsive high yielding varieties, use of high analyses of fertilizers, mainly N, P, K fertilizers lead to the individual agriculture aiming higher production potential and higher total production, which lead to many problem related to depletion of soil health with deficiencies of nutrient element (Patil *et al.* 2001).

Soil is considered to be store house of plant nutrient even though there is continuous removal by intensive cropping and loses through leaching and erosion which depleted content to great extent. Secondly the replenishment of nutrient to the soil did not keep pace with removal nutrients by crops, because wide gap between supply and removal of nutrient (Sarkar *et al*.2002).

One of the basic challenge in our Indian agriculture facing today is to increase agriculture produce from limited land resources to meet the demand of growing population. In order to meet the need of growing population, there are few options; one to increase the yield per hectare through better management and the second to increase the area under plough by putting present additional marginal land to proper use or combination of both.

Soil fertility an integral property of soil is the capacity of soil to supply nutrients needed by crop in proper form and at proper rate. A comprehensive knowledge of soil fertility status is quite essential for efficient use of any production input. Introduction of hybrids and high yielding varieties in mid-sixties and further continues use of newly hybrids, high fertilizers responsive varieties created nutritional physiological problems including exhaustion of soil nutrient resource. Thus, it is

necessary to take stock of available soil fertility data periodically and further recognize the scheduling of balance fertilizers for sustainable agriculture.

The evaluation of soil fertility includes the measurement of available plant nutrients and estimation of capacity of soil to maintain a continuous supply of plant nutrients for a crop. This availability of nutrients depends on various factors such as types of soils, nature of irrigation facilities, pH and organic matter content.

Soil is a medium for plant growth and development that leads to crop productivity depends on many factors and soil fertility is major amongst all. Soil fertility has a direct relation with crop yields, provided other factors are at optimum level. Soil fertility must be periodically estimated because there is continuous removal of macro and micro nutrients by the crop intensively grown in every crop season. Due to continuous cropping system for periods without adequate supply of additional amounts of nutrients, there is every possibility of deficiencies of essential nutrients in due course of time. The productivity of soil depends equally on its physical properties and nutrients. Unless the soil is in appropriate structural conditions, the nutrient present in soil would not be in available to plants (Jibhakate *et al*. 2009).

Soil quality mainly depends on the response of soil to different land use systems and management practices, which may often modify the soil properties and soil productivity. Effect of land use systems on soil properties provides an opportunity to evaluate sustainability of land use systems and thus the basic process of soil degradation in relation to land use, and hence the soil and crop management must be given high priority. The ability of soil to support crop growth for optimum crop yield response is most important component of soil fertility that determines the productivity of agricultural systems. Many of the processes that influence the soil fertility and productivity are controlled by different characteristics of soil. However, the information on effect of land use systems on soil quality to give recommendations for optimal and sustainable utilization of land resource is scanty (Saqeebula *et al.* 2012). Therefore, knowledge of physico-chemical characteristics of soil became necessary.

The introduction of high yielding crop varieties and intensive agriculture with modern agro-techniques and less use of onfarm organic manures, most soils are becoming deficient in major N, P, K nutrients. Such deficiency of N, P and K nutrients affect the yield, growth and nutrition of crops to great extent. Therefore, it is worthwhile to know the distribution pattern of N, P and K in soils as affected by various factors for the efficient management through external application (Biswas *et al.* 2011).

Land is a finite natural resource and there is no scope to increase the area under cultivation. The food production in India can only be increased by increasing the crop productivity. The higher productivity can only achieved with better information on land and its use. In the present dynamic situation accurate meaningful, current data on land use are essential. Information on the land use pattern facilitates a better understanding of land utilization that is vital for land evaluation and is a process of estimating the potential of the lands for the alternate uses, land use planning and development (Kannan *et al.* 2010).

The soils of south central part of Maharashtra are developed on basaltic and metamorphic rocks of varying geological age and also on alluvium derived from such rocks. The soils of Parbhani district scientifically known as " Mixed Montmorillonitic Hyperthermic Typic Chromostert". Therefore, an attempt was made to know the Studies on fertility status of central tahsils of Parbhani district (Manwat, Parbhani and Purna) with following objectives.

OBJECTIVES

1. To evaluate the physical-chemical properties of soils of central tahsils Parbhani district.
2. To evaluate the fertility status of soils of central tahsils of Parbhani district.
3. To establish the relationship between physical-chemical properties and fertility status of soils.
4. To prepare the fertility indices of central tahsils of Parbhani district.

Chapter- II

REVIEW OF LITERATURE

The rational utilization, improvement and conservation of soil resource is not possible without thorough understanding of its physical-chemical properties and nutrient availability in soil. Macronutrients (N, P, K, and S) and micronutrients (Zn, Fe, Mn, Cu) are important soil elements that control its fertility. Soil fertility is one of the important factor controlling yield of crops. Characterization of soil in relation to evaluation of fertility status of a particular area is an important aspect in context of agriculture production. The present investigation was undertaken to study the physical, chemical properties and nutrient availability in soils of Central tahsils of Parbhani District. Based on the available information the literature was reviewed under the following headings and their sub-headings.

2.1 Physical-chemical properties of soils.

2.1.1 Soil reaction (pH)

2.1.2 Electrical conductivity (EC)

2.1.3 Organic carbon (org. C)

2.1.4 Calcium carbonate ($CaCO_3$)

2.2 Status of available Macro-nutrient in soil.

2.2.1 Available Nitrogen

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2.4 Correlation between Physical-chemical properties and available nutrients in soils.

2.4.1 Soil pH and available nutrients.

2.4.2 EC and available nutrients.

2.4.3 Organic carbon and available nutrients.

2.4.4 $CaCO_3$ and available nutrients.

2.1.1 Soil reaction (pH)

Kadao *et al*. (2002) studied Banana growing soils of Wardha district of Maharashtra and indicated that pH was ranged from 7.9 to 8.4 in different horizons.

Bhatnager *et al.* (2003) analyzed some profiles of Shivpuri district of Madhya Pradesh and noticed that pH value varied from 7.71 to 8.30 in Inceptisols and 7.60 to 8.60 in Vertisols, respectively.

Raut and Mali (2003) observed that on an average the pH of all the samples in Vertisols was 7.93, while in Inceptisols and Entisols 7.97 and 7.84, respectively.

Waikar *et al.* (2003) indicated that the pH values in the soils of South Central Maharashtra were ranged between 6.18 to 8.44.

Shamudheen *et al.* (2007) reported that these soils have pH value varied from 5 to 5.7 and Shinde *et al*. (2007) reported that the pH of soils ranged from 7.0 to 8.79 for Deoni tahsil of Latur district.

Yadav and Meena (2009) studied the Dengana soil series of Rajasthan and showed that the pH was ranged from 7.32 to 9.45.

Ashok Kumar and Jagdish Prasad (2010) reported that the range of pH in the soils of Ahmednager district of Maharashtra ranges from 8.2 to 8.9.

Deshmukh *et al.* (2012) conducted a study to know the chemical characteristics of the soils and their classification from Sangamner area, Ahmednagar district, Maharashtra. For this purpose, 62 surface soil samples were analyzed for different parameters by standard procedures. pH ranged from 8 to 9.7 reflecting alkaline nature of soils.

Vijayakumar *et al.* (2013) studied salt affected soils of Ongole division, Prakasam district, Andhra Pradesh and reported that the pH of soil ranged from 6.5 to 9.1. and Haribhushan *et al*. (2013) studied soils of Senapati district of Manipur and showed that the pH was ranged from 5.08 to 6.97.

2.1.2 Electrical Conductivity

Ghuge (2002) reported that EC of Vertisol, Inceptisol and Entisol of Ujana (Ahmadpur) were ranged from 0.17 to 0.48, 0.19 to 0.40 and 0.20 to 0.48 dSm^{-1} respectively.

Padole and Mahajan (2003) observed that the EC of swell-shrink soils of Vidharbha region were ranged from 0.13 to 1.54 dSm^{-1}.

Waikar *et al*. (2004) studied that the soils from Maharashtra region and reported that EC of these soils were varied from 0.12 to 0.86 dSm^{-1}.

Sood *et al*. (2009) studied soils of Muktsar district of Punjab and observed that electrical conductivity varied from 0.11 to 6.69 with a mean value of 0.63 dSm^{-1}.

Singh *et al.* (2009) analyzed soils of Ghazipur district of Uttar Pradesh and reported that electrical conductivity varied between 0.10 to 0.38 dSm^{-1} of the normal soils. And Yadav and Meena (2009) studied the Dengana soil series of Rajastan and found that the electrical conductivity varied from 0.11 to 1.84 dSm^{-1}.

Vijayakumar *et al.*, (2013) studied salt affected soils of Ongole division, Prakasam district, Andhra pradesh and reported that the electrical conductivity ranged from 0.03 to 17 dSm^{-1}. Also Haribhushan *et al*. (2013) studied soils of Senapati district of Manipur and showed that the electrical conductivity varied from 0.02 to 0.22 dSm^{-1} with mean value of 0.07 dSm^{-1}.

2.1.3 Organic Carbon

Dhage *et al.* (2000) analyzed soils of Shevgaon tahsil (Ahmednagar Dist) and indicated that the organic carbon content ranged from 1.5g kg^{-1} to 12 g kg^{-1} with the mean value of 5.26 g kg^{-1}. Majority of the soils were low to moderate in organic carbon content.

Sharma and Bali (2000) reported that organic carbon content (6.8 g kg^{-1}) increased significantly in cultivated soil over uncultivated soil (5.1 g kg^{-1}). The organic carbon content was higher in surface soil as compared to sub surface soil.

Maji *et al.* (2005) analyzed soils over basaltic terrain in sub-humid tropics of Central India and reported that organic carbon content of soils ranges from 0.9 to 9.7 g kg^{-1}. Also Rajkumar *et al*. (2005) analyzed Aridsols of Punjab and indicated that organic carbon content ranges from 1.4 to 4.0 g $kg^{-1.}$

Jat and Yadav (2006) studied Mustard growing soils of Jaipur district and observed that organic carbon varied from 1.9 to 5.0 g $kg^{-1.}$

Chaudhari and Kadu (2007) analyzed 390 soil samples from Dhule tahsil of Dhule district and reported that the organic carbon content of soil varied from 0.12 to 1.09 per cent.

Shamudheen *et al*. (2007) reported that these soils have organic carbon content varied from 0.28 to 2.49 per cent was more at the surface and showed a decrease with depth might be due to leaching environment existing in the area.

Shinde *et al*. (2007) reported that the organic carbon ranged from 0.10 to 1.50 per cent for Deoni tahsils of Latur district.

Sharma *et al*. (2008) studied the soils of Amritsar district of Punjab and found that the organic carbon content ranged from 0.16 to 0.97 per cent with an average value of 0.61 per cent.

Vaidya and Mali (2008) reported that the soils of kini farm College of Agriculture Osmanabad are low to moderate in organic carbon, neutral to alkaline (6.8 to 7.2) in reaction and calcareous in nature (<5 per cent).

Yadav and Meena (2009) studied the Dengana soil series of Rajasthan and observed that the organic carbon content varied from 0.3 to 5.4 g kg^{-1}.

Vijayakumar *et al.,* (2013) studied salt affected soils of Ongole division, Prakasam district, Andhra pradesh and reported that the organic carbon content ranged from 0.6 to 12.9 g kg^{-1} with mean value of 4.2 g kg^{-1}.

Haribhushan *et al*. (2013) studied soils of Senapati district of Manipur and found that organic carbon content ranged from 6.0 to 25.2 with mean value of 14.74 g kg^{-1}.

2.1.4 Calcium carbonate ($CaCO_3$)

Giri *et al*. (2002) analyzed gypsiferous soils in Bikaner district of Rajasthan and observed that the soils are low to moderately calcareous i.e. $CaCO_3$ content 3 to 14.5 per cent.

Bhatnager *et al.* (2003) studied profiles of Shivpuri district of Madhya Pradesh and noticed that Calcium carbonate ranged from 12.5 to 48.7 g kg^{-1} in Inceptisols and 8.5 to 71.6 g kg^{-1} in Vertisols, respectively.

Waikar *et al.* (2003) studied soils of drought prone South Central part of Maharashtra and reported that the $CaCO_3$ content ranged from 47.80 to 73.30 g kg^{-1} in different horizons.

Bhaskar *et al*. (2005) observed that the $CaCO_3$ content varies from 6.3 to 44.7 g kg^{-1} with irregular distribution the sola except in Dangari Bil where it decreased gradually with depth. The surface horizons contain more than 20 g kg^{-1} $CaCO_3$.

Thangasamy *et al.* (2005) reported that the $CaCO_3$ content was less in soils of Chittor district, Andhra Pradesh which ranged from 4.1 to 108.1 g kg^{-1}.

Meena *et al.* (2006) analyzed the clay loam soils of Rajasthan and reported that the $CaCO_3$ were varied from 0.20 to 10.0 per cent with mean of 0.45 per cent.

Yadav and Meena (2009) studied the Dengana soil series of Rajasthan and observed that the $CaCO_3$ were varied from 0.50 to 4.0 percent. also, Jibhakate *et al. (*2009) studied the physico-chemical status of soils of Katol tahasil in Nagpur district and showed that the $CaCO_3$ content of these soils were ranged from 3.84 to 9.69 per cent.

2.2 Status of available Macro-nutrient in soil.

2.2.1 Available Nitrogen

Dhage *et al.* (2000) reported that the available of N content of soils from Shevegaon tahsils of Ahmednagar district were ranges between 59.58 to 228.92 kg ha^{-1} with a mean value of 165.9 kg ha^{-1}.

Ghuge *et al.* (2002) reported that the available N content in Vertisol, Inceptisol and Entisol were ranged from 175.61 to 269.69, 144.50 to 269.69 and 141.20 to 232.06 kg ha^{-1} with mean values of 232.17, 206.82 and 183.49 kg ha^{-1} N respectively. These soils were low to medium in available N content. The available N was associated with organic carbon content in these soils. The lower content of available N was might be due to hot and dry climate complex.

Waikar (2004) reported that the available N content was varied between 137 to 251 kg ha^{-1} from soils of Marathwada region.

Meena *et al*. (2006) studied the clay loam soils of Tonk district of Rajasthan and reported that the available N content of these soils were varied from 125-555 kg ha^{-1} with mean 309 kg ha^{-1}.

Waghmare and Takankhar (2007) analyzed 100 representative samples from soils of Nilanga tahsil and reported that available N varied from 100.3 to 366.9 kg ha^{-1}.

Jibhakate *et al.* (2009) studied the physical-chemical status of soils of Katol tahsil in Nagpur district and found that the available N of these soils was ranged from 135.47 to 321.73 kg ha^{-1}.

Rajeshwar *et al.* (2009) studied that the range of available N in the soils of Garikapadu of Krishna district of Andhra Pradesh were ranged from 133 to 188 kg ha^{-1}.

Thakare and Ingle (2010) studied soil properties in highly fertilized and intensively cultivated area of Jalgaon district, Maharashtra. Talukwise hundred and forty one soil samples under low, medium and high fertilizer consumption categories were drawn for analysis. These soils were found low to moderate in available N (100-351 $kgha^{-1}$).

Saqeebulla *et al*., (2012) studied physico-chemical properties of soils under different land use systems. The study indicated that the available nitrogen was low to medium (100.35 to 426.50 kg).

Vijayakumar *et al.,* (2013) studied salt affected soils of Ongole division, Prakasam district, Andhra pradesh and reported that the available N varied from 66 to 329 kg ha^{-1}, with a mean value of 178 kg ha^{-1}.

Haribhushan *et al*. (2013) analyzed two hundred representative soil samples from Senapati district of Manipur and reported that available N varied from 290.20 to 893.17 kgha^{-1} with a mean value of 382.04 kg ha^{-1}.

2.2.2 Available Phosphorous

Waikar *et al*. (2004) analyzed the soils from Marathwada and reported that the available P content in these soils was ranged from 10.0 to 19.1 kg ha. These soils were low to medium in available P content.

Ratnakumari *et al.* (2006) reported that the soils of Guntur district in the available P content were ranged from 4.60 to 20.33 mg kg^{-1} with an average of 7.82 mg kg^{1}.

Waghmare and Takankhar (2007) studied the chemical properties and micronutrient status of some soils of Ausa and Nilanga tahsil of Latur district in Maharashtra and showed that the available P content of these soils were ranged from 4.22 to 24.98 kg ha^{-1} and 4.22 to 28.13 kg ha^{-1} respectively.

Bidari *et al.* (2008) conducted study on different pedons of Dharwad district in North Karnataka and indicated that available P was ranged from 3.56 to 22.05 kg ha^{-1} which decreased with increasing depth.

Rajeshwar *et al.* (2009) studied that the range of available P in the soils of Garikapadu of Krishna district of Andhra Pradesh were ranged from 5.3 to 33.4 kg ha^{-1}.

Singh *et al.,* (2011) studied status of available major in arid soils of Churu district of western Rajasthan. Random soil samples from 0-30cm depth were collected and analyzed. The available phosphorus content was varied from 7-80 kg ha^{-1}.

Biswas *et al.*, (2011) studied distribution of, phosphorus in an Aeric Haplaquept in relation to soil properties. The phosphorous content varied from low (4.16%) medium (58.57%) out of total soil samples analyzed.

Vijayakumar *et al.* (2013) studied salt affected soils of Ongole division, Prakasam district, Andhra pradesh and reported that the available phosphorus content was varied from 15 to 118 kg ha^{-1}. with a mean value of 64 kg ha^{-1}.

Haribhushan *et al*., (2013) analyzed two hundred representative soil samples from Senapati district of Manipur and reported that available Phosphorus content was varied from 24.62 to 64.37 kgha^{-1} with a mean value of 38.31 kg ha^{-1}.

2.2.3 Available Potassium

More and Gavali (2000) recorded that the available K in swell-shrink soils ranged from 120 to 370 mg kg^{-1} with mean value of 228.50 mg kg^{-1}. 99 per cent soils were rich in available K and only 10 per cent soils were found medium in available potassium.

Padole and Mahajan (2003) studied the status of available K from swell-shrink soils of Vidharbha region (Maharashtra) and reported that the available K content in these soils were ranged from 118 to 257 kg ha^{-1} .

Bhalerao and Pharande (2003) analyzed Potassium behaviour in salt affected swell-shrink soils and recorded that the exchangeable K content in saline, saline-sodic and sodic soil ranged from 113 to 308, 142 to 467, and 148 to 441 mg kg^{-1} with an average of 195, 261 and 258 mg kg^{-1} , respectively.

Garg *et al.* (2003) recorded the available K content of soil at different altitudes of Sikkim state were ranged from 0.7 to 2.5 cmol(p^{+}) kg^{-1}.

Waikar *et al*. (2004) observed that the available K content varied from 263 to 451 kg ha^{-1} between the drought-prone and the transitionally high rainfall zones.

Hundal *et al.* (2006) reported that the available K content in the soils of Punjab was ranged from 7.22 to 885.34 kg ha^{-1}.

Jibhakate *et al.* (2009) studied the physico-chemical status of soils of Katol tahasil in Nagpur district and found that the available K of these soils was ranged from 319.10 to 554.00 kg ha^{-1}.

Rajeshwar *et al.* (2009) studied that the range of available K in the soils of Garikapadu of Krishna district of Andhra Pradesh were varied from 110 to 389 kg ha^{-1}.

Singh *et al.,* (2011) studied status of available major in arid soils of Churu district of western Rajasthan. Random soil samples from 0-30cm depth were collected and analyzed. The available potassium was found about 108-837 kgha^{-1}.

Mahesh Kumar *et al.* (2011) reported that the availability of Potassium content varied from 102 kg to 837 kg K_2O ha^{-1} in Naurangpura soil series with a pooled mean of 258 kg K_2O ha^{-1}.

Biswas *et al*. (2011) studied distribution of potassium in an Aeric Haplaquept in relation to soil properties. The potassium content from low (95.26 %) to medium (4.74%) out of total soil samples analyzed.

Vijayakumar *et al.,* (2013) studied salt affected soils of Ongole division, Prakasam district, Andhra Pradesh and reported that the available potassium content varied from 110 to 1580 kg ha^{-1}, with a mean value of 707 kg ha^{-1}.

Haribhushan *et al.* (2013) analyzed two hundred representative soil samples from Senapati district of Manipur and reported that available Potassium content was varied from 55.60 to 359.11 kg ha^{-1} with a mean value of 208.86 kg ha^{-1}.

2.2.4 Available Sulphur

Giri *et al.* (2002) worked on status of plant available sulphur in soils of Bikaner district of Rajasthan and revealed that available sulphur varied from 0.80 to 18.50 me L^{-1}.

Bhatnagar *et al.* (2003) showed the available sulphur content in some profiles of Shivpuri district of Madhya Pradesh varied from 11.25 to 13.25 and 9.87 to 16.25 with the mean of 12.27 and 12.40 mg kg^{-1} in Inceptisols and Vertisols, respectively.

Raut and Mali (2003) recorded that the available sulphur showed an average content of 51.0, 53.6 and 48.0 mg kg^{-1} in Vertisols, Inceptisols and Entisols, respectively.

Thangasamy *et al.* (2005) reported that the available sulphur in soils of Chittoor district, Andhra Pradesh was ranged from 12.5 to 35.2 mg kg^{-1}.

Mehra *et al*. (2006) reported that available sulphur content in various districts of Rajasthan ranged between 2.31-52.88 mg kg-^{1}.

Ravte (2008) analyzed the soils of Ausa and Nilanga tahsils of Latur district and reported that the available S content in these soils were ranged from 3.62 to 84.61 mg kg^{-1} respectively.

Rakesh Kumar *et al*., (2009) appraised available nutrients status in SanthalParagans region of Jharkhand. One hundred soil samples (0-20cm) were collected from each of the two dominant soil series. The available S was varied from 2.8-17.6 ppm Dumka series and 6.5-2.8 ppm in Lachimpur soil series.

Das *et al.* (2011) reported that the Available sulphur in Entisol of Assam ranged from the lowest of 13.4 mg kg^{-1} in Sibsagar district to the highest of 21.9 mg kg^{-1} in Dibrugarh district with mean value 15.4 mg kg^{-1}.

Bacchewar and Gajbhiye (2011) studied status of secondary nutrients and soil properties in soils of Latur District of Maharashtra and revealed that available S contents ranged from 32.98 to 85.53 mg kg^{-1} with mean value of 22.88 mg kg^{-1}.

Medhe *et al*. (2012) studied correlation of chemical properties, secondary nutrients and micronutrient anions from the soils of Chakur tahsil of Latur district Maharashtra. Hundred soil samples from Chakur tahsil of Latur district (M.S.) The available (S) Sulphur was ranged from 2.28 to 41.33 mg kg^{-1}.

Saqeebulla *et al*., (2012) studied physical-chemical properties of soils under different land use systems. The sulphur status was higher than the critical limits in different land system and it was ranging from 9.82 to 37.49 mg kg^{-1}.

Vijayakumar *et al.*, (2013) studied salt affected soils of Ongole division, Prakasam district, Andhra Pradesh and reported that the available sulphur content ranged

from 11 to 117 mg kg^{-1}, with a mean value of 47 mg kg^{-1}.

Haribhushan *et al.* (2013) analyzed two hundred representative soil sample from Senapati district of Manipur and reported that available Sulphur content was varied from 6.20 to 95.10 mg kg^{-1} with a mean value of 22.65 mg kg^{-1}.

2.3 Micronutrient Status of soils

2.3.1 Iron

Dhage *et al*. (2000) reported that the DTPA-Fe content in soils of Shevgaon tashil of Ahmednagar district were ranged between 2.22 to 9.06 mg kg^{-1}.

Gupta *et al.* (2003) studied vertic distribution of micronutrient in some soil series of Northern Madhya Pradesh and reported the DTPA-Fe content were varied from 6.0 to 35.2 mg kg^{-1}.

Hundal *et al.* (2006) studied the available nutrient content in different soil sub-groups of Punjab and reported that the DTPA-Fe content were varied from 11.35 and 29.68 ppm in the Shiwalik hills and alluvial plains, respectively.

Balpande *et al.* (2007) studied the grape growing soils in Nasik district, Maharashtra indicated that the DTPA extractable Fe ranged from 2.52 to 9.22 mg kg^{-1} in different horizons.

Yadav *et al.*, (2009) studied the Dengana soil series of Rajasthan and observed that DTPA extractable Fe content varied between 0.20-18.73 mg kg^{-1} with an average value of 6.29 mg kg^{-1}.

Singh *et al*. (2009) analyzed DTPA-extractable micronutrient in the soils of Ghazipur district and observed that DTPA-extractable Fe content of the surface soil varied between 10.9 and 29.5 mg kg^{-1}.

Vijayakumar *et al.* (2011) analyzed that the the content of DTPA- Fe in Natural Disaster Proned Coastal Soils varied from 4.1 to 6.72 mg kg^{-1} with an average value of 5.72mg kg^{-1}.

Singh *et al.*, (2011) studied status of DTPA extractable in arid soils of Churu district of western Rajasthan. Random soil samples from 0-30cm depth were

collected and analyzed. The data revealed that the content of DTPA-Fe varied from 2.7-32 mg kg^{-1}.

2.3.2 Zinc

Dhage *et al.* (2000) studied DTPA-extractable in soils of Shevagaon Tahsil and reported that the DTPA Zn showed a range 2.04 to 11.38 ppm.

Mathur *et al.* (2006) studied status of zinc in irrigated North-West plain soils of Rajasthan and noticed that available Zn ranged from 0.20 to 2.8 mg kg^{-1} with a mean value of 0.61 mg $kg^{-1.}$

Sood *et al.* (2009) analyzed micronutrient status in soils of Muktsar district of Punjab and recorded that the available Zn content in the soils varied from 0.11 to 4.70 mg kg^{-1} with a mean value of 1.13 mg kg^{-1}.

Yadav and Meena (2009) studied the Dengana soil series of Rajastan and showed that the DTPA extractable Zn content varied from 0.21 to 2.18 mg kg^{-1} with an average value of 0.65 mg kg^{-1}.

Kumar *et al*. (2011) studied DTPA-extractable in arid soils of Churu district of Western Rajasthan and recorded that the available Zn varied from 0.18 to 4.6 mg kg^{-1} with the mean value of 0.82 mg kg^{-1}.

2.3.3 Manganese

Kadao *et al*. (2002) studied DTPA-extractable status of Banana growing soils of Wardha district Maharashtra and reported that the DTPA-extractable Mn content varied from 1.35 to 16.16.98 mg kg^{-1}.

Gupta *et al.* (2003) analyzed some soil series of Northern Madhya Pradesh were found to vary in the available Mn from 0.8 to 14.5 mg kg^{-1}.

Malewar (2005) analyzed 4747 soil sample of Marathwada region and recorded that the DTPA-Mn content in these soils ranged from 1.20 to 72.84 mg kg^{-1}.

Hundal *et al.* (2006) indicated that the DTPA-extractable Mn content in Punjab soils was ranged between 0.07 to 18.56 mg kg^{-1}

Shinde (2007) studied physico-chemical properties and nutrient availability of soils of Udgir and Deoni tahsil of Latur district and found that the Mn content of soils were ranged from 0.14 to 21.30 mg kg^{-1} and 0.32 to 17.5 mg kg^{-1} respectively.

Waghamare and Takankhar (2007) studied the chemical properties and micronutrient status of some soils of Ausa tahasil of Latur, Maharashtra and showed that the Mn content of these soils were ranged from 1.23 to 13.57 mg kg^{-1} with an average value of 7.57 mg kg^{-1}.

Yadav and Meena ,(2009) studied the Dengana soil series of Rajasthan and observed that DTPA-extractable Mn content varied from 0.43-7.57 mg kg^{-1} with an average value of 2.72 mg kg^{-1}.

Rajeshwar *et al.* (2009) studied that the range of available Mn in the soils of Garikapadu of Krishna district of Andhra Pradesh were ranged from 2.6 to 19.7 mg kg^{-1}.

Kumar *et al*. (2011) studied status of DTPA major and micronutrient in arid soils of Churu district of Western Rajasthan and reported that DTPA-extractable Mn ranged from 4.0 to 35.0 mg kg^{-1}.

Singh *et al*. (2011) analyzed that the Mn content in red soils of Vindyan Region ranged from between 11.42 to 27.91 mg kg^{-1} for upland, 2.87 to 23.25 mg kg^{-1} for medium land and 38.4 to 40.31 mg kg^{-1} for low land.

Saqeebulla *et al*. (2012) the study indicated that the mean DTPA extractable manganese was highest (20.76 mgkg^{-1}) in mango cashew system and lowest in (2.64 mg kg^{-1}) paddy system.

2.3.4 Copper

Dhage *et al*. (2000) analyzed the soils of Shevgaon tahsil of Ahmednagar district and recorded that the DTPA-Cu in these soils were ranges between 2.04 to 11.38 mg kg^{-1} with an average value 3.55 mg kg^{-1}.

Venkatesh *et al.* (2003) studied the micronutrients cations under various land use systems of Meghalaya and reported that the Cu content of soil ranges from 0.20 to 1.74 mg kg^{-1}.

Sharma *et al.* (2006) analyzed status of available major and micro-nutrients in the soils of Leh district of Ladakh and noticed that the content of Cu ranged from 0.43 to 3.13 mg kg-^{1} with a highest mean value of 1.71 mg kg^{-1} in the soils of Nubra block as compared to soils of other blocks.

Singh *et al.* (2006) studied that the micronutrients status of soils under different vegetation in Uttaranchal Hills and reported that the Cu content of soils were varied from 0.79 to 6.44 mg kg^{-1}.

Yadav and Meena .,(2009) studied the Dengana soil series of Rajasthan and observed that available Cu ranged between 0.09 to 3.05 mg kg^{-1} with an average value of 0.50 mg kg^{-1}.

Sahoo *et al.* (2010) studied soils of Langol hill, Manipur and observed that the DTPA-extractable Cu ranged from 0.74 to 2.58 mg kg^{-1}.

Kumar and Babel (2011) studied that the Cu content were varied between0.17 to 3.32, mg kg^{-1} in the soil of Jhunjhunu tahsil of Jhunjhunu district, Rajasthan.

Vijayakumar *et al.* (2011) analyzed that the DTPA-Cu content of Natural Disaster Proned Coastal Soils samples varied from 0.20 to 1.15 mg kg^{-1} with the mean value of 0.708 mg kg^{-1}.

Saqeebulla *et al*. (2012) the study indicated that the mean DTPA Copper was highest (2.19 mg kg^{-1}) under paddy land uses systems.

2.4 Correlation between physical-chemical properties and available nutrients in soils

2.4.1 Soil pH and available nutrients

Mali and Raut (2001) showed that the available sulphur in Vertisols, Inceptisols, and Entisols was negatively correlated with pH.

Kadao *et al.* (2002) conducted the study on micronutrient status in Banana growing soils of Wardha district of Maharashtra and revealed that DTPA-extractable Cu had negative relationship with pH (r = -0.30).

Bhatnagar *et al*. (2003) studied distribution of sulphur in some profiles of Shivpuri district of Madhya Pradesh and observed that the pH had negative or very low positive correlation with all the forms of sulphur.

Sharma *et al.* (2003) analyzed the soils from Nagpur district in semi-arid region of Rajasthan and observed that the available Zn, Cu, Fe and Mn were negatively correlated with soil pH.

Hundal *et al.* (2006) studied available nutrient status of soils of Punjab, North West India and indicated that the available Mg in soils was significantly and positively correlated with soil pH (r =- 0.340**).

Indulkar *et al.* (2007) stated that the available N and K showed positive significant correlation with pH (r= 0.37**) and (r= 0.39**) in soils of Ausa and Nilanga tahsil of Latur district.

Talukdar *et al.* (2009) studied status of micronutrient in soils of Golaghat district in Assam under rice and Sugarcane ecosystem and observed that the all micronutrient recorded significant negative correlation with soil pH.

2.4.2 EC and available nutrients

Sharma *et al.* (2003) analyzed micronutrient distribution in soils of semi-arid Rajasthan and noticed that the non significant correlations between electrical conductivity and available Zn, Cu, Fe, and Mn.

Mathur *et al.* (2006) stated the DTPA extractable Zn content of irrigated north-west plain soils of Rajasthan was significantly positive correlated with EC.

Indulkar *et al.* (2007) stated that the available N showed positive significant correlation with EC (r= 0.22*) in soils of Ausa and Nilanga tahsil of Latur district.

Indulkar *et al.* (2007) stated that the available K showed positive significant correlation with EC (r= 0.21*) in soils of Ausa and Nilanga tahsil of Latur district.

Yadav and Meena (2009) studied the Degana soil series of Rajasthan and found that the DTPA extractable Fe, Mn, Zn and Cu were significantly and positively correlated with Electrical Conductivity

2.4.3 Organic carbon and available nutrients

Sharma *et al.* (2003) studied micronutrient distribution in soils of semi-arid Rajasthan and a significant positive correlation of Zn, Cu, Fe, and Mn, was observed with organic carbon.

Patil and Meisheri (2004) analyzed DTPA-extractable Zn, Cu, Mn and Fe in soils of Konkan region and observed that the DTPA- Zn, Mn and Fe were found to be positively correlated with organic carbon. (r = 0.001), (r =0.219), (r =0.039), respectively. DTPA- Cu negatively correlated (r =-0.054) with organic carbon.

Meena *et al.* (2006) studied status of macro and micronutrient in some soils of Tonk district of Rajasthan reported that the significant positive correlation between (r =0.797**) organic carbon and available phosphorus.

Somasundaram *et al*. (2009) studied the micronutrient status of soils under different land use system in Chambal ravines and observed that the positive correlation of Mn, Zn, Fe and Cu was found with organic carbon.

Bacchewar and Gajbhiye (2011) studied that the Organic carbon in soils was negatively correlated with exchangeable Ca.

Kumar *et al.* (2011) analyzed available nutrient status of Arid soils and Found the significant and positive correlation of Fe, Mn and Cu with organic carbon content of the soils (r = 0.325), (r = 0.409) and (r = 0.508), respectively.

2.4.4 $CaCO_3$ and available nutrients

Malewar *et al*. (2004) studied the variation of DTPA-extractable micronutrients with soil properties in semi-arid part of northern Marathwada in Maharashtra and showed that $CaCO_3$ were negatively and significantly correlated with DTPA-extractable micronutrients.

Mathur *et al.* (2006) stated the DTPA extractable Zn content of irrigated north-west plain soils of Rajasthan was significantly negative correlated with $CaCO_3$.

Indulkar *et al.* (2007) stated that the available N and available P showed positive and negative significant correlation with $CaCO_3$, (r= 0.29**) and (r= -0.83**) respectively in soils of Ausa and Nilanga tahsil of Latur district.

Sharma *et al.* (2007) showed that the iron status had negative correlation with free $CaCO_3$ in soils of dry temperate zone of Himachal Pradesh.

Singh *et al.* (2009) analyzed DTPA- extractable micronutrient and noticed that the micronutrients were no significant correlation with $CaCO_3$.

Yadav and Meena (2009) studied soils of Degana soil series of Rajasthan and showed the availability of Zn was reduced significantly with an increase in $CaCO_3$ (r = -0.718).

Kumar *et al.* (2011) analyzed available nutrient status of arid soils and observed that the available Fe, Mn, Zn and Cu were negatively correlated with $CaCO_3$.

Chapter - III

MATERIAL AND METHODS

The material used and methods adopted to study the fertility status of central tahsils of Parbhani District during Year 2013 were grouped and presented under the following heads.

3.1 Geography and Climate

3.2 Site selection

3.3 Collection of soil samples

3.4 Methods of Soil analysis

3.5 Soil nutrient Index value

3.6 Statistical analysis

3.1 Geography and Climate

Parbhani is situated at a height of about 423.46 meters above the mean sea level within the Godavari drainage basin in the central part of India between 76^0, 46' East longitude and 19^0, 16' North longitude.

The area falls under semi-arid tropics. The average annual precipitation of the district is 916 mm, mostly concentrated during the monsoon months from June to October. The daily mean maximum temperature varied from 21 to 41^0 where the daily mean minimum temperature ranged from 12 to 23^0 in the month of December and May, respectively. The mean minimum and maximum relative humidity varied between 25 to 63 and 85 to 96 percent, respectively. The month of July, August and September are humid. The rest period is dry. Parbhani is grouped under assured rainfall zone.

3.2 Site selection

The sites were selected from central tahsils of Parbhani districts (Manwat Parbhani, and Purna).

3.3 Collection of soil samples.

The soil samples were collected by digging the pit up to 15 cm depth as per standard procedure of soil sampling 225 samples (75 each tahsil) were collected from central tahsils of Parbhani district (Manwat, Parbhani, and Purna).

Table no 1.The details of soil samples, names of Farmers and location

Manwat thasil

Sr. No.	Sample No.	Farmers Name	Village
1.	V1 S1	Pisalkar Sakharam	Nagarjavala
2.	V1 S2	Pisalkar Ram	Nagarjavala
3.	V1 S3	Pisalkar Amabasaheb	Nagarjavala
4.	V1 S4	Huge Sadashiv	Nagarjavala
5.	V1 S5	Naybal Data	Nagarjavala
6.	V2 S1	Huge Chandu	Ukhalgao
7.	V2 S2	Gadge Shivaji	Ukhalgao
8.	V2 S3	Naybal Ahsok	Ukhalgao
9.	V2 S4	Khandare Balaji	Ukhalgao
10.	V2 S5	Shande Balaji	Ukhalgao
11.	V3 S1	Pimple Ganesh	Bonderwadi
12.	V3 S2	Pimple Bhagwan	Bonderwadi
13.	V3 S3	Pimple Uttam	Bonderwadi
14.	V3 S4	Pimple Babaram	Bonderwadi
15.	V3 S5	Pimple Shital	Bonderwadi
16.	V4 S1	Pimple Shivahi Shankar	Manwat
17.	V4 S2	Jadhav Baburao Shyamrao	Manwat
18.	V4 S3	Honed Prakash Rambhau	Manwat
19.	V4 S4	Honed Prakash Dattaram	Manwat
20.	V4 S5	Pimple Arjun Gopal	Manwat
21.	V5 S1	Sheikh Jhaus Sheikh Jahagir	Manwat Road
22.	V5 S2	Sheikh Basir Sheikh Jahagir	Manwat Road
23.	V5 S3	Ambore Rahul Gangadhar	Manwat Road
24.	V5 S4	Jangle Rameshwar Sidhram	Manwat Road
25.	V5 S5	Jangle Uttam Sindhram	Manwat Road
26.	V6 S1	Ganjare Dipak Shankar	Kholva
27.	V6 S2	Ganjare Seema Shyamrao	Kholva
28.	V6 S3	Ganjare Mahesh Narayan	Kholva

29.	V6 S4	Dhape Jotiba	Kholva
30.	V6 S5	Bhise Mahesh Digaji	Kholva
31.	V7 S1	Bhise Narayan Pralhad	Atola
32.	V7 S2	Bhise Dattarao Shankar	Atola
33.	V7 S3	Bhise Shankarrao	Atola
34.	V7 S4	Bhise Mahadev	Atola
35.	V7 S5	Pathade Subhas	Atola
36.	V8 S1	Karde Bhagwat Shivaji	Somthana
37.	V8 S2	Karde Narayan Madhukar	Somthana
38.	V8 S3	Karde Atmaram Dagaduba	Somthana
39.	V8 S4	Nirval Shivaji Radhakishan	Somthana
40.	V8 S5	Nirval Vijay Radhakishan	Somthana
41.	V9 S1	Samrat Dattajirao	Narlad
42.	V9 S2	Samrat Mahadevrao	Narlad
43.	V9 S3	Kansole Bhikaji	Narlad
44.	V9 S4	Deshmukh Gulab Shankarrao	Narlad
45.	V9 S5	Deshmukh Subhas Gulabrao	Narlad
46.	V10 S1	Phad Manik Gangdhar	Mangrul
47.	V10 S2	Phad Chandrakala Manik	Mangrul
48.	V10 S3	Phad Ganesh Manic	Mangrul
49.	V10 S4	Pathare Haribhau Kashiram	Mangrul
50.	V10 S5	Pathare Bhaskar Dattarao	Mangrul
51.	V11 S1	Pathare Haribhau Manik	Kothal
52.	V11 S2	Pathare Manik Sudhakar	Kothal
53.	V11 S3	Pathare Haribhau Dajiba	Kothal
54.	V11 S4	More Gulab Digambarrao	Kothal
55.	V11 S5	More Shivaji Digambar	Kothal
56.	V12 S1	More Dilip Manikrao	Ramtakli
57.	V12 S2	More Sanjay Manikrao	Ramtakli
58.	V12 S3	More Bharat Manoj	Ramtakli
59.	V12 S4	Deshmukh Ganpat Sahebrao	Ramtakli
60.	V12 S5	Deshmukh Ganpati	Ramtakli
61.	V13 S1	Deshmukh Ganesh Ganpat	Rampuri
62.	V13 S2	KambleYadav Sakharam	Rampuri
63.	V13 S3	Kamble Sakharam	Rampuri
64.	V13 S4	Kamble Sujit	Rampuri
65.	V13 S5	Mudhgalkar Anil	Rampuri
66.	V14 S1	Mudhgalkar Soniya Anilrao	Etoli
67.	V14 S2	Ghodke Bhagwan Bajirao	Etoli
68.	V14 S3	Ghodke Vishakha Bhagwanrao	Etoli
69.	V14 S4	Ghodke Sudhakar Bajirao	Etoli
70.	V14 S5	Ghodke Bhimabai Sudhakar	Etoli
71.	V15 S1	Ghodke Ramkishan Bajirao	Kubhari
72.	V15 S2	Ghodke Kranti Ramkishan	Kubhari

73.	V15 S3	Dharpade Babusssrao Ramprasad	Kubhari
74.	V15 S4	Dharpade Vijay Baburao	Kubhari
75.	V1 S5	Dharpade Vilas Baburao	Kubhari

Table No 2.The details of soil samples, names of Farmers and location of Parbhani thasil

Sr. No.	Sample No.	Farmers Name	Village
1.	V1 S1	Kadam Pandurang Baburao	TattuJawla
2.	V1 S2	Kadam Bhimrao Manik	TattuJawla
3.	V1 S3	Kadam Shivram Gangasagar	TattuJawla
4.	V1 S4	Kadam Sadashiv Nagorao	TattuJawla
5.	V1 S5	Kadam Jagnath Anand	TattuJawla
6.	V2 S1	Dhage Pandurang Vishnath	Pingali
7.	V2 S2	Kadam Limbaji Bajirao	Pingali
8.	V2 S3	Kadam Kishan Limbaji	Pingali
9.	V2 S4	Kankute Shivaji Raghoji	Pingali
10.	V2 S5	Kadam Vishbhar Dattarao	Pingali
11.	V3 S1	Kadam Digabar Dattarao	sayala
12.	V3 S2	Shinde Balasaheb	Sayala
13.	V3 S3	Khanting Shankar Murlidhr	Sayala
14.	V3 S4	Khanting Bhagwan Limbaji	Sayala
15.	V3 S5	Shinde Nanoba Baburao	Sayala
16.	V4 S1	Shinde Munjaji Nanoba	Singanapur
17.	V4 S2	Kadam Munjabhau	Singanapur
18.	V4 S3	Kadam Shankar	Singanapur
19.	V4 S4	Kadam Haribhau	Singanapur
20.	V4 S5	Kadam Parnita Munjabhau	Singanapur
21.	V5 S1	Kadam Shivaji shrirang	Borwad
22.	V5 S2	Kadam Balasaheb	Borwad
23.	V5 S3	Kadam Pandurang Shrirang	Borwad
24.	V5 S4	Khupse Akanath Bhaurao	Borwad
25.	V5 S5	Khupse Vinayak Haribhau	Borwad
26.	V6 S1	Khupse Maroti Nanoba	shapur
27.	V6 S2	Khupse Gandadhar Nanoba	shapur
28.	V6 S3	Grime Parlhad Shankar	Shapur
29.	V6 S4	Khupse Sunil Namdev	Shapur
30.	V6 S5	Grime Tukaram Vishanath	shapur
31.	V7 S1	Deshmukh Panduran Gangadhar	Pedgaon
32.	V7 S2	Suryawanshi Sanjay Gangadhar	Pedgaon
33.	V7 S3	Deshmukh Ranganath Gangadhar	Pedgaon
34.	V7 S4	Kale Munjaji Ram	Pedgaon
35.	V7 S5	Kale Shivaji Ram	Pedgaon
36.	V8 S1	Kale Baburao Ramji	Thombriumri
37.	V8 S2	Kale Parmeshwar Baburao	Thombriumri

38.	V8 S3	Kale Balasaheb Ramji	Thombriumri
39.	V8 S4	Rasal Janardhan	Thombriumri
40.	V8 S5	Rasal Shyamrao	Thombriumri
41.	V9 S1	Rasal Rajesh	Brahmangaon
42.	V9 S2	Gadge Madhukar	Brahmangaon
43.	V9 S3	Gadge Bharat	Brahmangaon
44.	V9 S4	Gadge Udhav	Brahmangaon
45.	V9 S5	Gadge Bhagwan	Brahmangaon
46.	V10 V1	Sudewad Sayanna	Wadgaon
47.	V10 V2	Sudewad Shrinivas	Wadgaon
48.	V10 V3	Kopher Yashwant	Wadgaon
49.	V10 V4	Bhagwat Baliram Rathod	Wadgaon
50.	V10 V5	Gawali Baburao Vitthal	Wadgaon
51.	V11 V1	Gopal Ramprasad Annasaheb	Dharmapuri
52.	V11 V2	Annasaheb Gopal	Dharmapuri
53.	V11 V3	Gajanan Ramprasad Gopal	Dharmapuri
54.	V11 S4	Deshmukh Ganeshrao	Dharmapuri
55.	V11 S5	Kave Gajanan Asaram	Dharmapuri
56.	V12 S1	Narkar Dhondiba Baburao	Zari
57.	V12 S2	Shanve Abhijit Devidas	Zari
58.	V12 S3	Dinde Laxmanrao	Zari
59.	V12 S4	Jadhav Rambhau Niurati	Zari
60.	V12 S5	Deshmukh Kantrao	Zari
61.	V13 S1	Deshmukh Bhimrao Pandurang	Pimpla
62.	V13 S2	Deshmukh Bhausaheb Namdev	Pimpla
63.	V13 S3	Deshmukh Laxmanrao Annasaheb	Pimpla
64.	V13 S4	Yade Pavan Sahebrao	Pimpla
65.	V13 S5	Yade Sahebrao	Pimpla
66.	V14 S1	Shinde Munja Maroti	Surpimpari
67.	V14 S2	Kamlakar Sukhdev Babar	Surpimpari
68.	V14 S3	Babar Arvind Digabarrao	Surpimpari
69.	V14 S4	Babar Bhagwan Baburao	Surpimpari
70.	V14 S5	Jadhav Nanoba	Surpimpari
71.	V15 S1	Dhumal Navnath Annasaheb	Kalishwadi
72.	V15 S2	Babar Chotu	Kalishwadi
73.	V15 S13	Jadhav Bandu Rambhau	Kalishwadi
74.	V15 S14	Jadhav Rambhau	Kalishwadi
75.	V15 S15	Jadhav Kishan Shamrao	Kalishwadi

Table no.3. The details of soil samples, names of Farmers and location of Purna tahsil

Sr. No.	Sample No.	Farmers Name	Village
1.	V1 S1	Bhusare Ashok Babanrao	Nawaki
2.	V1 S2	Bhusare Sitaram Sakharamji	Nawaki
3.	V1 S3	Bhusare Bhojaji Mahadev	Nawaki
4.	V1 S4	Bhusare Keshav Sairam	Nawaki
5.	V1 S5	Kale Munjaji Harbaji	Nawaki
6.	V2 S1	Kale Prakash Munjaji	Mategaon
7.	V2 S2	Bobade Bhujang Dinaji	Mategaon
8.	V2 S3	Bobade Baburao Chanduji	Mategaon
9.	V2 S4	Bobade Shyamji	Mategaon
10.	V2 S5	Sheikh Jani Mohammad	Mategoan
11.	V3 S1	Kaji Sayed Dilwar	Purna
12.	V3 S2	Ranbabare Digambar Yogappa	Purna
13.	V3 S3	Ranbabare Yankat Digambar	Purna
14.	V3 S4	Jogdand Parshuram Gangaram	Purna
15.	V3 S5	Parve Rangnath Sambhaji	Purna
16.	V4 S1	Jogdand Sadashiv Parasram	Goar
17.	V4 S2	Bhusare Digambar Sakharamji	Goar
18.	V4 S3	Parve Shivaji Rangnath	Goar
19.	V4 S4	Kalgande Minakshi Shivaji	Goar
20.	V4 S5	Parve Digambar Annasaheb	Goar
21.	V5 S1	Shinde Sudhakar Shankar	Dhanora
22.	V5 S2	Parve Dagadu Munjaji	Dhanora
23.	V5 S3	Deshmukh Mahadev Bajirao	Dhanora
24.	V5 S4	Deshmukh Shivram Vyankat	Dhanora
25.	V5 S5	Deshmukh Baburao Govindrao	Dhanora
26.	V6 S1	Deshmukh Vankat	Changephal
27.	V6 S2	Rathod Rahul Ramrao	Changephal
28.	V6 S3	Rathod Ramrao Kishan	Changephal
29.	V6 S4	Rathod Ramrao	Changephal
30.	V6 S5	Kaji Dilawar	Changephal
31.	V7 S1	Rathod Pratik Rahul	Kawalgaon
32.	V7 S2	Rathod Laxmibai Ramrao	Kawalgaon
33.	V7 S3	Rathod Janabai Rahul	Kawalgaon
34.	V7 S4	Rathod Umeshrao	Kawalgaon
35.	V7 S5	Kale Ankush Gangaram	Kawalgaon
36.	V8 S1	Kale Keshavrao Pandurang	Dhanora Kale
37.	V8 S2	Kale Kerba Shriram	Dhanora Kale
38.	V8 S3	Kale Kishan Pandurang	Dhanora Kale
39.	V8 S4	Kale Balasaheb Kerbaji	Dhanora Kale
40.	V8 S5	Kale Badrinath Prakash	Dhanora Kale
41.	V9 S1	Kale Damoda raosaheb	Regaon

42.	V9 S2	Kale Vinayak Balasaheb	Regaon
43.	V9 S3	Partwar Pankaj Gangadharrao	Regaon
44.	V9 S4	Kale Nanoba Shivaji	Regaon
45.	V9 S5	Gadhve Kerba Prabhakar	Regaon
46.	V10 S1	Gadhve Annasaheb Prebhakar	Tadkalas
47.	V810S2	Paratwar Madhukar Gangadhar	Tadkalas
48.	V10 S3	Bhosale Baburao Kanba	Tadkalas
49.	V10 S4	Bhosaleb Kanba Baburao	Tadkalas
50.	V10 S5	Bhosale Ramrao Digambar	Tadkalas
51.	V11 S1	Bhosale Kishan Ramrao	Shirkalas
52.	V11 S2	Bhosale Vishal Balasaheb	Shirkalas
53.	V11 S3	Parihar Jivansingh	Shirkalas
54.	V11 S4	Parihar Raja Jivansingh	Shirkalas
55.	V11 S5	Parihar Pankaj Jivansingh	Shirkalas
56.	V12 S1	Gadade Nanoba Vitthalrao	Balsa
57.	V12 S2	Gadade Narayanrao Baliram	Balsa
58.	V12 S3	Rathod Aditya Annasaheb	Balsa
59.	V12S4	Rathod Vinayak Bajirao	Balsa
60.	V12 S5	Kamble Rattan Savaji	Balsa
61.	V13 S1	Kamle Anil Savaji	Limbla
62.	V13 S2	Kamble Rahul Sopanrao	Limbla
63.	V13 S3	Kale Madhukarrao	Limbla
64.	V13 S4	Kale Savita Madhukarrao	Limbla
65.	V13 S5	Kale Sachin Madhukarrao	Limbla
66.	V14 S1	Kale Shivaji Sopanrao	Yerendeshwar
67.	V14 S2	Kale Bajirao	Yerendeshwar
68.	V14 S3	Kale Sanjay Baburao	Yerendeshwar
69.	V14 S4	Kale Sandip Balasaheb	Yerendeshwar
70.	V15S5	Deshmukh Shrikant Shivaji	Yerendeshwar
71.	V15 S1	Deshmukh Sachin Shivaji	Chudawa
72.	V15 S2	Deshmukh Ramrao Bapurao	Chudawa
73.	V15 S3	Deshmukh Sandip Bapurao	Chudawa
74.	V15S4	Deshmukh Vikas Kishan	Chudawa
75.	V15 S5	Bhalekar sunil shamrao	Chudawa

3.4 Methods of soil analysis

3.4.1 Preparation of soil samples:

Soil samples collected from central tahsil of Parbhani district (Parbhani, Manwat and Purna) were brought to the laboratory, thoroughly mixed, air dried, grinded with porcelain mortar and pestle and passed through 2 mm sieve for general analysis and for organic carbon and micronutrients soil passed through muslin cloth. The sieved soil

samples were stored in cloth bags with proper labeling for further analysis. All the precautions were followed in the estimation of micronutrients, particularly A. R. grade chemicals, uncontaminated glassware's and use of double distilled water as outlined by Jackson (1973) were scrupulously followed in order to avoid contamination.

3.4.2 Soil reaction (pH):

It was determined in soil water suspension (1:2.5) using digital pH meter (Jackson, 1973).

3.4.3 Electrical conductivity:

It was estimated in soil water suspension 1:2.5 ratio using digital conductivity bridge (Jackson, 1973).

3.4.4 Calcium carbonate:

The free calcium carbonate was determined by rapid titration method as outlined by Piper (1966).

3.4.5 Organic carbon:

It was assessed by Walkely and Black's rapid titration method as described by Jackson (1973) and organic matter was estimated by multiplying a factor 1.724 to the organic carbon.

3.4.6 Available Nitrogen:

It was determined by using alkaline potassium permanganate method as suggested by Subbiah and Asija (1956).

3.4.7Available phosphorus:

It was determined by using 0.5 M sodium bicarbonate as an extractant as outlined by Olsen *et al.* (1954).

3.4.8 Available potassium:

This was estimated by using normal neutral ammonium acetate as an extractant and extractant was subscribed to Flame photometer (Jackson, 1973).

3.4.9 Available Sulphur:

It was determined by using extractant 1:5 soil and 0.15 per cent $CaCl_2$ solution on spectrophotometer at 340 nm (Willams and Steinberg, 1969).

3.4.10 DTP-extractatable Iron, Zinc, Manganese and Copper:

These were estimated as per the procedure described by Lindsay and Norvell (1978). For this 10 g finely sieved soil (0.5 mm) was shaken in 20 ml of 0.005 M DTPA solution (Diethylenetriaminepenta Acetic Acid containing 0.1 M triethanol amine and 0.01 M calcium chloride, adjusted to pH 7.3 with HCl) for two hours and then filtered and filtrate was subjected to measurement on Atomic Absorption Spectrophotometer (AAS-200), at recommended wavelengths for Fe, Zn, Mn and Cu.

3.5 Soil Nutrient Index

Soil Nutrient index was calculated as per the formula suggested by Ramamoorthy and Bajaj (1969)

$$NIV = \frac{\text{No. of samples Low x 1 + No. of samples Medium x 2 + No. of samples High x 3}}{\text{Total number of samples}}$$

Rating of NIV:

Sr. No.	Category	Value
1.	Low	< 1.67
2.	Medium	1.67 – 2.33
3.	High	> 2.33

3.5.1 Preparation of fertility maps

Thematic map of nutrient status of soils from central tahsils of Parbhani district, were prepared in photo-shop by using above ratings for different nutrients.

3.6 Statistical analysis

So as to establish relation between soil properties and soil nutrient status, the data will be exposed for simple correlation equations. The simple ‘r’ values emerged out will be used for interpretation of results (Panse and Sukhatme, 1985).

Chapter - IV

RESULTS AND DISCUSSION

Soil characterization in relation to evaluation of fertility status of the soils of an area or region is an important aspect in context of sustainable agricultural production. Because of imbalanced and inadequate fertilizer use coupled with low efficiency of other inputs, the response of chemical fertilizer nutrients has declined tremendously under intensive agriculture in recent years. Hence, to study the fertility status and to assess soil physical-chemical properties of central tahsils Parbhani district (Manwat, Parbhani and Purna) were selected for study during the year 2013.

The results obtained from laboratory soil analysis the samples were statistically analyzed and presented in tabulated as well as graphical form under the following suitable heads.

4.1 Fertility status of soils of Manwat tahsil Parbhani district.

4.2 Fertility status of soils of Parbhani tahsil Parbhani district.

4.3 Fertility status of soils of Purna tahsil Parbhani district.

4.4 Soil nutrient index value of central tahsils of Parbhani district (Manwat, Parbhani and Purna).

4.5 Correlation between the physical-chemical properties and available nutrients in soils of Manwat, Parbhani and Purna of Parbhani district.

4.1 Fertility status of soils of Manwat tahsil of Parbhani district.

The Manwat tahsil comprise fifteen villages viz., Nagarjavala, Ukalgaon, Bonderwadi, Manwat, Manwatroad, Khola, Atola, Somthana, Narlad, Kothal, Mangrul, Ramtakli, Rampuri, Etoli and Kumbhari. The Village wise details are given below in table no. 4.

The data revealed that in Nagarjavala village of Manwat tahsil the pH of soils varied from 7.1-7.4 with mean of 7.2 indicating neutral soil reactions. The EC ranged between 0.41-0.56 dSm^{-1} with mean of 0.49 dSm^{-1} The organic carbon and

calcium carbonate content was found to be varied from 0.82-1.4 per cent with mean of 1.15 per cent and 6-10 per cent with mean 8 per cents respectively indicating moderate to moderately high organic carbon and calcareous nature of soils. The available N, P, K and S varied from 190-260 kg ha^{-1} (213 kg ha^{-1}), 12.03-22.84 kg ha^{-1} (17.21 kg ha^{-1}) and 380-535 kg ha^{-1} (444.6 kg ha^{-1}), 2.52-5.09 respectively. Indicating moderate nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 3.2-6.7 ppm (5.2 ppm), 20.7-25.7 ppm (24.5 ppm), 0.19-0.68 ppm (0.34 ppm) and 1.3-3.7 ppm (2.96 ppm) indicating the deficiency of DTPA-Zn in soils of Nagarjavala village.

The data revealed that In Ukhalgaon village of Manwat tahsil the pH of soils varied from 7.1-7.5 with mean of 7.3 indicating moderately neutral soil reactions. The EC ranged between 0.51-0.69 dSm^{-1} with mean of 0.49 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.82-1.32 per cent with mean of 1.06 per cent and 5-9 per cent with mean 6.5 per cent indicating moderate to moderately high organic carbon and calcareous nature of soils. The available N, P, K and S varied from 160-250 kg ha^{-1} (202.6 kg ha^{-1}), 17.8-23.87 kg ha^{-1} (21.57 kg ha^{-1}) and 400-542 kg ha^{-1} (476.2.6 kg ha^{-1}), 4.5-7.35 (6.13 kg ha) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 3.7-6.7 ppm (5.7 ppm), 21.3.-26.1 ppm (24.24 ppm), 0.20-0.55 ppm (0.36 ppm) and 1.12-3.3 ppm (2.31 ppm) indicating the deficiency of DTPA-Zn in soils of Ukhalgaon village.

The data revealed that in Bonderwadi village of Manwat tahsil the pH of soils varied from 7.4-7.6 with mean of (7.5) indicating neutral soil reaction. The EC ranged between 0.56-0.68 dSm^{-1} with mean of 0.63 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.05-1.15 per cent with mean of 0.50 per cent and 6.4-14 per cent with mean 10.4 per cent indicating low to moderately high organic carbon and high calcareous nature of soils. The available N, P, K and S varied from 102--250 kg ha^{-1} (177 kg ha^{-1}), 15.6-21.74 kg ha^{-1} (19.46 kg ha^{-1}) and 483-680 kg ha^{-1} (595.6 kg ha^{-1}), 3.09-6.7 (5.66 kg ha^{-1}) respectively indicating low nitrogen,

very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 4.5-6.7 ppm (5.66 ppm), 21.7.-29.7 ppm (24.08 ppm), 0.24-0.48 ppm (0.29 ppm) and 2.4-3.8 ppm (3.12 ppm) indicating the deficiency of DTPA-Zn in soils of Bonderwadi village.

The data revealed that in Manwat village of Manwat tahsil the pH of soils varied from 7.4-7.5 with mean of (7.4) indicating moderately neutral soil reaction. The EC ranged between 0.35-0.58 dSm^{-1} with mean of 0.46 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.05-1.03 per cent with mean of 0.46 per cent and 5-11 per cent with mean 7.38 per cent indicating low to moderately high organic carbon and calcareous nature of soils. The available N, P, K and S varied from 132-250 kg ha^{-1} (161.2 kg ha^{-1}) 16.92-23.97 kg ha^{-1} (21.46 kg ha^{-1}) and 320-925 kg ha^{-1} (651.4 kg ha^{-1}), 2.21-4.38 (3.25) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 1.5-3.59 ppm (2.60 ppm), 27.4-30.8 ppm (29.36 ppm), 0.37-10.2 ppm (2.369 ppm) and 1.22-3.6 ppm (2.45 ppm) indicating the deficiency of DTPA-Zn in soils of Manwat village.

The data revealed that in Manwat road village of Manwat tahsil the pH of soils varied from 7.4-7.5 with means of (7.4) indicating neutral soil reaction. The EC ranged between 0.32-0.69 dSm^{-1} with mean of 0.55 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.02-0.65 per cent with mean of 0.36 per cent and 5-14 per cent with mean 9.8 per cent indicating low to medium organic carbon and high calcareous nature of soils. The available N, P, K and S varied from 90.6-170 kg ha^{-1} (139.9 kg ha^{-1}) 11.28-22.09 kg ha^{-1} (16.15 kg ha^{-1}) and 708-1084 kg ha^{-1} (920.8 kg ha^{-1}), 2.35-4.66 (4.19 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 3.8-9.8 ppm (7.36 ppm), 30.1-33.8 ppm (32.08 ppm), 0.15-0.41ppm (0.321 ppm) and 2.45-3.65 ppm (3.05 ppm) indicating the deficiency of DTPA-Zn in soils of Manwat road village.

The data revealed that in Khola village of Manwat tahsil the pH of soils varied from 7.4-7.6 with mean of (7.5) indicating moderately neutral soil reaction. The EC ranged between 0.36-0.65 dSm^{-1} with mean of 0.49 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.42-1.05 per cent with mean of 0.63 per cent and 6-7 per cent with mean 6.4 per cent indicating low to moderately high organic carbon and calcareous nature of soils. The available N , P, K and S varied from 140-227 kg ha^{-1} (169.8 kg ha^{-1}) 10.34-23.03 kg ha^{-1} (19.21 kg ha^{-1}) and 344-1122 kg ha^{-1} (835.4 kg ha^{-1}), 3.32-7.35 (5.06 kg ha^{-1}) respectively indicating medium nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 5.8-9.7 ppm (7.28 ppm), 25.7-28.6 ppm (27.38 ppm), 0.10-0.25 ppm (0.166 ppm) and 2.48-3.45 ppm (2.97 ppm) indicating the deficiency of DTPA-Zn in soils of Khola village.

The data revealed that in Atola village of Manwat tahsil the pH of soils varied from 7.2-7.6 with mean of (7.4) indicating moderately neutral soil reaction. The EC ranged between 0.33-0.55 dSm^{-1} with mean of 0.43 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.26-0.53 per cent with mean of 0.37 per cent and 6.4-8.1 per cent with mean 9.14 per cent indicating low organic carbon and calcareous nature of soils. The available N, P, K and S varied from 93.6-164 kg ha^{-1} (125.7 kg ha^{-1}) 19.3-24.81 kg ha^{-1} (22.14 kg ha^{-1}) and 669-1058 kg ha^{-1} (884 kg ha^{-1}), 3.46-5.02 (4.11) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 6.4-8.1 ppm (7.22 ppm), 24.5-28.7 ppm (26.32 ppm), 0.16-0.37 ppm (0.286 ppm) and 2.6-3.7 ppm (3.03 ppm) indicating the deficiency of DTPA-Zn in soils of Atola village.

The data revealed that in Somthana village of Manwat tahsil the pH of soils varied from 7.5-7.8 with mean of (7.6) indicating moderately alkaline soil reaction. The EC ranged between 0.42-0.63 dSm^{-1} with mean of 0.0.52 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.36-1.15 per cent with mean of 0.89 per cent and 5.4-13 per cent with mean 8.24 per cent indicating low to moderately

high organic carbon and high calcareous nature of soils. The available N, P, K and S varied from 142-286 kg ha^{-1} (211.6 kg ha^{-1}) 10.34-23.31 kg ha^{-1} (19.34 kg ha^{-1}) and 348-730 kg ha^{-1} (568.6 kg ha^{-1}), 2.78-5.1 (3.93) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA- extractable Fe, Mn, Zn and Cu content varied from 3.4-5.4 ppm (4.16 ppm), 30.7-32.2 ppm (31.26 ppm), 0.17-0.37 ppm (0.28 ppm) and 1.7-3.7 ppm (2.58 ppm) indicating the deficiency of DTPA-Zn in soils of Somthana village.

The data revealed that in Narlad village of Manwat tahsil the pH of soils varied from 7.1-7.6 with mean of (7.4) indicating moderately neutral soil reaction. The EC ranged between 0.41-0.68 dSm^{-1} with mean of 0.59 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.38-0.62 per cent with mean of 0.49 per cent and 5-9 per cent with mean 7.2 per cent indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 108-188 kg ha^{-1} (145.2 kg ha^{-1} 18.2-25.38 kg ha^{-1} (21.31 kg ha^{-1}) and 640-835 kg ha^{-1} (715.4 kg ha^{-1}), 2.65-4.3 (3.24 kg ha) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA extractable Fe, Mn, Zn and Cu content varied from 2.65-4.3 ppm (4.79 ppm), 20.4-29.5 ppm (25.34 ppm), 0.15-0.25 ppm (0.20 ppm) and 2.6-3.8 ppm (3.18 ppm) indicating the deficiency of DTPA-Zn in soils of Narlad village.

The data revealed that in kothal village of Manwat tahsil the pH of soils varied from 7.3-7.5 with mean of (7.4) indicating moderately neutral soil reaction. The EC ranged between 0.32-0.52 dSm^{-1} with mean of 0.43 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.51-2.5 per cent with mean of 1.30 % and 6-9 per cent with mean 7.2 % indicating low to moderately high organic carbon and high calcareous nature of soils. The available N, P, K and S varied from 160-275 kg ha^{-1} (202.2 kg ha^{-1}) 19.69-26.32 kg ha^{-1} (23.01.46 kg ha^{-1}) and 350-1058 kg ha^{-1} (769 kg ha^{-1}), 2.74-6.5 (4.05) respectively indicating medium nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 0.68-6.85 ppm (5.14 ppm), 21-25.7

ppm (23.58 ppm), 0.135-0.29 ppm (0.202 ppm) and 1.45-2.45 ppm (2.01 ppm) indicating the deficiency of DTPA-Zn in soils of kothal village.

The data revealed that in Mangrul village of Manwat tahsil the pH of soils varied from 7.3-7.4 with mean of (7.4) indicating neutral soil reaction. The EC ranged between 0.43-0.56 dSm^{-1} with mean of 0.47 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.38-1.62 per cent with mean of 0.91 per cent and 5-10 per cent with mean 7.2 per cent indicating low to moderately high organic carbon and calcareous nature of soils. The available N, P, K and S varied from 87.6-208 kg ha^{-1} (172.5 kg ha^{-1}) 13.53-22.93kg ha^{-1} (18.34 kg ha^{-1}) and 413-1009 kg ha^{-1} (785.8 kg ha^{-1}), 2.85-5.6 (3.86) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 5.7-8.71 ppm (7.17 ppm), 10.34-16.4 ppm (13.72 ppm), 0.044-0.246 ppm (0.162 ppm) and 1.98-3.7 ppm (2.52 ppm) indicating the deficiency of DTPA-Zn in soils of Mangrul village.

The data revealed that in Ramtakli village of Manwat tahsil the pH of soils varied from 7.3-7.5 with mean of (7.4) indicating moderately neutral soil reaction. The EC ranged between 0.35-0.56 dSm^{-1} with mean of 0.50 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.44-0.97 per cent with mean of 0.62 per cent and 5-9 per cent with mean 7.0 per cent indicating low to moderately medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 110-234 kg ha^{-1} (163.4 kg ha^{-1} 10.62-23.92 kg ha^{-1} (20.19 kg ha^{-1}), 878-1137 kg ha^{-1} (1032 kg ha^{-1}), 2.8-10 (6.26) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 2.3-6.9 ppm (2.72 ppm), 20.4-24.5 ppm (22.64 ppm), 0.136-0.692 ppm (0.334 ppm) and 2.1-3.52 ppm (2.82 ppm) indicating the deficiency of DTPA-Zn in soils of Ramtakli village.

The data revealed that in Rampur village of Manwat tahsil the pH of soils varied from 7.4-7.6 with mean of (7.5) indicating moderately neutral soil reaction. The

EC ranged between 0.52-0.62 dSm^{-1} with mean of 0.57 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.31-0.61 per cent with mean of 0.43 per cent and 5-8 per cent with mean 6.06 per cent indicating low to moderately medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 140-300 kg ha^{-1} (187 kg ha^{-1})16.5-25.09 kg ha^{-1} (20.80 kg ha^{-1}) and 700-980 kg ha^{-1} (870 kg ha^{-1}), 3.4-5.09 (4.10 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 5.7-8.1 ppm (6.66 ppm), 16.5-26.7 ppm (20.26 ppm), 0.13-0.18 ppm (0.15 ppm) and 2.3-3.47 ppm (2.7 ppm) indicating the deficiency of DTPA-Zn in soils of Rampur village.

The data revealed that in Etoli village of Manwat tahsil the pH of soils varied from 7.4-7.7 with mean of (7.5) indicating moderately neutral soil reaction. The EC ranged between 0.42-0.54 dSm^{-1} with mean of 0.46 dSm^{-1} the organic carbon and calcium carbonate content was found to be varied from 0.38-0.65 per cent with mean of 0.52 per cent and 6.16-9.2 per cent with mean 8.07 per cent indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 145-199 kg ha^{-1} (177.6 kg ha^{-1}) 15.07-22.1 kg ha^{-1} (18.33 kg ha^{-1}) and 340-970 kg ha^{-1} (532 kg ha^{-1}), 3.07-5.08 (3.77 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 2.4-7.45 ppm (5.75 ppm), 10.7-19.7 ppm (16.42 ppm), 0.28-0.56 ppm (0.402 ppm) and 1.5-3.7 ppm (2.91ppm) indicating the deficiency of DTPA-Zn in soils of Etoli village.

The data revealed that in Kumbhari village of Manwat tahsil the pH of soils varied from 7.3-7.9 with mean of (7.5) indicating moderately alkaline soil reaction. The EC ranged between 0.45-0.0.62 dSm^{-1} with mean of 0.55 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.23-0.46 per cent with mean of 0.38 per cent and 5-9 per cent with mean 6.92 per cent indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 95.3-157 kg ha^{-1} (120.4 kg ha^{-1}) 18.6-21.47 kg ha^{-1} (20.06 kg ha^{-1}) and 801-940 kg ha^{-1} (874 kg ha^{-1}

^{1}), 3.5-6.5 (4.79) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 5.7-8.5 ppm (7.02 ppm), 14.6-16.7 ppm (15.64 ppm), 0.38-0.90 ppm (0.54 ppm) and 1.8-2.6 ppm (2.36 ppm) indicating the deficiency of DTPA-Zn in soils of kumbhari village.

Table no.4: Fertility status of soils of Manwat tahsil of parbhani district

Soil Property	Villages of Manwat tahsil				
	Nagarjavala	**Ukhalgaon**	**Bonderwadi**	**Manwat**	**Manwat Road**
pH	7.1-7.4 (7.2)	7.1-7.5 (7.3)	7.4-7.6 (7.5)	7.4-7.5 (7.4)	7.4-7.5 (7.4)
EC (dSm^{-1})	0.41-0.56 (0.49)	0.51-0.69 (0.59)	0.56-0.68 (0.63)	0.35-0.58 (0.46)	0.32-0.69 (0.55)
Org. Carbon (%)	0.82-1.4 (1.15)	0.82-1.32 (1.06)	0.05-1.15 (0.50)	0.05-1.03 (0.41)	0.02-0.65 (0.36)
$CaCO_3$ (%)	6-8 (8)	5-9 (6.4)	6.3-14 (10.4)	5-11 (7.38)	6-14 (9.8)
N ($kg\ ha^{-1}$)	190-260 (213)	160.-250 (202.6)	102-250 (177)	132-250 (161.2)	90.6-170 (139.9)
P ($kg\ ha^{-1}$)	12.03-22.84 (17.21)	17.8-23.87 (21.57)	15.6-21.74 (19.46)	16.32-23.97 (21.46)	11.28-22.09 (16.15)
K ($kg\ ha^{-1}$)	380-535 (444.6)	400-542 (477.2)	483-680 (595.6)	320-925 (651.4)	708-1084 (920.8)
S ($mg\ kg^{-1}$)	2.52-5.09 (3.59)	4.5-7.35 (6.13)	3.09-7.35 (4.03)	2.21-4.38 (3.25)	2.35-8.66 (4.19)
Fe ($mg\ kg^{-1}$)	3.2-6.7 (5.2)	3.7-6.7 (5.76)	4.5-6.7 (5.66)	1.5-3.59 (2.60)	3.8-9.8 (32.08)
Mn ($mg\ kg^{-1}$)	20.7-25.7 (24.5)	21.3-26.1 (24.24)	21.7-29.7 (24.80)	27.4-30.8 (29.36)	30.1-33.8 (5.8)
Zn ($mg\ kg^{-1}$)	0.19-0.68 (0.341)	0.20-0.55 (0.36)	0.24-0.48 (0.29)	0.37-10.2 (2.36)	0.15-0.41 (0.32)
Cu ($mg\ kg^{-1}$)	1.3-3.7 (2.96)	1.12-3.6 (2.31)	2.4-3.8 (3.12)	1.22-3.6 (2.45)	2.45-3.65 (3.05)

Table no.4: Fertility status of soils of Manwat tahsil of parbhani district

Soil Property	Villages of Manwat tahsil				
	Khola	**Atola**	**Somthana**	**Narlad**	**Kothal**
pH	7.4-7.6 (7.5)	7.2-7.6 (7.4)	7.5-7.8 (7.6)	7.1-7.6 (7.4)	7.3-7.5 (7.4)
EC (dSm^{-1})	0.36-0.65 (0.49)	0.33-0.55 (0.43)	0.42-0.63 (0.52)	0.41-0.68 (0.59)	0.32-0.52 (0.43)
Org. Carbon (%)	0.42-1.05 (0.63)	0.26-0.53 (0.37)	0.36-1.15 (0.89)	0.38-0.62 (0.49)	0.51-2.5 (1.30)
$CaCO_3$ (%)	6.0-7.0 (6.4)	6.4-13 (9.14)	5.4-13 (8.24)	5-9 (7.2)	6-9 (7.2)
N ($kg\ ha^{-1}$)	140-227 (169.8)	93.6-164 (125.7)	142-286 (211.6)	108-188 (145.2)	160-275 (202.2)
P ($kg\ ha^{-1}$)	10.34-23.03 (19.21)	19.3-24.81 (22.14)	10.3423.31 (19.35)	18.2-25.38 (21.31)	19.69-26.32 (23.01)
K ($kg\ ha^{-1}$)	112-344 (835.4)	669-1058 (884)	348-730 (568.6)	640-835 (715.4)	100-1058 (719.2)
S ($mg\ kg^{-1}$)	3.32-7.35 (5.06)	3.46-5.02 (4.11)	2.78-5.1 (3.93)	2.65-4.3 (3.24)	2.74-6.5 (4.05)
Fe ($mg\ kg^{-1}$)	5.8-9.7 (7.28)	6.4-8.1 (7.22)	3.4-5.4 (4.16)	2.45-6.7 (4.79)	0.68-6.85 (5.14)
Mn ($mg\ kg^{-1}$)	25.7-28.6 (27.38)	24.5-28.7 (26.32)	30.7-32.6 (31.26)	20.4-29.5 (25.34)	21-25.7 (23.58)
Zn ($mg\ kg^{-1}$)	0.10-0.25 (0.16)	0.168-0.37 (0.28)	0.17-0.37 (0.28)	0.15-0.25 (0.20)	0.13-0.29 (0.20)
Cu ($mg\ kg^{-1}$)	2.48-3.45 (2.97)	2.6-3.7 (3.03)	1.73.7 (2.58)	2.6-3.8 (3.18)	1.45-2.45 (2.01)

Table no.4:Fertility status of soils of Manwat tahsil of parbhani district

Soil Property	Villages of Manwat Tahsil				
	Mangrul	**Ramtakli**	**Rampuri**	**Etoli**	**Kumbhari**
pH	7.3-7.4 (7.4)	7.3-7.5 (7.4)	7.4-7.6 (7.5)	7.4-7.7 (7.5)	7.3-7.9 (7.5)
EC (dSm^{-1})	0.43-0.56 (0.47)	0.35-0.56 (0.50)	0.52-0.62 (0.57)	0.42-0.54 (0.46)	0.45-0.62 (0.55)
Org. Carbon (%)	0.38-1.62 (0.91)	0.44-0.97 (0.62)	0.31-0.61 (0.43)	0.38-0.65 (0.52)	0.23-0.46 (0.38)
$CaCO_3$ (%)	5-10 (7.2)	5-9 (7)	5-8 (6.06)	6.16-9.2 (8.07)	5-9 (6.92)
N ($kg\ ha^{-1}$)	87.6-208 (172.5)	110-234 (136.4)	140-300 (187.2)	145-199 (177.6)	95.3-157 (120.4)
P ($kg\ ha^{-1}$)	13.5-22.9 (18.3)	10.6-23.9 (20.1)	16.5-25.0 (20.8)	15.07-22.1 (18.3)	18.6-21.4 (20.0)
K ($kg\ ha^{-1}$)	413-1009 (785.8)	878-1137 (1032)	700-980 (870)	340-970 (532)	801-940 (874.2)
S ($mg\ kg^{-1}$)	2.85-5.6 (3.86)	2.8-10 (6.26)	3.4-5.09 (4.10)	3.07-5.08 (3.77)	3.5-6.5 (4.79)
Fe ($mg\ kg^{-1}$)	5.7-8.71 (7.17)	2.3-6.9 (5.72)	5.7-8.1 (6.66)	2.4-7.45 (5.75)	5.7-8.5 (7.02)
Mn ($mg\ kg^{-1}$)	10.4-16.4 (13.72)	20.4-24.5 (22.64)	16.5-26.7 (20.26)	10.7-19.7 (16.42)	14.6-16.7 (15.64)
Zn ($mg\ kg^{-1}$)	0.044-0.246 (0.162)	0.136-0.692 (0.334)	0.137-0.18 (0.152)	0.28-0.56 (0.40)	0.38-0.9 (0.54)
Cu ($mg\ kg^{-1}$)	1.98-3.7 (2.52)	2.1-3.52 (2.82)	2.3-3.47 (2.7)	1.5-3.7 (2.91)	1.8-2.6 (2.36)

The result showed that, all the samples of Manwat tahsil were moderately neutral in soil reaction with mean pH 7.1-7.9 (7.4) This may be because of formation these soils from basaltic parent material rich in basic cations as reported by Mali and Raut (2001). The electrical conductivity was varied from 0.32 – 0.69 dSm^{-1} (0.52 dSm^{-1}), indicating no salt accumulation in all the samples. Similar results were obtained by

Jibhkate *et al*. (2009). The organic carbon content of soils of Manwat tahsil varied from 0.23-2.5 per cent (0.67 per cent) which indicates that these soils contains low to moderately high organic carbon. Out of total 75 samples 29 samples were low (0.05-0.50 per cent), 20 moderate (0.51-72 per cent) and 26 contained moderately high (0.82-1.80 per cent) organic carbon. This might be due to increased rate of decomposition as concluded by Rashmi *et al*. (2009).The free calcium carbonate content varied from 5-14 per cent (7.79 per cent), which showed that these soils were calcareous in nature. The result was similar with the finding of Kene *et al*. (1987) and it may be due to nature of parent material from which these soils were formed. It is presented in fig 1, 2, and 3.

The available N, P, K and S content of soils of Manwat tahsil was found to be varied from 87.6-300 kg ha^{-1} (171.29 kg ha^{-1}), 10.34-26.32 kg ha^{-1} (19.90 kg ha^{-1}), 350-1137 kg ha^{-1} (736.23 kg ha^{-1} 2.21-10.2 (4.29) indicating that these soil contains low to moderate, very low to low in phosphorus, very high amount of potassium and deficient in sulphur. Total 94.66 per cent samples showed low (87.65-220 kg ha^{-1}), and 5.33 per cent samples showed moderate (242-275 kg ha^{-1}) available nitrogen content. The low to moderate nitrogen content of soil may be due to the low organic matter content of the soil which confirmed with the finding of Vineetha and Malewar *et al*. (2009) or it may be due the rapid loss of applied N by the means of leaching and DE nitrification resulted in low amount of N in soil Tur *et al.* (2008). In case of available phosphorus 98.66 per cent samples are medium and 1.33 per cent samples are high (15-30 kg ha^{-1}) in phosphorus. and concluded that this may be due to application of lower doses of P fertilizer or fixation of P on clay minerals or $CaCO_3$ surfaces with the time elapsed between fertilizer application and crop uptake. All the samples contained very high amount of available potassium. It may be due to occurrence of potash rich minerals like mica and feldspar in the soil. Similar result reported by Tur *et al.* (2008).

The DTPA extractable Fe (0.68-9.8ppm), Mn (10.4-33.8 ppm), were found sufficient and Zn was found deficient in these soils with their mean values Zn (0.044-10.2 ppm), Cu (1.12-3.8) 5.8 ppm, 23.83 ppm, 10.4 ppm and 2.73 ppm respectively. All the samples were found sufficient with respect to Fe, Mn and Cu content and deficient Zn

content. Similar results were reported by Mahesh Kumar *et al. (*2011) and Murthy *et al.* (2005). It is presented in fig.1, 2, and 3.

4.2 Fertility status of soils of parbhani tahsil Parbhani district

The Parbhani tahsil comprise fifteen villages of Tattujawla, Pingali, Sayala, Singanapur, Borwand, Shahapur, Pedgaon, Thombriumri, Bhramhangaon, Wadgaon, Dh armapuri, Zari, Pimpla, Surpimpari, and Kalishwadi the Village wise details are given below in table no. 5.

The data revealed that in Tattujawla village viz., Parbhani tahsil the pH of soils varied from 7.9-8.16 with mean of (8.03) indicating moderately alkaline soil reaction. The EC ranged between 0.28-0.49 dSm^{-1} with mean of 0.36 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.05-0.61 per cent with mean of (0.37 per cent) and 5-8 per cent with mean (8per cent) indicating moderate low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 72-95.6 kg ha^{-1} (83.5 kg ha^{-1}), 8.4-15.7 kg ha^{-1} (11.14 kg ha^{-1}) and 856-963 kg ha^{-1} (904.6 kg ha^{-1}), 3.34-5.1 kg ha^{-1} (4.25) respectively indicating low Nitrogen, very low to low Phosphorus, very high Potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 1.26-3.64 ppm (2.12 ppm), 11.6-13.1 ppm (12.29 ppm), 0.21-0.84 ppm (0.410 ppm) and 1.34-3 ppm (2.22 ppm) indicating the deficiency of DTPA-Zn in soils of Tattujawla village.

The data revealed that in Pingali village of Parbhani tahsil the pH of soils varied from 7.8-8.1 with mean of (7.93) indicating moderately alkaline soil reaction. The EC ranged between 0.28-0.46 dSm^{-1} with mean of 0.33 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.15-0.67 per cent with mean of (0.49 per cent) and 6-10 per cent with mean (7.6 per cent) indicating moderate low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 86.4-189.1 kg ha^{-1} (142.2 kg ha^{-1}), 7.73-15.03 kg ha^{-1} (9.82 kg ha^{-1}), 409-845 kg ha^{-1} (639.98 kg ha^{-1}), and 2.95-4.2 kg ha^{-1} (3.66) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 1.63-7.7 ppm (5.05 ppm),

11.6-17.8 ppm (14.22 ppm), 0.14-0.58 ppm (0.346 ppm) and 1.5-2.7 ppm (1.98 ppm) indicating the deficiency of DTPA-Zn in soils of Pingali village.

The data revealed that in Sayala village of Parbhani tahsil the pH of soils varied from 7.63-7.93 with mean of (7.78) indicating alkaline soil reaction. The EC ranged between 0.12-0.26 dSm^{-1} with mean of 0.18 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.19-1.05 per cent with mean of (0.56 per cent) and 5.2-7.3 per cent with mean (6.32 per cent) indicating moderate low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 67.3-230 kg ha^{-1} (130.7 kg ha^{-1}), 6.59-19.5 kg ha^{-1} (14.60 kg ha^{-1}) and 400.32-769.44 kg ha^{-1} (590.79 kg ha^{-1}), 3.29-3.61kg ha^{-1} (3.43) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 1.29-6.8 ppm (3.72 ppm), 12-18 ppm (16.2 ppm), 0.33-0.52 ppm (0.424 ppm) and 1.5-2.8 ppm (2.32 ppm) indicating the deficiency of DTPA-Zn in soils of Sayala village.

The data revealed that in Singanapur village of Parbhani tahsil the pH of soils varied from 7.75-8.3 with mean of (8.01) indicating moderately alkaline soil reaction. The EC ranged between 0.23-0.46 dSm^{-1} with mean of 0.35 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.29-1.05 per cent with mean of (0.51 %) and 5-8 per cent with mean (6.2 per cent) indicating moderate low to high organic carbon and calcareous nature of soils. The available N, P, K and S varied from 100.3-202.6 kg ha^{-1} (151.3 kg ha^{-1}), 6.78-17.09 kg ha^{-1} (10.06 kg ha^{-1}) and 141.52-784 kg ha^{-1} (379.28 kg ha^{-1}), 3.37-5.1 kg ha^{-1} (3.81) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA extractable Fe, Mn, Zn and Cu content varied from 3.3-9.2 ppm (5.82 ppm), 13-19 ppm (16.0 ppm), 0.12-0.42 ppm (0.278 ppm) and 2.15-2.8 ppm (2.33 ppm) indicating the deficiency of DTPA-Zn in soils of Singanapur village.

The data revealed that in Borwand village of Parbhani tahsil the pH of soils varied from 7.4-8.09 with mean of (7.74) indicating moderately alkaline soil reaction. The EC ranged between 0.35-0.54 dSm^{-1} with mean of 0.42 dSm^{-1}. The organic carbon

and calcium carbonate content was found to be varied from 0.27-0.55 per cent with mean of (0.0.40 per cent) and 5-8 per cent with mean (6.2 per cent) indicating moderate low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 90.3-180.3 kg ha^{-1} (123.8 kg ha^{-1}), 12.7-23.7 kg ha^{-1} (18.23 kg ha^{-1}) and 325-860 kg ha^{-1} (592 kg ha^{-1}), 3.27-4.25kg ha^{-1} (3.724) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA extractable Fe,Mn, Zn and Cu content varied from 2.7 to 7.9 ppm (4.94 ppm), 17 to 32 ppp (22 ppm), 0.18 to 0.54 ppm (0.372 ppm) and 2.7 to 3.7 ppm (3.18 ppm) indicating the deficiency of DTPA-Zn in soils of Borwand village.

The data revealed that in Shahapur village of Parbhani tahsil the pH of soils varied from 7.88-8.3 with mean of (8.036) indicating moderately alkaline soil reaction. The EC ranged between 0.33-0.45 dSm^{-1} with mean of 0.39 dSm^{-1} The organic carbon and calcium carbonate content was found to be varied from 0.56-0.65 per cent with mean of (0.39 per cent) and 6-8.6 per cent with mean (7.46 per cent) indicating medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 131.1-202.6 kg ha^{-1} (175.1 kg ha^{-1}), 9.14-23.03 kg ha^{-1} (17.39 kg ha^{-1}) and 271-900.14 kg ha^{-1} (665.47 kg ha^{-1}), 2.86-3.77 kg ha^{-1} (3.55) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA extractable Fe, Mn, Zn and Cu content varied from 2.89-8.5 ppm (5.36 ppm), 19-26 ppm (23.4 ppm), 0.18-0.44 ppm (00.325 ppm) and 2.8-3.7 ppm (3.34 ppm) indicating the deficiency of DTPA-Zn soils of Shahapur village.

The data revealed that in Pedgaon village of Parbhani tahsil the pH of soils varied from 7.1-8.5 with mean of (7.85) indicating moderately alkaline soil reaction. The EC ranged between 0.21-0.45dSm^{-1} with mean of 0.33 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.23-0.65 per cent with mean of (0.0.53 per cent) and 7-9 per cent with mean (7.84 per cent) indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 80.03-152.3 kg ha^{-1} (124.0 kg ha^{-1}), 5.54-20.2 kg ha^{-1} (12.92 kg ha^{-1}) and 590-780 kg ha^{-1}

(703.66 kg ha^{-1}), 3.26-3.88 kg ha^{-1} (3.46 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA- extractable Fe, Mn, Zn and Cu content varied from 2.8-8.7 ppm (5.5 ppm), 20.1-22.7 ppm (21.56 ppm), 0.22-0.58 ppm (0.36 ppm) and 1.58-3.8 ppm (2.336 ppm) indicating the deficiency of DTPA-Zn in soils of Pedgaon village.

The data revealed that Thombriumri village of Parbhani tahsil the pH of soils varied from 7.9-8.3 with mean of (8.3) indicating moderately alkaline soil reaction. The EC ranged between 0.27-0.58 dSm^{-1} with mean of 0.46 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.39-0.63 per cent with mean of (0.50 per cent) and 6.8-9 per cent with mean (8.04 per cent) indicating moderate low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 77.2-129.8 kg ha^{-1} (104.6 kg ha^{-1}), 7.53-20.03 kg ha^{-1} (15.11 kg ha^{-1}) and 651.84-970 kg ha^{-1} (729.5 kg ha^{-1}), 3.65-7.35 kg ha^{-1} (5.51kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 6.4-8.9 ppm (7.56 ppm), 23.4-26 ppm (25 ppm), 0.30-0.54 ppm (0.414 ppm) and 1.6-4.1 ppm (2.926 ppm) indicating the deficiency of DTPA-Zn in soils of Thombriumri village.

The data revealed that Bhramhangaon village of Parbhani tahsil the pH of soils varied from 7.8-8.4 with mean of (8.14) indicating moderately alkaline soil reaction. The EC ranged between 0.32-0.41 dSm^{-1} with mean of 0.35 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.50-0.75 per cent with mean of (0.49 per cent) and 5-8.5 per cent with mean (6.5 per cent) indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 108.9-155.1 kg ha^{-1} (126.8 kg ha^{-1}), 8.95-21.74 kg ha^{-1} (17.06 kg ha^{-1}), 389-943 kg ha^{-1} (613.46 kg ha^{-1}), 3.08-9.98 kg ha^{-1} (6.06 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 2.4-8.4 ppm (4.58 ppm), 10.7-17.9 ppm (14.72 ppm), 0.13-0.55 ppm (0.297 ppm) and 1.7-3.7 ppm (2.62 ppm) indicating the deficiency of DTPA-Zn in soils of Bhramhangaon village.

The data revealed that Wadgaon village of Parbhani tahsil the pH of soils varied from 7.12-7.7 with mean of (7.38) indicating alkaline soil reaction. The EC ranged between 0.31-0.44 dSm^{-1} with mean of 0.37 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.54-0.67 per cent with mean of (0.37 per cent) and 5-7 per cent with mean (5.6 per cent) indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 80.9-180 kg ha^{-1} (135.4 kg ha^{-1}), 6.58-23.7 kg ha^{-1} (11.85 kg ha^{-1}), 327-580 kg ha^{-1} (392 kg ha^{-1}), 2.75-4.2 kg ha^{-1} (4.45 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 2.69-5.8 ppm (4.45 ppm), 20.8-23.5 ppm (21.96 ppm), 0.18-0.30 ppm (0.239 ppm) and 2.2-3.7 ppm (2.948 ppm) indicating the deficiency of DTPA-Zn in soils of Wadgaon village.

The data revealed that Dharmapuri village of Parbhani tahsil the pH of soils varied from 7.1-7.91 with mean of (7.55) indicating alkaline soil reaction. The EC ranged between 0.24-0.62 dSm^{-1} with mean of 0.44 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.32-0.40 per cent with mean of (0.40 per cent) and 5.2-9 per cent with mean (6.68 per cent) indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 86.3-177.2 kg ha^{-1} (121.6 kg ha^{-1}), 8.52-18.9 kg ha^{-1} (12.68 kg ha^{-1}), 344.55-906 kg ha^{-1} (657 kg ha^{-1}), 3.2-3.98 kg ha^{-1} (3.63 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA extractable Fe, Mn, Zn and Cu content varied from 6.4-8.9 ppm (7.66 ppm), 10.8-13.8 ppm (11.98 ppm), 0.18-0.34 ppm (0.272 ppm) and 1.6-3.57 ppm (2.19 ppm) indicating the deficiency of DTPA-Zn in soils of Dharmapuri village.

The data revealed that Zari village of Parbhani tahsil the pH of soils varied from 7.53-7.9 with mean of (7.74) indicating alkaline soil reaction. The EC ranged between 0.36-0.68 dSm^{-1} with mean of (0.44 dSm^{-1}). The organic carbon and calcium carbonate content was found to be varied from 0.43-0.68 per cent with mean of (0.44 per cent) and 5.5-9.5 per cent with mean (8.2 per cent) indicating moderate low to medium

organic carbon and calcareous nature of soils. The available N, P, K and S varied from 119.2-169 kg ha^{-1} (142.3 kg ha^{-1}), 6.68-8.2 kg ha^{-1} (7.35 kg ha^{-1}), 439.8-490.2 kg ha^{-1} (467 kg ha^{-1}), 3.2-9.05 kg ha^{-1} (5.59 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 3.5-8.9 ppm (6.16 ppm), 13.4-19.4 ppm (17.34 ppm), 0.19-0.54 ppm (0.31 ppm) and 1.81-3.7 ppm (2.46 ppm) indicating the deficiency of DTPA-Zn in soils of Zari village.

The data revealed that Pimpla village of Parbhani tahsil the pH of soils varied from 7.3-7.8 with mean of (7.49) indicating alkaline soil reaction. The EC ranged between 0.32-0.62 dSm^{-1} with mean of (0.51 dSm^{-1}). The organic carbon and calcium carbonate content was found to be varied from 0.63-0.70 per cent with mean of (0.66 per cent) and 5.0-8.5 per cent with mean (6.72 per cent) indicating moderate to high organic carbon and calcareous nature of soils. The available N, P, K and S varied from 120.1-173 kg ha^{-1} (154.3 kg ha^{-1}), 6.68-7.83 kg ha^{-1} (7.29 kg ha^{-1}), 433-529 kg ha^{-1} (469.85 kg ha^{-1}), 3.04-8.36 kg ha^{-1} (5.82 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 3.8-7.7 ppm (5.64 ppm), 10.7-19.8 ppm (14.5 ppm), 0.18-0.89 ppm (0.439 ppm) and 1.12-2.14 ppm (1.73 ppm) indicating the deficiency of DTPA-Zn in soils of Pimpla village.

The data revealed that Kalishwadi village of Parbhani tahsil the pH of soils varied from 7.6-8.3 with mean of (8.0) indicating alkaline soil reaction. The EC ranged between 0.44-0.64 dSm^{-1} with mean of (0.51 dSm^{-1}). The organic carbon and calcium carbonate content was found to be varied from 0.27-0.87 per cent with mean of (0.51 per cent) and 5.25-6.75 per cent with mean (5.86 per cent) respectively indicating low to high organic carbon and calcareous nature of soils. The available N, P, K and S varied from 112.2-238 kg ha^{-1} (150 kg ha^{-1}), 6.8-12.25 kg ha^{-1} (8.8kg ha^{-1}), 317-512 kgha^{-1} (447 kg ha^{-1}), 2.75-7.2 kg ha^{-1} (4.25 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 6.5-10.05 ppm (8.15 ppm), 8.18-9.7

ppm (8.98 ppm), 0.10-0.38 ppm (0.19 ppm) and 2.4-3.54 ppm (2.96 ppm) indicating the deficiency of DTPA-Zn in soils of Kalishwadi village.

Table: no.: 5. Fertility status of soils of Parbhani tahsil of Parbhani district

Soil Property	Villages of Parbhani Tahsil				
	Tattujawla	**Pingali**	**Sayala**	**Singnapur**	**Borwad**
pH	7.9-8.16 (8.03)	78.8-8.1 (7.9)	7.63-7.93 (7.78)	7.75-8.3 (8.01)	7.4-8.09 (7.74)
EC (dSm^{-1})	0.28-0.49 (0.36)	0.28-0.46 (0.33)	0.12-0.26 (0.18)	0.23-0.46 (0.35)	0.35-0.54 (0.42)
Org. Carbon (%)	0.05-0.61 (0.37)	0.15-0.67 (0.49)	0.19-1.05 (0.56)	0.29-1.05 (0.51)	0.27-0.55 (0.40)
$CaCO_3$ (%)	5-8 (6.6)	6-10 (7.6)	5.2-7.3 (6.32)	5-8 (6.2)	5-8 (6.28)
N ($kg\ ha^{-1}$)	72-95.6 (83.5)	86.4-189.1 (142.2)	67.3-230 (130.7)	100.3-202.6 (151.3)	90.3-180.3 (123.8)
P ($kg\ ha^{-1}$)	8.4-15.7 (11.14)	7.73-15.03 (9.82)	6.59-19.5 (14.60)	6.78-17.09 (10.06)	12.7-23.7 (18.23)
K ($kg\ ha^{-1}$)	856-963 (904.6)	409-845 (639.98)	400.32-769 (590.79)	141.52-784 (379.28)	325-860 (592.36)
S ($mg\ kg^{-1}$)	3.34-5.1 (4.2)	2.95-4.2 (3.66)	3.29-3.61 (3.43)	3.37-5.1 (3.81)	3.27-4.25 (3.72)
Fe ($mg\ kg^{-1}$)	1.26-3.64 (2.12)	1.63-7.7 (5.05)	1.29-6.8 (3.72)	3.3-9.2 (5.82)	2.7-7.9 (4.94)
Mn ($mg\ kg^{-1}$)	11.6-13.1 (12.29)	11.6-17.8 (14.22)	12-18 (16.2)	13-19 (16)	17-34 (22)
Zn ($mg\ kg^{-1}$)	0.21-0.84 (0.41)	0.14-0.58 (0.346)	0.33-0.52 (0.42)	0.12-0.42 (0.27)	0.18-0.54 (0.372)
Cu ($mg\ kg^{-1}$)	1.34-3 (2.22)	1.5-2.7 (1.98)	1.5-2.8 (2.32)	2.15-2.8 (2.33)	2.7-3.7 (3.18)

Table: no.: 5. Fertility status of soils of Parbhani tahsil of Parbhani district

Soil Property	Villages of Parbhani Tahsil				
	Shahapur	**Pedgaon**	**Thombriumri**	**Bhramhangaon**	**Wadgaon**
pH	7.8-8.3 (8.03)	7.1-8.5 (7.8)	7.9-8.3 (8.16)	7.8-8.4 (8.14)	7.12-7.7 (7.3)
Ec (dSm^{-1})	0.33-0.45 (0.39)	0.21-0.45 (0.33)	0.27-0.58 (0.46)	0.32-0.41 (0.35)	0.31-0.44 (0.37)
Org. Carbon (%)	0.56-0.65 (0.60)	0.23-0.65 (0.53)	0.39-0.63 (0.5)	0.05-0.75 (0.49)	0.54-0.67 (0.60)
$CaCO_3$ (%)	6-8.6 (7.46)	7-9 (7.84)	6.8-9 (8.04)	5-8.5 (6.5)	5-7 (5.6)
N ($kg\ ha^{-1}$)	131.1-230 (175.1)	80.03-152.3 (124)	77.2-129.8 (104.6)	108-155 (126.8)	80.9-180 (135.4)
P ($kg\ ha^{-1}$)	9.14-23.03 (17.39)	5.54-20.2 (12.92)	7.53-20.03 (15.11)	8.95-21.74 (17.06)	6.58-23.7 (11.85)
K ($kg\ ha^{-1}$)	271-900 (665.4)	590-780 (703.66)	97.07-846.32 (601.08)	389.6-943 (613.46)	327-580 (392)
S ($mg\ kg^{-1}$)	2.8-3.77 (3.55)	3.26-3.88 (3.46)	3.65-7.35 (5.51)	3.08-9.98 (6.06)	2.75-4.2 (3.46)
Fe ($mg\ kg^{-1}$)	2.8-8.5 (5.3)	2.8-8.7 (5.5)	6.4-8.9 (7.56)	2.4-8.4 (4.58)	2.69-5.8 (4.45)
Mn ($mg\ kg^{-1}$)	19-26 (23.4)	20.1-22.7 (21.56)	23.4-26 (25)	10.7-17.9 (14.72)	20.8-23.5 (21.96)
Zn ($mg\ kg^{-1}$)	0.18-0.44 (0.32)	0.22-0.58 (0.36)	0.3-0.54 (0.41)	0.13-0.55 (0.29)	0.18-0.34 (0.239)
Cu ($mg\ kg^{-1}$)	2.8-4.2 (3.34)	1.58-3.8 (2.33)	1.6-4.1 (2.9)	1.7-3.7 (2.62)	2.2-3.7 (2.94)

Table: no.: 5. Fertility status of soils of Parbhani tahsil of Parbhani district

Soil Property	Village of Parbhani Tahsil				
	Dharmapuri	**Zari**	**Pimpla**	**Surpimpari**	**Kalishwadi**
PH	7.1-7.9 (7.55)	7.5-7.9 (7.74)	7.3-7.8 (7.49)	7.6-8.3 (8)	7.59-7.78 (7.65)
EC (dSm^{-1})	0.24-0.62 (0.44)	0.36-0.62 (0.44)	0.32-0.62 (0.51)	0.44-0.64 (0.51)	0.34-0.52 (0.43)
Org. Carbon (%)	0.32-0.52 (0.40)	0.43-0.68 (0.51)	0.63-0.70 (0.66)	0.27-0.87 (0.51)	0.21-0.95 (0.37)
$CaCO_3$ (%)	5.2-9 (5.6)	5.5-9.5 (8.2)	5-8.5 (6.72)	5.25-6.75 (5.86)	5.25-9 (7.08)
N ($kg\ ha^{-1}$)	86.3-177.2 (121.6)	119.2-169 (142.3)	120.1-173.2 (154.3)	112.2-238 (10.95)	117-201 (147.8)
P ($kg\ ha^{-1}$)	8.52-18.9 (12.68)	6.6-8.2 (7.35)	6.687.83 (7.29)	6.8-12.25 (8.8)	6.12-13 (8.70)
K ($kg\ ha^{-1}$)	344-906 (657.61)	439-490.2 (467.53)	433-529 (469.85)	317-512 (447.8)	300-521 (422.2)
S ($mg\ kg^{-1}$)	3.2-3.98 (3.68)	3.2-9.05 (5.59)	3.04-8.36 (5.82)	2.75-7.2 (4.25)	3.08-9.05 (5.4)
Fe ($mg\ kg^{-1}$)	6.4-8.9 (7.66)	3.5-8.9 (6.16)	3.8-7.7 (5.64)	4.7-8.7 (6.42)	6.5-10.05 (8.15)
Mn ($mg\ kg^{-1}$)	10.8-13.8 (11.98)	13.4-19.4 (17.34)	10.719.8 (14.5)	20.4-23.7 (22.08)	8.18-9.7 (8.98)
Zn ($mg\ kg^{-1}$)	0.18-0.34 (0.272)	0.19-0.54 (0.31)	0.180.89 (0.439)	0.21-0.74 (0.43)	0.105-0.38 (2.96)
Cu ($mg\ kg^{1}$)	1.6-3.57 (2.19)	1.81-3.7 (2.46)	1.122.8 (1.73)	1.7-3.7 (2.59)	2.4-3.54 (2.96)

Thus, the results of Parbhani tahsil reveled that, all the soil samples the result showed that, all the samples of Parbhani tahsil were moderately alkaline in soil reaction with mean pH 7.1-8.4 (7.83) this may be because of formation these soils from basaltic parent material rich in basic cations as reported by Mali and Raut (2001). The electrical conductivity was varied from 0.12-0.64 dSm^{-1} (0.39 dSm^{-1}), indicating no salt

accumulation in all the samples. Similar results were obtained by Jibhkate *et al*. (2009). The organic carbon content of soils of Parbhani tahsil varied from 0.05-1.05 per cent (0.50 per cent) which indicates that these soils contains low to moderately high organic carbon. Out of 60 per cent samples were low (0.15- 0.48 per cent), 46.66 per cent moderate (0.52-75 per cent), 6.66 per cent samples and contained moderately high (0.87-1.05 per cent) organic carbon. This might be due to increased rate of decomposition. The free calcium carbonate content varied from 5-10 per cent (6.86 per cent), which showed that these soils were calcareous in nature. It may be due to nature of parent material from which these soils were formed. It is presented in fig 4.

The available N, P, K and S content of soils of Parbhani tahsil was found to be varied from 67.3-238 kg ha^{-1} (134.3 kg ha^{-1}), 5.54-23.7 kg ha^{-1} (12.20 kg ha^{-1}), 141-970.7 kg ha^{-1} (569.86 kg ha^{-1}) 2.75-9.98 (4.38) indicating that these soil contains low to moderate, very low to low phosphorus, very amount of potassium and deficient sulphur It is presented in fig. Out of 98.66 per cent samples showed low (67.3-230 kg ha^{-1}), and 1.33 per cent moderate (238 kg ha^{-1}) available nitrogen content. The low to moderate nitrogen content of soil may be due to the low organic matter content of the soil which confirmed with the finding of Vineetha and Malewar *et al.* (2009) or it may be due the rapid loss of applied N by the means of leaching and DE nitrification resulted in low amount of N in soil Tur *et al.* (2008). In case of available phosphorus 49.33 per cent samples contained very low (< 10 kg ha^{-1}) while 50.66 per cent were medium (15-30 kg ha^{-1}) in phosphorus. Similar result reported by Tur *et al.* (2008) and concluded that this may be due to application of lower doses of P fertilizer or fixation of P on clay minerals or $CaCO_3$ surfaces with the time elapsed between fertilizer application and crop uptake. All the samples contained very high amount of available potassium. It may be due to occurrence of potash rich minerals like mica and feldspar in the soil. Similar result reported by Tur *et al.* (2008).

The DTPA-extractable Fe (1.26-10.05 ppm), Mn (8.18-32.0 ppm), were found sufficient and Zn was found deficient in these soils with their mean values Zn (0.105-0.89 ppm), Cu (1.12-4.2), 5.54 ppm, 17.48 ppm, 0.342 ppm and 2.544 ppm

respectively. All the samples were found sufficient with respect to Fe, Mn and Cu content and deficient with respect to Zn content. Similar results were reported by Mahesh Kumar *et al.* (2011) and Murthy *et al.* (2005). It is presented in fig.5, 6.

4.3 Fertility status of soils of Purna tahsil of Parbhani district

The purna tahsil comprise fifteen Villages viz., Nawki, Mategaon, Purna, G oar, Dhanora, Changphal, Kawlgaon, Dhanorakale, Regaon, Tadkalas, Shirkalas, Balsa, L imbla, Yerendeshwar, and Chudwa, The Village wise details are given below in table no. 6.

The data revealed that in Nawki village of Purna tahsil the pH of soils varied from 7.6-7.8 with mean of (7.69) indicating moderately alkaline soil reaction. The EC ranged between 0.45-0.57 dSm^{-1} with mean of 0.53 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.31-0.56 per cent with mean of 0.43 per cent and 5.5-10 per cent with mean (7.5 per cent) indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 110-160 kg ha^{-1} (131.4 kg ha^{-1}), 6.43-22.09 kg ha^{-1} (12.90 kg ha^{-1}) and 380-845 kg ha^{-1} (668.8 kg ha^{-1}), 1.1-2.27 respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 1.73-6.7 ppm (3.86 ppm), 10.7-11.89 ppm (11.5 ppm), 0.20-1.75 ppm (0.962 ppm) and 1.2-1.7 ppm (1.38 ppm) indicating the deficiency of DTPA-Zn in soils of Nawaki village.

The data revealed that in Mategaon village of Purna tahsil the pH of soils varied from 7.15-7.60 with mean of (7.36) indicating neutral to alkaline soil reaction. The EC ranged between 0.31-0.51 dSm^{-1} with mean of 0.42 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.20-0.42 per cent with mean of (0.28 per cent) and 5-10 per cent with mean (6.8 per cent) indicating low in organic carbon and calcareous nature of soils. The available N, P, K and S varied from 110-174 kg ha^{-1} (133.2 kg ha^{-1}), 7.0-21.7 kg ha^{-1} (12.13 kg ha^{-1}) and 540-898 kg ha^{-1} (732.2 kg ha^{-1}), 1.42-2.58 respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and

Cu content varied from 3.8-9.02 ppm (5.51 ppm), 8.5-10.7 ppm (9.72 ppm), 0.24-0.49 ppm (0.3654 ppm) and 1.39-1.84 ppm (1.604 ppm) indicating the deficiency of DTPA-Zn in soils of Mategaon village.

The data revealed that in Purna village of Purna tahsil the pH of soils varied from 7.16-7.70 with mean of (7.50) indicating neutral to alkaline soil reaction. The EC ranged between 0.25-0.36 dSm^{-1} with mean of 0.32 dSm^{-1} The organic carbon and calcium carbonate content was found to be varied from 0.12-0.32 per cent with mean of (0.25 per cent) and 5.-7 per cent with mean (6.1 per cent) indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 130-148 kg ha^{-1} (142.2 kg ha^{-1}), 7.0-24.01 kg ha^{-1} (17.56 kg ha^{-1}) and 449-602 kg ha^{-1} (512.2 kg ha^{-1}), 1-3 kg ha^{-1} (2.0 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 1.15-5.6 ppm (2.89 ppm), 10.23-12.6 ppm (11.14 ppm), 0.29-0.59 ppm (0.57 ppm) and 1.76-3.8 ppm (2.77 ppm) indicating the deficiency of DTPA-Zn in soils of Purna village.

The data revealed that in Goar village of Purna tahsil the pH of soils varied from 7.40-7.50 with mean of (7.44) indicating moderately neutral soil reaction. The EC ranged between 0.18-0.33 dSm^{-1} with mean of 0.24 dSm^{-1} The organic carbon and calcium carbonate content was found to be varied from 0.22-0.37 per cent with mean of 0.30 per cent and 5.0-7.0 per cent with mean (5.9 per cent) indicating low organic carbon and calcareous nature of soils. The available N, P, K and S varied from 92.2-180 kg ha^{-1} (139.44 kg ha^{-1}), 5.12-20.11 kg ha^{-1} (10.33 kg ha^{-1}) and 540-984 kg ha^{-1} (787.4 kg ha^{-1}), 1.7-4.5respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 1.33-5.60 ppm (3.32 ppm), 10.65-10.70 ppm (10.77 ppm), 0.51-0.99 ppm (0.783 ppm) and 2.56-3.1 ppm (2.72 ppm) indicating the deficiency of DTPA-Zn in soils of Goar village.

The data revealed that in Dhanora village of Purna tahsil the pH of soils varied from 7.46-7.55 with mean of (7.5) indicating moderately neutral soil reaction. The

EC ranged between 0.21-0.43 dSm^{-1} with mean of 0.37 dSm^{-1} The organic carbon and calcium carbonate content was found to be varied from 0.26-0.52 per cent with mean of (0.39 per cent) and 5.0-8.0 per cent with mean (6.5 per cent) indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 82.6-179 kg ha^{-1} (128.72 kg ha^{-1}), 9.65-23.75 kg ha^{-1} (18.14 kg ha^{-1}) and 120-1373 kg ha^{-1} (885.8 kg ha^{-1}), 1.7-2.5respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 1.4-2.63 ppm (2.02 ppm), 10.7-12.9 ppm (11.92 ppm), 0.28-0.97 ppm (0.566 ppm) and 1.14-3.58 ppm (2.42 ppm) indicating the deficiency of DTPA-Zn in soils of Dhanora village.

The data revealed that in Changephal village of Purna tahsil the pH of soils varied from 7.4-7.65 with mean of (7.54) indicating netural to alkaline soil reaction. The EC ranged between 0.25-0.39 dSm^{-1} with mean of 0.32 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.15-0.60 per cent with mean of 0.36 per cent and 6.0-9.2 per cent with mean (7.5 per cent) indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 97.2- 656 kg ha^{-1} (221.64 kg ha^{-1}), 7.26-23.7 kg ha^{-1} (18.86 kg ha^{-1}) and 374-956.2 kg ha^{-1} (714.4 kg ha^{-1}), 1.36-2.4 kg ha^{-1} (1.80 kg ha^{-1}) respectively indicating low to medium nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA- extractable Fe, Mn, Zn and Cu content varied from 4.1-9.7 ppm (5.69 ppm), 8.1-10. ppm (8.8 ppm), 0.16-3.8 ppm (1.17 ppm) and 1.45-2.16 ppm (2.0 ppm) indicating the deficiency of DTPA-Zn in soils of Changephal village.

The data revealed that in Kawlgaon village of Purna tahsil the pH of soils varied from 7.7-8.3 with mean of (8.02) indicating netural to alkaline soil reaction. The EC ranged between 0.42-0.63 dSm^{-1} with mean of 0.51 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.15-0.5 per cent with mean of 0.36 per cent and 5-8 per cent with mean (6.2 per cent) indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 79.6-16 kg ha^{-1} (125.5 kg ha^{-1}), 6.15-21.8 kg ha^{-1} (14.4 kg ha^{-1}) and 440-658 kg ha^{-1} (593.4 kg ha^{-1}),

1.13-2.53 kg ha^{-1} (1.93 kg ha^{-1}) respectively indicating low to medium nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 1.05-6.7 ppm (5.17 ppm), 8.9-10.7 ppm (9.73 ppm), 0.42-3.41 ppm (1.11 ppm) and 1.4-3.41 ppm (2.45 ppm) indicating the deficiency of DTPA-Zn in soils of Kawlgaon village.

The data revealed that in Dhanora kale village of Purna tahsil the pH of soils varied from 7.44-7.60 with mean of (7.50) indicating neutral to alkaline soil reaction. The EC ranged between 0.45-0.56 dSm^{-1} with mean of 0.50 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.31-0.45 per cent with mean of 0.38 per cent and 5.3-7.2 per cent with mean (6.3 per cent) indicating low organic carbon and calcareous nature of soils. The available N, P, K and S varied from 140-158 kg ha^{-1} (151.2 kg ha^{-1}), 5.87-20.53 kg ha^{-1} (14.58 kg ha^{-1}) and 840-990 kg ha^{-1} (934 kg ha^{-1}), 1.1-2.4 kg ha^{-1} (1.688 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 2.37-7.4 ppm (6.05 ppm), 10.7-12.3 ppm (11.07 ppm), 0.217-1.74 ppm (1.270 ppm) and 1.07-1.34 ppm (1.15 ppm) indicating the deficiency of DTPA-Zn in soils of Dhanora kale village.

The data revealed that in Ragaon village of Purna tahsil the pH of soils varied from 7.7-8.2 with mean of (7.8) indicating moderately alkaline soil reaction. The EC ranged between 0.41-0.51 dSm^{-1} with mean of 0.45 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.22-0.75 per cent with mean of 0.43 per cent and 5.0-8.0 per cent with mean (6.3 per cent) indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 149-258 kg ha^{-1} (176 kg ha^{-1}), 4.74-18.01 kg ha^{-1} (10.98 kg ha^{-1}) and 480-980 kg ha^{-1} (681 kg ha^{-1}), 1.64-2.7 kg ha^{-1} (2.06 kg ha^{-1}) respectively indicating low to medium nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA extractable Fe, Mn, Zn and Cu content varied from 1.342-8.1 ppm (5.24 ppm), 10.7-15.9 ppm (14.74 ppm), 0.16-1.72 ppm (0.70 ppm) and 1.5-4.77 ppm (2.57 ppm) indicating the deficiency of DTPA-Zn in soils of Regaon village.

The data revealed that in Tadkalas village of Purna tahsil the pH of soils varied from 7.54-7.90 with mean of (7.68) indicating netural to alkaline soil reaction. The EC ranged between 0.24-0.34 dSm^{-1} with mean of 0.31 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.23-0.75 per cent with mean of 0.39 per cent and 6.0-10 per cent with mean (7.9 per cent) indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 147-205 kg ha^{-1} (174.8 kg ha^{-1}), 4.6-10.03 kg ha^{-1} (6.55 kg ha^{-1}) and 540-1209 kg ha^{-1} (808.2 kg ha^{-1}), 1.0-3.6 kg ha^{-1} (2.202 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 1.76-8.06 ppm (5.42 ppm), 14.7-19.7 ppm (16.74 ppm), 0.21-0.992 ppm (0.57 ppm) and 1.2-3.1 ppm (1.81 ppm) indicating the deficiency of DTPA-Zn in soils of Tadkalas village.

The data revealed that in Shirkalas village of Purna tahsil the pH of soils varied from 7.60-7.76 with mean of (7.67) indicating moderately alkaline soil reaction. The EC ranged between 0.42-0.48 dSm^{-1} with mean of 0.45 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.22-0.65 per cent with mean of 0.38 per cent and 5.0-8.0 per cent with mean (6.2 per cent) indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 97.2-180 kg ha^{-1} (129.08 kg ha^{-1}), 7.8-22.7 kg ha^{-1} (15.97 kg ha^{-1}) and 570-996 kg ha^{-1} (723.2 kg ha^{-1}), 1.7-3.8 kg ha^{-1} (3.10 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA- extractable Fe, Mn, Zn and Cu content varied from 1.16-5.7 ppm (3.11 ppm), 16.1-17.8 ppm (16.94 ppm), 0.57-0.77 ppm (0.566 ppm) and 1.3-3.4 ppm (2.48 ppm) indicating the deficiency of DTPA-Zn in soils of Shirkalas village.

The data revealed that in Balsa village of Purna tahsil the pH of soils varied from 7.6-8.3 with mean of (7.85) indicating moderately alkaline soil reaction. The EC ranged between 0.28-0.38 dSm^{-1} with mean of 0.33 dSm^{-1} The organic carbon and calcium carbonate content was found to be varied from 0.11-0.30 per cent with mean of

0.21 per cent and 4.4-9.3 per cent with mean (7.2 per cent) indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 90.6-180 kg ha^{-1} (151.72 kg ha^{-1}), 6.48-26.08 kg ha^{-1} (14.32 kg ha^{-1}) and 300-1020 kg ha^{-1} (610 kg ha^{-1}), 1.0-3.0 kg ha^{-1} (2.032 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 2.5-5.6 ppm (3.96 ppm), 14.5-18.4 ppm (15.59 ppm), 0.28-0.84 ppm (0.624 ppm) and 1.14-3.4 ppm (2.26 ppm) indicating the deficiency of DTPA-Zn in soils of Balsa village.

The data revealed that in Limbla village of Purna tahsil the pH of soils varied from 7.4-7.9 with mean of (7.62) indicating neutral to alkaline soil reaction. The EC ranged between 0.28-0.48 dSm^{-1} with mean of 0.36 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.40-0.90 per cent with mean of 0.58 per cent and 6.5-9.3 per cent with mean (7.5 per cent) indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 140-189 kg ha^{-1} (161 kg ha^{-1}), 15.33-22.8 kg ha^{-1} (19.15 kg ha^{-1}) and 400-570 kg ha^{-1} (496.4 kg ha^{-1}), 1.38-3.09 kg ha^{-1} (2.37 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 1.50-5.7 ppm (3.17 ppm), 20.1-21.9 ppm (21.18 ppm), 0.28-0.94 ppm (0.618 ppm) and 1.2-5.4 ppm (2.661 ppm) indicating the deficiency of DTPA-Zn in soils of Limbla village.

The data revealed that in Yerendeshwar village of Purna tahsil the pH of soils varied from 7.49-7.60 with mean of (7.52) indicating moderately alkaline soil reaction. The EC ranged between 0.31-0.51 dSm^{-1} with mean of 0.41 dSm^{-1} The organic carbon and calcium carbonate content was found to be varied from 0.10-0.24 per cent with mean of 0.18 per cent and 6.4-8.5 per cent with mean (7.5 per cent) indicating low organic carbon and calcareous nature of soils. The available N, P, K and S varied from 126-182 kg ha^{-1} (156.6 kg ha^{-1}), 11.36-20 kg ha^{-1} (16.82 kg ha^{-1}) and 400-590 kg ha^{-1} (501.2 kg ha^{-1}), 1.42-2.4 kg ha^{-1} (1.79 kg ha^{-1}) respectively indicating low nitrogen, very low to low phosphorus, very high potassium content deficient Sulphur

respectively . The DTPA extractable Fe, Mn, Zn and Cu content varied from 1.24-2.4 ppm (4.15 ppm), 23.7-27.8 ppm (25.1 ppm), 0.31-2.37 ppm (1.07 ppm) and 2.6-3.8 ppm (3.16 ppm) indicating the deficiency of DTPA-Zn in soils of Yerendeshwar village.

The data revealed that in Chudwa village of Purna tahsil the pH of soils varied from 7.2-7.9 with mean of (7.54) indicating moderately alkaline soil reaction. The EC ranged between 0.47-0.65 dSm^{-1} with mean of 0.53 dSm^{-1}. The organic carbon and calcium carbonate content was found to be varied from 0.22-0.41 per cent with mean of 0.31 per cent and 5.3-7.2 per cent with mean (6.14 per cent) indicating low to medium organic carbon and calcareous nature of soils. The available N, P, K and S varied from 105-174 kg ha^{-1} (138 kg ha^{-1}), 11.28-20.8 kg ha^{-1} (16.13 kg ha^{-1}) and 340-890 kg ha^{-1} (698.2 kg ^{1}), 1.482.7 kg ha^{1} (1.9 kg ha^{1}) respectively indicating low nitrogen, very low to lowphosphorus, very high potassium content, deficient Sulphur respectively. The DTPA-extractable Fe, Mn, Zn and Cu content varied from 1.75-5.7 ppm (3.21 ppm), 20.7-27.1 ppm (25.16 ppm), 0.37-0.86 ppm (0.70 ppm) and 1.2-2.8 ppm (1.93 ppm) indicating the deficiency of DTPA-Zn in soils of Chudwa village.

Table.no.6. Fertility status of soils of Purna tahsil of Parbhani district

Soil Property	Villages of Purna tahsil				
	Nawki	**Mategaon**	**Purna**	**Goar**	**Dhanora**
pH	7.6-7.8 (7.69)	7.15-7.6 (7.36)	7.16-7.7 (7.50)	7.4-7.5 (7.44)	7.46-7.55 (7.5)
EC (dSm^{-1})	0.45-0.57 (0.53)	0.31-0.51 (0.42)	0.25-0.36 (0.32)	0.18-0.33 (0.24)	0.21-0.43 (0.37)
Org. Carbon (%)	0.31-0.56 (0.43)	0.20-0.42 (0.28)	0.12-0.32 (0.25)	0.220.37 (0.30)	0.26-0.52 (0.39)
$CaCO_3$ (%)	5.5-10 (7.5)	5-10 (6.8)	5-7 (6.1)	5-7 (5.9)	5-8 (6.5)
N ($kg\ ha^{-1}$)	110-160 (131.4)	110-174 (133.2)	130-148 (142.2)	92.2-180 (139.44)	82.6-179 (128.72)
P ($kg\ ha^{-1}$)	6.43-22.09 (12.90)	7-21.7 (12.13)	7-24.01 (17.56)	5.12-20.11 (10.33)	9.65-23.75 (18.14)

K (kg ha^{-1})	380-845 (668.8)	540-898 (732.2)	449-602 (512.2)	540-984 (787.4)	120-1373 (885.8)
S (mg kg^{-1})	1.1-2.27 (1.53)	1.42-2.58 (1.94)	1-3 (2.002)	1.7-4.5 (2.77)	1.7-2.5 (2.09)
Fe (mg kg^{-1})	1.73-6.7 (3.86)	3.8-9.02 (5.51)	1.15-5.6 (2.89)	1.33-5.6 (3.32)	1.4-2.63 (2.02)
Mn (mg kg^{-1})	10.7-11.89 (11.5)	8.5-10.7 (9.72)	10.23-12.6 (11.14)	10.56-10.9 (10.77)	10.7-12.9 (11.92)
Zn (mg kg^{-1})	0.2-1.75 (0.96)	0.24-0.49 (0.36)	0.29-0.59 (12.2)	0.51-0.99 (0.783)	0.282-0.97 (0.56)
Cu (mg kg^{-1})	1.2-1.7 (1.38)	1.39-1.84 (1.60)	1.76-3.8 (2.77)	2.56-3.1 (2.72)	1.14-3.58 (2.42)

Table no. 6. Fertility status of soils of Purna tahsil of Parbhan district

Soil Property	**Villages of Purna tahsil**				
	Changephal	**Kawlgaon**	**Dhanora Kale**	**Regaon**	**Tadkalas**
pH	7.4-7.65 (7.54)	7.7-8.3 (8.02)	7.44-7.60 (7.50)	7.7-8.2 (7.84)	7.5-7.9 (7.68)
EC (dSm^{-1})	0.25-0.39 (0.32)	0.42-0.63 (0.51)	0.45-0.56 (0.50)	0.41-0.51 (0.45)	0.24-0.34 (0.31)
Org. Carbon (%)	0.15-0.60 (0.36)	0.15-0.57 (0.36)	0.31-0.45 (0.38)	0.22-0.75 (0.43)	0.23-0.75 (0.39)
$CaCO_3$ (%)	6-9.2 (7.5)	5-8 (6.2)	5.3-7.2 (6.3)	5-8 ()6.3	6-10 (7.9)
N (kg ha^{-1})	97.2-656 (221.64)	79.6-161 (125.52)	140-158 (151.2)	149-258 (176)	147-205 (174.8)
P (kg ha^{-1})	7.26-23.7 (18.86)	6.15-21.85 (14.46)	5.3-7.2 (6.3)	4.74-18.01 (10.98)	4.6-10.03 (6.55)
K (kg ha^{-1})	374-956.26 (714)	440-658 (593.4)	840-990 (934)	480-980 (681)	540-1209 (808.2)
S (mg kg^{-1})	1.36-2.4 (1.80)	1.13-2.53 (1.93)	1.1-2.4 (1.68)	1.64-2.7 (2.06)	1-3.6 (2.20)

Fe (mg kg^{-1})	4.1-9.7 (5.69)	1.05-6.7 (5.17)	6.8-7.4 (6.05)	1.34-8.1 (5.24)	1.76-8.06 (5.42)
Mn (mg kg^{-1})	8.1-10.08 (8.85)	8.9-10.7 (9.73)	10.7-12.3 (11.07)	10.7-15.9 ()14.74	14.7-19.7 (16.74)
Zn (mg kg^{-1})	0.16-3.86 (1.17)	0.42-1.91 (1.11)	0.21-1.74 (1.27)	0.168-1.72 (0.70)	0.21-0.992 (0.579)
Cu (mg kg^{-1})	1.45-2.61 (2.07)	1.46-3.41 (2.4)	1.07-1.34 (1.15)	1.5-4.76 (2.57)	1.2-3.1 (1.81)

Table.no.6. Fertility status of soils of Purna tahsil of Parbhani district

Soil Property	**Villages of Purna tahsil**				
	Shirkalas	**Balsa**	**Limbla**	**Yerendeshwar**	**Chudwa**
pH	7.60-7.76 (7.67)	7.6-8.3 (7.85)	7.4-7.9 (7.62)	7.49-7.6 (7.52)	7.2-7.9 (7.52)
EC (dSm^{-1})	0.42-0.48 (0.456)	0.28-0.38 (0.33)	0.28-0.48 (0.36)	0.31-0.51 (0.41)	047-0.65 (0.53)
Org. Carbon (%)	0.22-0.65 (0.38)	0.11-0.30 (0.21)	0.40-0.90 (0.58)	0.1-0.24 (0.18)	0.22-0.41 (0.31)
$CaCO_3$ (%)	5-8 (6.2)	4.4-9.3 (7.2)	6.5-9.3 (7.5)	6.4-8.5 (7.5)	5.3-6.5 (18.2)
N (kg ha^{-1})	97.2-180 (129.08)	90.6-180 (151.72)	140-189 (161)	126-182 (156.6)	105-174 (138)
P (kg ha^{-1})	7.8-22.7 (15.97)	6.48-26.08 (14.32)	15.33-22.8 (19.15)	11.36-20 (16.82)	11.28-20.8 (16.13)
K (kg ha^{-1})	570-996 (723.2)	300-1020 (610)	400-570 (496.4)	400-590 (501)	340-890 (698)
S (mg kg^{-1})	1.7-3.8 (3.10)	1-3 (2.03)	1.38-3.09 (2.37)	1.42-2.4 (1.79)	1.48-2.7 (1.95)
Fe (mg kg^{-1})	1.16-5.7 (3.11)	2.5-5.6 (3.96)	1.50-5.7 (3.17)	1.24-6.7 (4.15)	1.75-5.7 (3.21)
Mn (mg kg^{-1})	16.1-17.8 (16.94)	14.5-18.4 (15.59)	20.1-21.9 (21.18)	23.7-27.8 (25.1)	20.7-27.1 (25.16)

Zn (mg kg^{-1})	0.57-0.77 (0.56)	0.28-0.84 (0.62)	0.28-21.9 (0.61)	0.31-2.37 (1.07)	0.37-0.86 (0.70)
Cu (mg kg^{-1})	1.3-3.4 (2.48)	1.14-3.4 (2.26)	1.2-5.4 (2.66)	2.6-3.8 (3.16)	1.2-2.8 (1.93)

Thus, the results of Purna tahsil reveled that, all the soil samples the result showed that, all the samples of Purna tahsil were moderately alkaline in soil reaction with mean pH 7.15-7.90 (7.54) this may be because of formation these soils from basaltic parent material rich in basic cations as reported by Mali and Raut (2001). The electrical conductivity was varied from 0.18-0.65 dSm^{-1} (0.40 dSm^{-1}), indicating no salt accumulation in all the samples. Similar results were obtained by Jibhkate *et al.* (2009). The organic carbon content of soils of Purna tahsil varied from 0.10-0.90 per cent (0.35 per cent) which indicates that these soils contains low to moderately high organic carbon. Out of 63 samples were low (0.10-49 per cent), 11 moderate (0.52-90 per cent), 1 samples and contained moderately high organic carbon. This might be due to increased rate of decomposition as concluded by Rashmi *et al.* (2009).The free calcium carbonate content varied from 4.4-10 per cent (7.5 per cent), which showed that these soils were calcareous in nature. It may be due to nature of parent material from which these soils were formed. It is presented in fig. 7.

The available N, P, K and S content of soils of Purna tahsil was found to be varied from 79.6-656 kg ha^{-1} (150.7 kg ha^{-1}), 4.6-26.08 kg ha^{-1} (14.59 kg ha^{-1}), 120-1373 kg ha^{-1} (689.76 kg ha^{-1}) 1.0-4.5 (2.08) indicating that these soil contains low to moderate, very low to low Phosphorus, very amount of Potassium and deficient Sulphur It is presented in fig. out of 98.66 per cent samples showed low (79.6-248 kg ha^{-1}), and 1.33 per cent samples are moderate available nitrogen content. The low to moderate nitrogen content of soil may be due to the low organic matter content of the soil which confirmed with the finding of Vineetha and Malewar *et al.* (2009) or it may be due the rapid loss of applied N by the means of leaching and DE nitrification resulted in low amount of N in soil Tur *et al.* (2008). In case of available phosphorus 33.33 per cent samples contained

very low (< 10 kg ha^{-1}) while 65.35 per cent were medium (15-30 kg ha^{-1}) in phosphorus. Similar result reported by Tur *et al*. (2008) and concluded that this may be due to application of lower doses of P fertilizer or fixation of P on clay minerals or $CaCO_3$ surfaces with the time elapsed between fertilizer application and crop uptake. All the samples contained very high amount of available potassium. It may be due to occurrence of potash rich minerals like mica and feldspar in the soil. Similar result reported by Tur *et al.* (2008).

The DTPA-extractable Fe (1.05-9.70 ppm), Mn (8.10-27.8 ppm), were found sufficient and Zn was found deficient in these soils with their mean values Zn (0.16-3.86 ppm), Cu (1.06-5.4), 4.18 ppm, 14.67 ppm, 1.55 ppm and 2.23 ppm respectively. All the samples were found sufficient with respect to Fe, Mn and Cu content and deficient with respect to Zn content. Similar results were reported by Mahesh Kumar *et al.* (2011) and Murthy *et al.* (2005). It is presented in fig.9.

4.4 Soil Nutrient Index Value

The nutrient index value of available macronutrients (N, P, K and S), and s ome micronutrient cations *viz.* , Fe, Mn, Zn, Cu of Manwat, Parbhani, and Purna tahsil s of Parbhani district were represented in table no.7 and also presented in Fig. 10.

The "nutrient index value" for soils of central tahsils of Parbhani district represents "Low fertility status" for Nitrogen, phosphorus. The value w orked out from nutrient index for Nitrogen, Phosphorus, are 1.03, and 1.54, respectively. against the nutrient index value < 1.67 for low, 1.67 to 2.33 for medium and > 2.33 for high fertility status of area. The "High Fertility Status" for Potassium, were 2.98 respectively. The secondary nutrient S is deficient in 100 percent soils and DTPA-Fe, 36, DTPA-Mn, 21.3, DTPA-Zn, 91.5, soils of central tahsils of Parbhani distric.

Table no. 7 (a): Soil nutrient index value central tahsils of Parbhani district

Sr.No.	Available Nutrients	Central tahsils Parbhani	
		NIV	Category
1	Nitrogen	1.03	Low
2	Phosphorus	1.54	Low
3	Potassium	2.98	High

Table no. 7 (b): Deficiency of secondary and micronutrients in central tahsils of parbhani district

Sr.no.	Available Nutrients	Deficient (%)	Sufficient (%)
1	Sulphur	100%	Nil
2	Iron	36.52%	63.48%
3	Manganese	21.3%	78.7%
4	Zinc	91.5%	8.4%
5	Copper	Nil	100%

The nutrient index value of available macronutrients (N, P, K and S), and some micronutrient cations *viz.*, Fe, Mn, Zn, Cu of Manwat tahsils of Parbhani district were represented in table no.8 and also presented in Fig. 11.

The "nutrient index value" for soils of Manwat tahsils of Parbhani distr ict represents "Low fertility status" for Nitrogen, phosphorus. The value worked out from nutrient index for Nitrogen, Phosphorus, are 1.4, and 1.3, respectively. against the nutrient index value < 1.67 for low, 1.67 to 2.33 for medium and > 2.33 for high fertility status of area. The "High Fertility Status" for Potassium, were 2.98 respectively. The secondary nutrient S is deficiency in 100 percentage soils and DTPA-Fe, 18.66, DTPA-Mn, 21.7, DTPA-Zn, 93.7 soils of Manwat tahsils of Parbhani district.

Table no. 8 (a) Soil nutrient index value Manwat tahsil of Parbhani district

Sr.No.	Available Nutrients	Manwat tahsil	
		NIV	Category
1	Nitrogen	1.4	Low
2	Phosphorus	1.3	Low
3	Potassium	4.0	High

Table no.8 (b):Deficiency of secondary and micronutrients in Manwat tahsil of Parbhani district

Sr. no.	Available Nutrients	Deficient (%)	Sufficient (%)
1	Sulphur	100%	Nil
2	Iron	18.66%	81.33%
3	Manganese	21.7%	78.3%
4	Zinc	93.33%	6.66%
5	Copper	Nil	100%

The nutrient index value of available macronutrients (N, P, K and S), and some micronutrient cations *viz.*, Fe, Mn, Zn, Cu of Parbhani tahsil of Parbhani district were represented in table no.9 and also presented in Fig. 12.

The "nutrient index value" for soils of Parbhani tahsil of Parbhani district represents "Low fertility status" for Nitrogen, phosphorus. The value worked out from nutrient index for Nitrogen is 1.3, respectively. "Medium fertility status" for phosphorus is 2.0 respectively. against the nutrient index value < 1.67 for low, 1.67 to 2.33 for medium and > 2.33 for high fertility status of area. The "High Fertility Status" for Potassium, were 3.0 respectively. The secondary nutrient S is deficient in 100 percent soils and DTPA-Fe, 30.66, DTPA-Mn, 30, DTPA-Zn, 100, soils of Parbhani tahsil of Parbhani district.

Table no. 9 (a) Soil nutrient index value Parbhani tahsil of Parbhani district

Sr.No.	Available Nutrients	Parbhani tahsil	
		NIV	Category
1	Nitrogen	1.3	Low
2	Phosphorus	2.0	Medium
3	Potassium	3.0	High

Table no. 9 (b): Deficiency of secondary and micronutrients Parbhani tahsil of parbhani district

Sr.no.	Available Nutrients	Deficient (%)	Sufficient (%)
1	Sulphur	100%	Nil
2	Iron	30.66%	69.33%
3	Manganese	30%	70%
4	Zinc	100%	Nil
5	Copper	Nil	100%

The nutrient index value of available macronutrients (N, P, K and S), and some micronutrient cations *viz.*, Fe, Mn, Zn, Cu of Purna tahsil o f Parbhani district were represented in table no.10 and also presented in Fig.13.

The "nutrient index value" for soils of Purna tahsils of Parbhani district represents "Low fertility status" for Nitrogen. The value worked out from nutrient index for Nitrogen, are 1.3, respectively."Medium fertility status" for phosphorus is 2.2 respectively. against the nutrient index value < 1.67 for low, 1.67 to 2.33 for medium and > 2.33 for high fertility status of area. The "High Fertility Status" for Potassium, were 2.98 respectively. The secondary nutrient S is deficient in 10

percent soils and DTPA-Fe, 61.33, DTPA-Mn, 33.6, DTPA-Zn, 81.33, soils of Purna tahsils of Parbhani district.

Table no. 10. (a) Soil nutrient index value Purna tahsil of Parbhani district

Sr.No.	Available Nutrients	Purna tahsil	
		NIV	Category
1	Nitrogen	1.3	Low
2	Phosphorus	2.2	Medium
3	Potassium	3.9	High

Table no. 10 (b): Deficiency of secondary and micronutrients in Purna tahsil of parbhani district

Sr.no.	Available Nutrients	Deficient (%)	Sufficient (%)
1	Sulphur	100%	Nil
2	Iron	61.33%	38.66%
3	Manganese	33.6%	66.4%
4	Zinc	81.33%	18.66%
5	Copper	Nil	100%

4.5. Correlation between the physical-chemical properties and availa ble nutrients in soils of Central tahsils of Parbhani district.

Table no. 11. Correlation between the physical chemical properties and available nutrients in soils of Central tahsils of Parbhani district.

Available Nutrients	Physico-chemical properties			
	pH	EC	O.C	$CaCO_3$
Nitrogen	- 0.120	- 0.034	0.417**	0.134
Phosphorus	- 0.201*	0.161*	0.195*	- 0.104
Potassium	0.0934	- 0.032	- 0.117	0.058
Sulphur	0.0079	0.151*	0.153*	0.082
Iron	- 0.030	0.175*	0.068	0.123
Manganese	- 0.156*	0.053	0.242**	0.239**
Zinc	- 0.0052	- 0.068	- 0.067	- 0.0144
Copper	- 0.044	0.0054	0.0020	0.058

* Significant at 5% level
** Significant at 1% level

The data given in table no.8 showed that the correlation coefficient between physical-chemical properties and available nutrient in the soils of Parbhani district (Manwat, Parbhani and Purna) from this data it was observed that significant positive correlation (r=0.417**) was found between organic carbon and available nitrogen. This relation was found between organic carbon and available N was negatively correlated with pH (r = -0.120) and electrical conductivity (r = -0.034).

This might be due to increased rate of nitrification which depends upon soil pH similar result were also reported by Shinde (2007).

The available phosphorous showed negative relationship with soil pH (r = -0.201*) and $CaCO_3$ (r = -0.104) the positive correlation with available phosphorus with electrical conductivity (r = -0.161) and organic carbon (r = -0.195) possible it might be

due to the fact that available P included mostly inorganic and organic phosphorus is low in soil.

The available potassium showed positive correlation with pH (r = 0.0234) which indicted the high degree of availability with pH in these soils similar results were also reported by Sharma *et al.* (2006) that there was a significant positive correlation between available potassium with pH (r = 0.240*) in soils of Leh district. The negative correlation was found in between organic carbon (r = 0.117).

The available sulphur in these soils was positively pH (r 0.0079), EC (r = 0.151), OC (r = 0.153) and $CaCO_3$ (r = 0.082) Similar results were observed by Mali and Raut (2001).

A negative significant relationship between available Fe and soil pH (= -0.030) was observed. A positive correlation was found between available Fe with organic carbon (r = 0.068).The results were in close agreement with findings of Murthy and Murthy (2005) and the negative correlation of available Fe with soil pH indicated that there is precipitation of available iron in to insoluble products which supports the classical phenomenon of induced iron deficiency.

A positive significant correlation was observed between available Mn and organic carbon (r = 0.242*). The significant positive relation with organic carbon indicates importance of organic matter in promoting the availability Micronutrients and which was confirmatory with the findings of Mahesh Kumar *et al.* (2011).

The available Zn showed negative correlation with pH (r = -0.052), EC (r = -0.068) organic carbon (r = -0.067) and $Caco_3$ (r = -0.0144) the negative correlation with pH may be attributed to their precipitation as hydroxide and carbonates, consequently making them immobile and an available to the plants.

The available copper showed negative significant correlation with pH (r =0.044) this might be due to precipitation of copper or hydroxide at higher pH and $CaCO_3$ content as found by Meena *et al* (2006).

Chapter-V

SUMMARY AND CONCLUSION

Location specific information on soil site conditions is prerequisite for optium crop production hence the present in vestigation was carried out during 2012-2013 to investigate the fertility status of the soils of Manwat, Parbhani and Purna tahsils of Parbhani district. Total two hundred twenty five (225) soil samples were collected from Manwat, Parbhani and Purna tahsils of Parbhani district of Marathwada region. Fourty five (45) villages were randomly selected from each tahsils and fifteen (15) surface soil samples (0 to 20cm) were collected from each village. These soil samples were studied for some physical and chemical characteristics like pH EC, organic carbon, calcium carbonate content along with available N, P, K and S and some micronutrients like Zn, Fe, Mn, Cu. The data has been interpreted in terms of physical and chemical properties, nutrient index and correlation study for nutrient availability. The results obtained are summarized below.

The pH values of Manwat tahsil varied from 7.10 to 7.90 with mean value of 7.47. These soils were normal to alkaline in nature, whereas Parbhani tahsil soil pH was ranged from 7.10 to 8.40 with mean value of 7.83 and Purna tahsils pH was ranged 7.45 to 7.90 with mean value of 7.54. These soils found were normal to alkaline in nature.

The Electrical conductivity of soils of Manwat tahsil ranged from 0.32-0.69 with a mean value 0.52 dSm^{-1}, Parbhani tahsil ranged from 0.30-0.58 with a mean value 0.48 dSm^{-1} and Purna tahsil ranged from 0.18-0.65with a mean value 0.40dSm^{-1}. The salinity was in safe limit for plant growth.

The mean value organic carbon content of soils of Manwat tahsil was varied from 0.32 to 0.69 per cent with average value 9.52, out of 75 samples 45 per cent samples were categorized under low, 21 per cent under medium and 33.33 per cent samples were categorized under higher status. Parbhani tahsil soils contain organic carbon in the range of 0.05 to 1.05 with average value of 0.50 per cent. Out of 75 samples

as 60 per cent samples are categorized under low, 46.66 per cent samples under medium and only 6.66 per cent samples were categorized under high status. Purna tahsil soils contain organic carbon in the range of 0.10 to 0.90 with average value of 0.35 per cent, out of 75 samples 86.66 per cent samples are categorized under low, 10 per cent samples under medium and only 2.66 samples were categorized under high status.

The calcium carbonate of Manwat tahsil soils was varied from 5.0 to10.5 with average value of 7.69 per cent. Where, 94.66 per cent samples were categorized under calcareous soil and more than 5 per cent samples were high calcareous in nature. Parbhani tahsil soils were varied from 5.0 to 10 per cent with average value of 6.89 per cent, where 100 per cent soil samples are categorized under calcareous in nature. Purna tahsil soils were varied from 4.4 to10 per cent with an average value 7.5 per cent, where, 100 per cent samples were categorized under calcareous soil.

The available Nitrogen in Manwat tahsil soils was ranged from, 87.6 to 300 kg ha^{-1} with mean value of 171.29 kg ha^{-1}, while Parbhani tahsil soils were ranged from 67.3 to 238 kg ha^{-1} with mean value of 134.3 kg ha^{-1} and Purna tahsil were ranged from 79.6 to 656 kg ha^{-1} with mean value of 150.7 kg ha^{-1}. These tahsils categorized under low nitrogen (below 140 kg ha^{-1}) status.

The available phosphorus content of soils of Manwat tahsil soils was varied from 10.34 to 26.32 with an average of 19.90 kg ha^{-1}, out of 75 samples 98.66 per cent samples were categoriesd under deficient and only one sample is sufficient. While, Parbhani tahsil soils were varied from 2.75 to 9.98 kg ha^{-1} phosphorus content, with an average 4.38 kg ha^{-1}, where, out of 75 samples, 90 per cent were found deficient and Purna tahsil soils were varied from 4.6 to 26.08 kg ha^{-1}, with an average 14.59 kg ha^{-1} phosphorus content. Where, out of 75 samples, 33.33 per cent samples were deficient, 65.35 per cent samples were sufficient, in available soil phosphorus content.

The available potassium content of Manwat tahsil soils varied from 100 to 1137 kg ha^{-1} with an average 729.10 kg ha^{-1}, while Parbhani tahsil soils varied from 141.10 to 970.7 kg ha^{-1}, with an average of 569.86 kg ha^{-1}, and Purna tahsil soils were

varied from 120 to 1373 kg ha^{-1} with an average value of 689.76 kg $ha^{-}1$.These soils were found very high in available potassium content (more than 300 kg ha^{-1}).

The available Sulphur content in soils of Manwat tahsil ranged from 2.21 to 10 kg ha^{-1}, with an average 4.29 kg ha^{-1}, while Parbhani tahsil soils ranged from 2.75 to 9.98 kg $ha^{-1}$with an average 4.38 kg ha^{-1}, and Purna tahsil soils varied from 1.0 to 4.5 kg ha^{-1} with an average 2.08 kg ha^{-1}. These soils were categorized as low in available Sulphur (below 12 ppm) content.

The DTPA Fe content of Manwat tahsil soils was in the range of 0.68 to 9.8 ppm, with an average 5.8 ppm, while Parbhani tahsil soils was in 1.26 to 10.05 ppm, with an average 5.54 and Purna tahsil soil was in 1.05 to 9.7 ppm, with an average 4.18 ppm. These soils were categorized as deficient in available Fe content (below 4.5 ppm).

The DTPA-Mn content in soils of Manwat tahsil was varied in 10.4 to 32.0 ppm, with an average 23.83 ppm, while Parbhani tahsil soils varied from 8.18 to 31.6 ppm, with an average 17.48 ppm and Purna tahsil soils varied from 8.1 to 24.8 ppm, with an average 14.67 ppm. Hence, these soils were found sufficient available Mn content.

The DTPA Zn content in soils of Manwat tahsil soils was varied in 0.04 to 10.2 ppm, with an average 10.4 ppm, where, Parbhani tahsil soils varied from 0.10 to 0.89 ppm, with an average 0.3 ppm and Purna tahsil soils varied from 0.16 to 3.86 ppm. Hence, these soils were categorized as deficient in DTPA-Zn.

The DTPA-Cu content in soils of Manwat tahsil soils was varied from 1.12 to 3.8 ppm, While Parbhani tahsil soils was varied from 1.12 to 4.2 ppm, with an average 2.54 ppm and Purna tahsil soils was varied from 1.06 to 5.4 ppm, with an average 2.23 ppm. All these samples were found Sufficient DTPA-Cu content.

In general, amongst available macro nutrients, available N and available P were found deficient in soils of Manwat, Parbhani and Purna tahsils of Parbhani district. Whereas, all soils of central tahsils of Parbhani district, were rich in available K content and deficient in available S content and DTPA-Zn content.

The available Nitrogen content of the soil showed significant positive correlation with organic carbon (0.417**) in central tahsils of Parbhani district. The

available phosphorus showed positive significant and negative significant correlation with organic carbon (r = 0.195*).The available Sulphur in central tahsils of Parbhani district soils was positively and significantly correlated with organic carbon (r =0.153*). The DTPA-Mn in central tahsils of Parbhani district soils was a negative but significant relationship between available Mn and pH (r =-0.156*) was observed while it showed significant positive correlation with organic carbon (r =0.242**) and was observed while showed significant positive correlation with $CaCO_3$ (r =0.239**).

Whereas Manwat tahsil the results, it can be concluded that the soils of were pH was varied, normal to alkaline in soil reaction, safe in electrical conductivity, calcareous in nature. low to medium in organic carbon content, low of Nitrogen, medium of Phosphorus, high in Potassium, deficient in Sulphur and Znic and Sufficient in Fe, Mn and Cu.

Whereas Parbhani tahsil the results, it can be concluded that the soils of were pH was varied, neutral to moderately alkaline in soil reaction, safe in electrical conductivity, non-calcareous to calcareous in nature. Low to medium in organic carbon content, low to medium of Nitrogen, medium of Phosphorus, high in Potassium, deficient in Sulphur and Znic and Sufficient in Fe, Mn and Cu.

Whereas Purna tahsil the results, it can be concluded that the soils of were pH was varied, normal to alkaline in soil reaction, safe in electrical conductivity, calcareous in nature. low in organic carbon content, low of Nitrogen, medium of Phosphorus, high in Potassium, deficient in Sulphur and Znic and Sufficient in Fe, Mn and Cu.

Summarizing the results, it can be concluded that the soils of central tahsils of Parbhani district, were neutral to moderately alkaline in soil reaction, safe in electrical conductivity, low to moderately high in organic carbon content and calcareous in nature. According to the concept of “Soil nutrient index”, in general the status of available nitrogen phosphorus, were “low” while “high” in content of potassium. The secondary nutrient S is deficient in 100 percent soils and DTPA-Fe, DTPA-Mn, 21.3, DTPA-Zn, 91.5, soils of central tahsils of Parbhani district.

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APPENDIX

SOIL CHARACTERISTICS OF MANWAT, PARBHANI AND PURNA TAHSIL

Village of Manwat Tahsil													
Sr.No	**Village**	**pH**	**EC** DSm^{-1}	**OC** %	**$CaCO_3$** %	**N** ($kg\ ha^{-1}$)	**P** ($kg\ ha^{-1}$)	**K** ($kg\ ha^{-1}$)	**S** ($mg\ kg^{-1}$)	**Cu** ($mg\ kg^{-1}$)	**Fe** ($mg\ kg^{-1}$)	**Mn** ($mg\ kg^{-1}$)	**Zn** ($mg\ kg^{-1}$)
1	**Nagarjavala**	7.4	0.41	1.35	7	190	15.7	380	5.09	3.2	25.7	0.24	3.1
2	**--do--**	7.4	0.42	0.82	8	205	14.2	488	4.5	5.7	25.7	0.19	3.1
3	**--do--**	7.3	0.54	1.4	6	220	22.84	388	2.52	5.7	25.6	0.21	1.3
4	**--do--**	7.1	0.56	1.32	9	260	12.03	535	3.1	6.7	24.8	0.68	3.7
5	**--do--**	7.1	0.54	0.9	10	190	21.3	432	2.78	4.7	20.7	0.38	3.6
	Average	**7.2**	**0.49**	**1.15**	**8**	**213**	**17.21**	**444.6**	**3.598**	**5.2**	**24.5**	**0.34**	**2.96**
	Range	**7.1-7.4**	**0.41-0.56**	**0.82-1.4**	**6-10**	**190-260**	**12.03-22**	**380-535**	**2.52-5.09**	**3.2-6.7**	**20.7-25**	**0.19-0.68**	**1.3-3.7**
6	**Ukhalgao**	7.1	0.56	1.06	6	183	17.8	542	6.75	6.1	21.3	0.32	1.12
7	**--do--**	7.4	0.58	1.05	6	160	22.56	511	7.35	6.6	24.5	0.55	1.14
8	**--do--**	7.2	0.64	1.32	9	180	23.87	416	5.3	3.7	25.6	0.5	3.1
9	**--do--**	7.5	0.69	1.05	5	240	23.45	400	6.75	5.7	23.7	0.24	3.6
10	**--do--**	7.4	0.51	0.82	6	250	20.21	517	4.5	6.7	26.1	0.20	2.6
	Average	**7.3**	**0.59**	**1.06**	**6.4**	**202.6**	**21.57**	**477.2**	**6.13**	**5.76**	**24.24**	**0.36**	**2.312**
	Range	**7.1-7.5**	**0.51-0.69**	**0.82-1.32**	**5-9**	**160-250**	**17.8-23.87**	**400-542**	**4.57.35**	**3.7-6.7**	**21.3-26.1**	**0.20-0.55**	**1.12-3.6**
11	**Bonderwadi**	7.5	0.56	0.8	10	200	20.21	617	3.2	5.7	23.14	0.26	2.54
12	**--do--**	7.4	0.62	1.15	14	205	21.74	483	3.09	5.7	21.7	0.26	3.5
13	**--do--**	7.4	0.65	0.05	12	250	20.49	629	7.35	4.5	23.7	0.24	3.8
14	**--do--**	7.5	0.67	0.45	6.3	102	19.27	680	3.3	6.7	25.8	0.24	3.4
15	**--do--**	7.6	0.68	.051	10	128	15.6	569	3.35	5.7	29.7	0.48	2.4
	Average	**7.5**	**0.63**	**0.50**	**10.4**	**177**	**19.46**	**595.6**	**4.05**	**5.66**	**24.808**	**0.29**	**3.128**
	Range	**7.4-7.6**	**0.56-0.68**	**0.05-1.15**	**6.3-14**	**102-250**	**15.6-21.74**	**483-680**	**3.09-7.35**	**4.5-6.7**	**21.7-29.7**	**0.24-0.48**	**2.4-3.8**

Village of Manwat Tahsil													
Sr.No	**Village**	**pH**	**EC dSm^{-1}**	**OC %**	**$CaCO_3$ %**	**N ($kg\ ha^{-1}$)**	**P ($kg\ ha^{-1}$)**	**K ($kg\ ha^{-1}$)**	**S ($mg\ kg^{-1}$)**	**Cu ($mg\ kg^{-1}$)**	**Fe ($mg\ kg^{-1}$)**	**Mn ($mg\ kg^{-1}$)**	**Zn ($mg\ kg^{-1}$)**
16	**Manwat**	7.5	0.49	0.05	6.4	144.2	16.92	855	3.28	2.9	30.1	0.44	2.41
17	--do--	7.5	0.58	0.23	5	132	21.15	925	3.4	1.5	30.8	0.42	3.6
18	--do--	7.4	0.46	0.31	8.4	140	23	330	4.38	2.35	29.8	0.4	2.8
19	--do--	7.4	0.35	1.03	11	250	23.97	320	3.01	3.59	28.7	0.37	2.23
20	--do--	7.4	0.42	0.45	6.12	140	22.3	827	2.21	2.7	27.4	10.2	1.22
	Average	**7.4**	**0.46**	**0.41**	**7.38**	**161.2**	**21.46**	**651.4**	**3.256**	**2.608**	**29.36**	**2.36**	**2.452**
	Range	**7.4-7.5**	**0.35-0.58**	**0.05-1.03**	**5-8.4**	**132-250**	**16.92-23.97**	**320-925**	**2.21-4.38**	**1.5-3.59**	**27.4-30.8**	**0.37-10.2**	**1.22-3.6**
21	**Manwat R.**	7.4	0.65	0.65	8	170	22.09	801	2.35	3.8	30.4	0.15	3.65
22	--do--	7.4	0.68	0.2	10	90.6	11.28	708	3.05	9.8	32.7	0.4	2.84
23	--do--	7.5	0.69	0.38	11	139	11.28	1009	3.66	7.7	33.4	0.41	2.45
24	--do--	7.3	0.32	0.02	14	140	21.43	1002	8.66	8.7	33.8	0.41	2.74
25	--do--	7.41	0.45	0.53	6	160	14.7	1084	3.25	6.8	30.1	0.21	3.6
	Average	**7.4**	**0.55**	**0.36**	**9.8**	**139.9**	**16.15**	**920.8**	**4.194**	**7.36**	**32.08**	**0.32**	**3.056**
	Range	**7.3-7.5**	**0.32-0.69**	**0.02-0.65**	**6-14**	**90.6-170**	**11.22-22.09**	**708-1084**	**2.35-8.66**	**3.8-9.8**	**30.1-33.8**	**0.15-0.41**	**2.45-3.65**
26	**Khola**	7.5	0.65	0.55	6	180	10.34	1122	4.19	6.4	25.7	0.1	2.48
27	--do--	7.60	0.44	0.61	7	160	21.6	1082	7.35	5.8	26.7	0.15	3.14
28	--do--	7.62	0.48	0.42	6	140	23.03	1005	5.35	9.7	28.6	0.1	3.45
29	--do--	7.50	0.36	1.05	7	227	20.5	624	5.09	6.1	27.5	0.25	2.54
30	--do--	7.4	0.56	0.53	6	142	20.58	344	3.32	8.4	28.4	0.21	3.24
	Average	**7.5**	**0.49**	**0.63**	**6.4**	**169.8**	**19.21**	**835.4**	**5.06**	**7.28**	**27.38**	**0.166**	**2.97**
	Range	**7.4-7.6**	**0.36-0.65**	**0.42-1.05**	**6-7**	**140-227**	**10.34-23.03**	**344-1122**	**3.32-7.35**	**5.8-9.7**	**25.7-28.6**	**0.10-0.25**	**2.48-3.45**
31	**Atola**	7.4	0.46	0.35	11	93.6	24.81	1058	3.46	7.6	28.7	0.35	3.45
32	--do--	7.6	0.36	0.45	13	164	23.5	1031	4.1	6.7	24.5	0.37	2.7
33	--do--	7.4	0.45	0.53	8	140	19.3	669	5.02	6.4	25.6	0.16	2.74
34	--do--	7.5	0.55	0.28	6.4	125	19.97	842	4.2	8.1	26.4	0.21	3.7
35	--do--	7.2	0.33	0.26	7.3	106	23.12	820	3.8	7.3	26.4	0.32	2.6
	Average	**7.4**	**0.43**	**0.37**	**9.14**	**125.7**	**22.14**	**884**	**4.116**	**7.22**	**26.32**	**0.286**	**3.038**
	Range	**7.2-7.6**	**0.33-0.55**	**0.26-0.53**	**6.4-13**	**93.6-164**	**19-24.81**	**669-1058**	**3.46-5.02**	**6.4-8.1**	**24-28.7**	**0.1-0.37**	**2.6-3.7**

Village of Manwat Tahsil													
Sr.No	**Village**	**pH**	**EC dSm^{-1}**	**OC %**	**$CaCO_3$ %**	**N ($kg\ ha^{-1}$)**	**P ($kg\ ha^{-1}$)**	**K ($kg\ ha^{-1}$)**	**S ($mg\ kg^{-1}$)**	**Cu ($mg\ kg^{-1}$)**	**Fe ($mg\ kg^{-1}$)**	**Mn ($mg\ kg^{-1}$)**	**Zn ($mg\ kg^{-1}$)**
36	**Somthana**	7.6	0.42	1.05	7.6	242	19.74	348	3.8	5.4	30.7	0.32	2.3
37	--do--	7.5	0.45	0.82	5.4	171	22.74	600	2.78	3.5	30.7	0.3	3.7
38	--do--	7.5	0.52	1.15	6.2	286	20.63	665	3.9	3.4	31.6	0.17	2.4
39	--do--	7.7	0.62	1.07	9	217	23.31	500	4.1	4.7	32.6	0.23	1.7
40	--do--	7.8	0.63	0.36	13	142	10.34	730	5.1	3.8	30.7	0.37	2.8
	Average	**7.6**	**0.52**	**0.89**	**8.24**	**211.6**	**19.35**	**568.6**	**3.936**	**4.16**	**31.26**	**0.28**	**2.58**
	Range	**7.5-7.8**	**0.42-0.63**	**0.36-1.15**	**5.4-13**	**142-286**	**10.34-23.31**	**348-730**	**2.78-5.1**	**3.4-5.4**	**30.7-32.6**	**0.17-0.37**	**1.7-3.7**
41	**Narlad**	7.6	0.41	0.43	9	188	22.86	659	4.3	2.45	29.5	0.23	3.1
42	--do--	7.5	0.68	0.44	6	127	18.2	643	3.1	4.54	28.7	0.19	2.8
43	--do--	7.5	0.65	0.61	5	185	20.15	640	3.09	4.5	27.4	0.25	3.6
44	--do--	7.1	0.61	0.62	9	108	20	835	3.1	5.8	20.7	0.15	3.8
45	--do--	7.2	0.62	0.38	7	118	25.38	800	2.65	6.7	20.4	0.17	2.6
	Average	**7.4**	**0.59**	**0.49**	**7.2**	**145.2**	**21.31**	**715.4**	**3.248**	**4.798**	**25.34**	**0.2**	**3.18**
	Range	**7.1-7.6**	**0.41-0.68**	**0.38-0.62**	**5-9**	**108-188**	**18.2-25.38**	**640-835**	**2.65-4.3**	**2.45-6.7**	**20.4-29.5**	**0.15-0.25**	**2.6-3.8**
46	**Kothal**	7.45	0.52	2.5	6	200	26.32	724	2.74	0.68	25.7	0.19	1.65
47	--do--	7.4	0.47	1.8	6	275	22.93	824	3.3	5.7	24.7	0.29	1.45
48	--do--	7.3	0.42	0.51	7	160	22.41	890	3.6	6.8	21	0.25	2.41
49	--do--	7.4	0.42	0.65	8	180	19.69	100	4.15	5.7	22.7	0.16	2.45
50	--do--	7.5	0.32	1.05	9	196	23.73	1058	6.5	6.85	23.8	0.15	2.1
	Average	**7.4**	**0.43**	**1.3**	**7.2**	**202.2**	**23.01**	**719.2**	**4.058**	**5.146**	**23.58**	**0.2**	**2.01**
	Range	**7.3-7.5**	**0.32-0.52**	**0.51-2.5**	**6-9**	**160-275**	**19.6-26.3**	**100-1058**	**2.74-6.5**	**0.68-6.85**	**21-25.7**	**0.13-0.29**	**1.45-2.45**
51	**Mangrul**	7.4	0.56	0.53	7	177	13.53	817	5.6	8.7	12.7	0.13	3.7
52	--do--	7.3	0.48	0.38	10	87.6	22.93	1009	4.2	6.06	13.7	0.24	2.4
53	--do--	7.4	0.46	1.62	5	190	16.5	1008	3.01	6.7	10.4	0.04	2.4
54	--do--	7.4	0.45	1.12	6	208	19.8	682	3.65	8.71	15.4	0.2	2.4
55	--do--	7.4	0.43	0.93	8	200	18.94	413	2.85	5.7	16.4	0.18	1.9
	Average	**7.4**	**0.47**	**0.91**	**7.2**	**172.5**	**18.34**	**785.8**	**3.862**	**7.174**	**13.72**	**0.16**	**2.5**
	Range	**7.3-7.4**	**0.43-0.56**	**0.38-1.62**	**6-10**	**87.6-208**	**13.53-22.93**	**413-1009**	**2.8-5.6**	**5.7-8.71**	**10.4-16.4**	**0.04-0.24**	**1.9-3.7**
56	**Ramtakli**	7.5	0.35	0.72	7	193	20.16	1072	2.85	6.2	23.4	0.36	2.8
57	--do--	7.5	0.54	0.97	6	234	10.62	1137	2.8	6.8	21.4	0.69	3.5
58	--do--	7.3	0.56	0.44	5	110	22.56	878	8.66	2.3	20.4	0.24	2.7
59	--do--	7.5	0.55	0.48	9	120	23.92	1099	7	6.9	23.5	0.23	2.1
60	--do--	7.4	0.54	0.5	8	160	23.73	975.5	10	6.4	24.5	0.13	2.9
	Average	**7.4**	**0.5**	**0.62**	**7**	**163.4**	**20.19**	**1032**	**6.262**	**5.72**	**22.64**	**0.33**	**2.8**
	Range	**7.3-7.5**	**0.35-0.56**	**0.44-0.97**	**5-9**	**110-234**	**10.6-23.9**	**878-1137**	**2.8-10**	**2.3-6.9**	**20.4-24.5**	**0.13-0.69**	**2.1-3.5**

Village of Manwat Tahsil													
Sr.No	**Village**	**pH**	**EC dSm^{-1}**	**OC %**	**$CaCO_3$ %**	**N ($kg\ ha^{-1}$)**	**P ($kg\ ha^{-1}$)**	**K ($kg\ ha^{-1}$)**	**S ($mg\ kg^{-1}$)**	**Cu ($mg\ kg^{-1}$)**	**Fe ($mg\ kg^{-1}$)**	**Mn ($mg\ kg^{-1}$)**	**Zn ($mg\ kg^{-1}$)**
61	**Rampuri**	7.5	0.62	0.58	6	183	22.03	700	3.9	5.7	20.6	0.14	2.78
62	--do--	7.5	0.58	0.61	8	300	25.09	840	3.4	6.4	26.7	0.16	3.47
63	--do--	7.5	0.57	0.35	5.3	140	16.5	890	5.09	8.1	19.1	0.14	2.54
64	--do--	7.6	0.56	0.31	6	171	23.31	940	4.27	6.7	18.4	0.18	2.41
65	--do--	7.4	0.52	0.32	5	142	17.08	980	3.88	6.4	16.5	0.13	2.3
	Average	**7.5**	**0.57**	**0.43**	**6.06**	**187.2**	**20.8**	**870**	**4.108**	**6.66**	**20.26**	**0.15**	**2.7**
	Range	**7.4-7.6**	**0.52-0.62**	**0.31-0.61**	**5-8**	**140-300**	**16.5-25.**	**700-980**	**3.4-5.0**	**5.7-8.1**	**16.5-26.7**	**0.13-0.18**	**2.3-3.47**
66	**Etoli**	7.4	0.52	0.65	9	188	15.38	340	3.45	5.8	19.7	0.56	3.13
67	--do--	7.4	0.44	0.61	6.16	199	18.03	550	5.08	2.4	18.7	0.28	3.56
68	--do--	9	0.42	0.49	9.2	189	21.07	340	3.67	6.6	17.3	0.32	3.7
69	--do--	7.6	0.42	0.38	7	145	22.1	460	3.07	6.5	15.7	0.35	2.7
70	--do--	7.7	0.54	0.51	9	167	15.07	970	3.61	7.45	10.7	0.5	1.5
	Average	**7.5**	**0.46**	**0.52**	**8.07**	**177.6**	**18.33**	**532**	**3.776**	**5.75**	**16.42**	**0.4**	**2.918**
	Range	**7.4-7.7**	**0.42-0.54**	**0.38-0.65**	**6.16-9.2**	**145-199**	**15.07-22.1**	**340-970**	**3.07-5.0**	**2.4-7.45**	**10.7-19.7**	**0.28-0.56**	**1.5-3.7**
71	**Kumbhari**	7.4	0.55	0.46	8	112	20.5	801	3.5	7.8	15.7	0.57	2.6
72	--do--	7.4	0.61	0.45	5	157	19.6	940	3.65	8.5	15.8	0.38	2.5
73	--do--	7.4	0.56	0.44	9	128	21.47	920	5.18	6.7	16.7	0.4	1.8
74	--do--	7.3	0.62	0.36	7	110	20.14	860	5.16	6.4	15.4	0.9	2.3
75	--do--	7.9	0.45	0.23	5.6	95.3	18.6	850	6.5	5.7	14.6	0.45	2.6
	Average	**7.5**	**0.55**	**0.38**	**6.92**	**120.4**	**20.06**	**874.2**	**4.798**	**7.02**	**15.64**	**0.54**	**2.36**
	Range	**7.3-7.9**	**0.45-0.62**	**0.23-0.46**	**5-9**	**95.3-157**	**18.6-21.47**	**801-940**	**3.5-6.5**	**5.7-8.5**	**14.6-16.7**	**0.38-0.90**	**1.8-2.6**

Villages of Parbhani Tahsil													
Sr. No	**Village**	**pH**	**EC dSm^{-1}**	**OC %**	**$CaCO_3$ %**	**N ($kg\ ha^{-1}$)**	**P ($kg\ ha^{-1}$)**	**K ($kg\ ha^{-1}$)**	**S ($mg\ kg^{-1}$)**	**Cu ($mg\ kg^{-1}$)**	**Fe ($mg\ kg^{-1}$)**	**Mn ($mg\ kg^{-1}$)**	**Zn** ($mg\ kg^{-1}$)
1	**TatuJawla**	7.9	0.35	0.052	7	86	9.8	963	4.24	1.7	11.6	0.28	1.34
2	--do--	8.1	0.28	0.45	5	72	10.37	880	4.46	1.4	11.8	0.84	2.3
3	--do--	7.9	0.36	0.31	7.5	95.6	8.4	869	3.34	1.26	12.24	0.21	2.7
4	--do--	8.12	0.49	0.45	8	87.3	15.7	955	5.1	3.64	13.1	0.31	3
5	--do--	8.16	0.34	0.61	5.5	76.6	11.44	856	4.13	2.6	12.7	0.41	1.78
	Average	**8.03**	**0.36**	**0.37**	**6.6**	**83.5**	**11.14**	**904.6**	**4.25**	**2.12**	**12.2**	**0.41**	**2.22**
	Range	**7.9-8.16**	**0.28-0.49**	**0.05-0.61**	**5-7.5**	**72-95.6**	**8.4-15.7**	**856-963**	**3.34-5.1**	**1.26-3.64**	**11.6-13.1**	**0.21-0.84**	**1.3-3.0**
6	**Pingali**	8	0.46	0.15	6	86.4	9.04	845	3.67	3.7	11.7	0.23	1.9
7	--do--	7.96	0.29	0.45	7	102.6	8.8	628.32	4.2	4.9	14.4	0.24	2.7
8	--do--	7.80	0.35	0.67	6	189.1	7.73	629.84	3.89	7.7	17.8	0.14	1.8
9	--do--	8.1	0.29	0.66	9	170.3	8.5	686.84	3.6	1.63	11.6	0.54	1.5
10	--do--	7.82	0.28	0.52	10	162.7	15.03	409.92	2.95	7.35	15.6	0.58	2
	Average	**7.936**	**0.33**	**0.49**	**7.6**	**142.2**	**9.82**	**639.98**	**3.662**	**5.05**	**14.22**	**0.34**	**1.98**
	Range	**7.8-8.1**	**0.28-0.46**	**0.15-0.67**	**6-10**	**86.4-189**	**7.73-15**	**409-845**	**2.95-4.2**	**1.63-7.7**	**11.6-17.8**	**0.14-0.58**	**1.5-2.7**
11	**Sayala**	7.93	0.17	0.52	6	120	6.59	594.72	3.61	1.29	18	0.5	2.7
12	--do--	7.63	0.26	0.45	7	86.5	19.3	488	3.38	2.7	18	0.33	1.5
13	--do--	7.68	0.12	0.62	5.2	150	19.5	400.32	3.29	3.14	12	0.43	2.8
14	--do--	7.88	0.18	1.05	7.3	230	18.15	769.44	3.46	4.7	15	0.34	2.47
15	--do--	7.8	0.19	0.19	6.12	67.3	9.47	701.48	3.43	6.8	18	0.52	2.14
	Average	**7.784**	**0.18**	**0.56**	**6.32**	**130.7**	**14.602**	**590.79**	**3.434**	**3.726**	**16.2**	**0.42**	**2.32**
	Range	**7.6-7.9**	**0.12-0.26**	**0.19-1.05**	**5.2-7.3**	**67.3-230**	**6.59-19.5**	**400-769**	**3.29-3.61**	**1.29-6.8**	**12-18**	**0.33-0.52**	**1.5-2.8**
16	**Singanapur**	7.75	0.23	0.31	8	119.8	6.78	784	3.5	9.2	13	0.12	2.17
17	--do--	8	0.31	0.45	7	152.9	7.03	320	3.61	6.4	14	0.22	2.15
18	--do--	8.2	0.46	0.29	5	180.9	17.09	141.52	5.1	3.3	18	0.321	2.16
19	--do--	7.8	0.35	1.05	6	202.6	9.61	325	3.37	4.7	19	0.42	2.8
20	--do--	8.3	0.42	0.47	5	100.3	9.8	325.92	3.5	5.5	16	0.31	2.41
	Average	**8.01**	**0.35**	**0.51**	**6.2**	**151.3**	**10.062**	**379.28**	**3.816**	**5.82**	**16**	**0.272**	**2.33**
	Range	**7.7-8.3**	**0.23-0.46**	**0.29-1.05**	**5-8**	**100-202**	**6.7-17**	**141-784**	**3.3-5.1**	**3.3-9.2**	**13-19**	**0.12-0.42**	**2.15-2.8**

Villages of Parbhani tahsil													
Sr. No	**Village**	**pH**	**EC dSm^{-1}**	**OC %**	**$CaCO_3$ %**	**N ($kg\ ha^{-1}$)**	**P ($kg\ ha^{-1}$)**	**K ($kg\ ha^{-1}$)**	**S ($mg\ kg^{-1}$)**	**Cu ($mg\ kg^{-1}$)**	**Fe ($mg\ kg^{-1}$)**	**Mn ($mg\ kg^{-1}$)**	**Zn** ($mg\ kg^{-1}$)
21	**Borwad**	7.8	0.35	0.55	5	108.9	12.7	325.92	3.8	2.7	18	0.18	3.7
22	--do--	7.75	0.54	0.31	5.4	99.4	22.5	445.76	4.25	3.6	17	0.54	2.9
23	--do--	8.09	0.45	0.27	8	140.3	23.7	860.16	3.58	4.7	32	0.38	3.4
24	--do--	7.7	0.35	0.42	7	180.3	17.26	478.24	3.27	5.8	20	0.48	2.7
25	--do--	7.40	0.41	0.48	6	90.3	15.03	851.76	3.72	7.9	23	0.28	3.2
	Average	**7.748**	**0.42**	**0.4**	**6.28**	**123.8**	**18.238**	**592.36**	**3.724**	**4.94**	**22**	**0.37**	**3.18**
	Range	**7.4-8.0**	**0.35-0.54**	**0.27-0.55**	**5-8**	**90.3-180**	**12.7-23.7**	**325-860**	**3.27-4.25**	**2.7-7.9**	**17-32**	**0.18-0.54**	**2.7-3.7**
26	**shahapur**	8.2	0.34	0.57	6	156.6	23.03	876.79	3.4	8.5	26	0.38	3.7
27	--do--	8.3	0.45	0.65	8	230	9.14	271.04	2.86	5.5	19	0.2	2.9
28	--do--	7.9	0.33	0.62	8.6	202.6	15.3	900.14	4.47	6.6	25	0.18	2.8
29	--do--	7.88	0.43	0.56	6.2	131.1	20.1	628.56	3.27	2.89	23	0.44	3.1
30	--do--	7.9	0.44	0.64	8.5	155.5	19.4	650.84	3.77	3.35	24	0.42	4.2
	Average	**8.03**	**0.39**	**0.6**	**7.46**	**175.1**	**17.39**	**665.47**	**3.554**	**5.36**	**23.4**	**0.32**	**3.34**
	Range	**7.8-8.3**	**0.33-0.45**	**0.56-0.65**	**6-8.6**	**131-230**	**9.14-23**	**271-900**	**2.8-4.4**	**2.8-8.5**	**19-26**	**0.18-0.44**	**2.8-4.2**
31	**Pedgaon**	8.5	0.45	0.64	7.2	151.3	11.02	680	3.45	4.8	20.1	0.34	1.7
32	**--do--**	7.65	0.36	0.54	7	80.03	5.54	779	3.88	8.7	21.3	0.22	1.58
33	**--do--**	7.9	0.21	0.61	7	152.3	12.8	780	3.32	5.8	22.7	0.58	2.7
34	**--do--**	7.10	0.29	0.23	9	86.2	20.2	689.32	3.26	2.8	21.9	0.27	3.8
35	**--do--**	8.12	0.34	0.65	9	150.2	15.08	590	3.4	5.4	21.8	0.39	1.9
	Average	**7.854**	**0.33**	**0.53**	**7.84**	**124**	**12.928**	**703.66**	**3.462**	**5.5**	**21.5**	**0.36**	**2.33**
	Range	**7.1-8.5**	**0.21-0.45**	**0.23-0.65**	**7.2-9**	**80-152**	**5.5-20.**	**590-780**	**3.2-3.8**	**2.8-8.7**	**20.1-22.**	**0.22-0.58**	**1.5-3.8**
36	**Thombriumri**	7.9	0.53	0.45	8	108.9	15.3	846.32	3.65	6.4	25.6	0.54	4.1
37	**--do--**	8.2	0.48	0.45	7.9	91.96	7.53	692.28	7.35	7.8	23.4	0.36	3.03
38	**--do--**	8.3	0.27	0.6	6.8	115.2	18.7	651.84	5.08	8.9	25	0.3	3.4
39	**--do--**	8.3	0.58	0.39	8.5	77.2	14.03	805.28	7.3	7.8	25	0.54	2.5
40	**--do--**	8.1	0.45	0.63	9	129.8	20.03	97.09	4.2	6.9	26	0.33	1.6
	Average	**8.16**	**0.46**	**0.5**	**8.04**	**104.6**	**15.118**	**601.08**	**5.516**	**7.56**	**25**	**0.41**	**2.92**
	Range	**7.9-8.3**	**0.27-0.58**	**0.39-0.63**	**6.8-9**	**77.2-129**	**7.53-20**	**97-846**	**3.6-7.35**	**6.4-8.9**	**23.4-26**	**0.3-0.54**	**1.6-4.1**

Villages of Parbhani tahsil													
Sr. No	**Village**	**pH**	**EC dSm^{-1}**	**OC %**	**$CaCO_3$ %**	**N ($kg\ ha^{-1}$)**	**P ($kg\ ha^{-1}$)**	**K ($kg\ ha^{-1}$)**	**S ($mg\ kg^{-1}$)**	**Cu ($mg\ kg^{-1}$)**	**Fe ($mg\ kg^{-1}$)**	**Mn ($mg\ kg^{-1}$)**	**Zn** ($mg\ kg^{-1}$)
41	**Bhramhangaon**	8.2	0.32	0.056	8.5	110	19.61	416.64	3.68	4.8	10.7	0.44	1.7
42	**--do--**	7.8	0.33	0.75	5	150	8.95	400	9.28	8.4	11.5	0.55	2.6
43	**--do--**	7.9	0.41	0.42	6	110	21.74	389.6	4.3	3.5	17.8	0.13	2.8
44		8.4	0.32	0.61	7	155.1	14.13	943	3.08	3.8	15.7	0.18	2.3
45	**--do--**	8.4	0.41	0.65	6	108.9	20.9	918.08	9.98	2.4	17.9	0.18	3.7
	Average	**8.14**	**0.35**	**0.49**	**6.5**	**126.8**	**17.066**	**613.46**	**6.064**	**4.58**	**14.72**	**0.29**	**2.62**
	Range	**7.8-8.4**	**0.32-0.41**	**0.05-0.75**	**5-8.5**	**108-155**	**8.9-21**	**389.6-943**	**3.08-9.98**	**2.4-8.4**	**Oct-17**	**0.13-0.55**	**1.7-3.7**
46	**Wadgaon**	7.12	0.44	0.62	7	80.9	8.2	389.76	3.87	2.69	21.5	0.18	2.8
47	**--do--**	7.2	0.36	0.65	5	156.4	6.58	580.76	4.2	3.36	20.8	0.3	3.7
48	**--do--**	7.50	0.32	0.67	5	140	8.22	327.04	3.18	4.7	22.6	0.29	2.2
49	**--do--**	7.40	0.31	0.56	6	180	12.56	331.52	2.75	5.8	21.4	0.18	3.54
50	**--do--**	7.7	0.42	0.54	5	119.7	23.7	331.84	3.3	5.7	23.5	0. 550	2.5
	Average	**7.384**	**0.37**	**0.6**	**5.6**	**135.4**	**11.852**	**392.18**	**3.46**	**4.45**	**21.96**	**0.23**	**2.94**
	Range	**7.1-7.7**	**0.31-0.44**	**0.54-0.67**	**5-7**	**80.9-180**	**6.5-23.7**	**327-580**	**2.7-4.2**	**2.6-5.8**	**20-23**	**0.18-0.30**	**2.2-3.7**
51	**Dharmapuri**	7.91	0.45	0.39	7.2	177.2	8.52	384.5	3.31	6.4	11.2	0.26	1.6
52	**--do--**	7.80	0.62	0.33	5.2	120	10.26	344.55	3.9	8.5	10.8	0.26	1.7
53	**--do--**	7.10	0.57	0.45	5.5	102.4	14.87	753	3.2	6.7	11.4	0.34	1.6
54	**--do--**	7.48	0.24	0.52	6.5	122.3	10.87	906	3.98	8.9	12.7	0.18	2.5
55	**--do--**	7.5	0.36	0.32	9	86.3	18.9	900	3.8	7.8	13.8	0.32	3.57
	Average	**7.55**	**0.44**	**0.4**	**6.68**	**121.6**	**12.684**	**657.61**	**3.638**	**7.66**	**11.98**	**0.27**	**2.19**
	Range	**7.1-7.9**	**0.24-0.62**	**0.32-0.52**	**5.2-9**	**86-177**	**8.5-18.9**	**344-906**	**3.2-3.98**	**6.4-8.9**	**10.8-13.8**	**0.18-0.34**	**1.6-3.5**
56	**Zari**	7.53	0.62	0.46	8.5	134	6.68	486.65	3.4	4.9	13.4	0.29	1.8
57	**--do--**	7.85	0.41	0.45	9.5	119.2	7.71	452.52	3.2	3.5	17.8	0.54	2.14
58	**--do--**	7.80	0.38	0.43	5.5	137	8.2	439.8	3.3	5.7	18.2	0.19	2.41
59	**--do--**	7.90	0.36	0.68	9	152.5	7.19	468.5	9.05	7.8	19.4	0.21	3.7
60	**--do--**	7.65	0.44	0.56	8.5	169	6.99	490.2	9.04	8.9	17.9	0.32	2.25
	Average	**7.746**	**0.44**	**0.51**	**8.2**	**142.3**	**7.354**	**467.53**	**5.598**	**6.16**	**17.34**	**0.31**	**2.46**
	Range	**7.5-7.9**	**0.36-0.62**	**0.43-0.68**	**5.5-5.5**	**119-169**	**6.6-8.2**	**439-490**	**3.2-9.0**	**3.5-8.9**	**13-19**	**0.19-0.54**	**1.8-3.7**

Villages of Parbhani Tahsil													
Sr. No	**Village**	**pH**	**EC dSm^{-1}**	**OC %**	**$CaCO_3$ %**	**N ($kg\ ha^{-1}$)**	**P ($kg\ ha^{-1}$)**	**K ($kg\ ha^{-1}$)**	**S (mg kg-)**	**Cu ($mg\ kg^{-1}$)**	**Fe ($mg\ kg^{-1}$)**	**Mn ($mg\ kg^{-1}$)**	**Zn** ($mg\ kg^{-1}$)
61	**Pimpla**	7.8	0.58	0.68	5	171.4	6.85	433	8.36	5.6	19.8	0.5	2.14
62	**--do--**	7.54	0.62	0.68	6.3	155.2	7.82	529	7.3	7.7	18.6	0.18	1.31
63	**--do--**	7.49	0.56	0.65	6	173.2	7.28	482	3.04	3.8	10.7	0.89	1.12
64	**--do--**	7.30	0.47	0.63	7.8	120.1	6.68	472	4.7	5.3	11.8	0.34	1.28
65	**--do--**	7.33	0.32	0.7	8.5	152	7.83	433.29	5.7	5.8	11.6	0.28	2.8
	Average	**7.492**	**0.51**	**0.66**	**6.72**	**154.3**	**7.292**	**469.85**	**5.82**	**5.64**	**14.5**	**0.43**	**1.73**
	Range	**7.3-7.8**	**0.32-0.62**	**0.63-0.70**	**5-8.5**	**120-173**	**6.6-7.8**	**433-529**	**3-8.36**	**3.8-7.7**	**10-19.8**	**0.18-0.89**	**1.1-2.8**
66	**Surpimpari**	8.1	0.46	0.39	5.25	136.6	8	435	2.75	4.7	21.7	0.74	3.7
67	**--do--**	8.2	0.53	0.68	6.36	238	7.7	485	3.4	5.7	21.9	0.4	1.7
68	**--do--**	8.3	0.44	0.27	5.25	115	6.8	317	4.2	7.8	22.7	0.4	2.5
69	**--do--**	7.8	0.49	0.87	5.7	153	9.25	490	7.2	5.2	20.4	0.41	2.65
70	**--do--**	7.6	0.64	0.38	6.75	112.2	12.25	512	3.7	8.7	23.7	0.21	2.41
	Average	**8**	**0.51**	**0.51**	**5.86**	**150.9**	**8.8**	**447.8**	**4.25**	**6.42**	**22.08**	**0.43**	**2.59**
	Range	**7.6-8.3**	**0.44-0.64**	**0.27-0.87**	**5.2-6.7**	**112-238**	**6.8-12**	**317-512**	**2.7-7.2**	**4.7-8.7**	**20-23.7**	**0.21-0.74**	**1.7-3.7**
71	**Kalishwadi**	7.59	0.49	0.95	7.28	201	11.1	495	3.08	10.05	9.17	0.18	3.1
72	**--do--**	7.78	0.34	0.25	9	117	6.12	300	3.26	8.7	8.18	0.15	2.4
73	**--do--**	7.61	0.35	0.22	5.25	156	13	521	3.68	7.8	8.4	0.1	2.65
74	**--do--**	7.64	0.52	0.21	7.15	142	6.5	495	8.36	6.5	9.45	0.38	3.14
75	**--do--**	7.65	0.45	0.23	6.75	123	6.8	300	9.05	7.7	9.7	0.15	3.54
	Average	**7.65**	**0.43**	**0.37**	**7.08**	**147.8**	**8.704**	**422.2**	**5.486**	**8.15**	**8.98**	**0.19**	**2.96**
	Range	**7.5-7.7**	**0.34-0.52**	**0.21-0.95**	**5.25-9**	**117-201**	**6.1-13**	**300-521**	**3-9.**	**6.5-10**	**8.18-9.7**	**0.10-0.38**	**2.4-3.54**

Villages of Purna Tahsil													
Sr.No	**Village**	**pH**	**EC dSm^{-1}**	**OC %**	**$CaCO_3$ %**	**N ($kg\ ha^{-1}$)**	**P ($kg\ ha^{-1}$)**	K ($kg\ ha^{-1}$)	**S ($mg\ kg^{-1}$)**	**Cu ($mg\ kg^{-1}$)**	**Fe ($mg\ kg^{-1}$)**	**Mn ($mg\ kg^{-1}$)**	**Zn ($mg\ kg^{-1}$)**
1	**Nawki**	7.8	0.45	0.45	5.5	115	6.43	380	1.57	1.73	11.4	1.53	1.25
2	--do--	7.6	0.56	0.46	6	120	12.22	540	2.27	5.6	11.8	0.27	1.2
3	--do--	7.63	0.54	0.39	10	110	15.8	773	1.26	6.7	11.89	1.06	1.39
4	--do--	7.65	0.53	0.56	6	152	7.99	806	1.48	2.6	11.71	0.2	1.36
5	--do--	7.80	0.57	0.31	10	160	22.09	845	1.1	2.67	10.7	1.75	1.7
	Average	**7.69**	**0.53**	**0.43**	**7.5**	**131.4**	**12.9**	**668.8**	**1.536**	**3.86**	**11.5**	**0.96**	**1.38**
	Range	**7.6-7.8**	**0.45-0.57**	**0.30.56**	**5.5-10**	**110-160**	**6.4-22**	**380-845**	**1.1-2.27**	**1.7-6.7**	**10.7-11**	**0.2-1.7**	**1.2-1.7**
6	**Mategoan**	7.49	0.51	0.37	10	174	13.16	741	2	3.8	10.7	0.34	1.39
7	--do--	7.17	0.41	0.2	6	130	21.7	898	1.83	4.99	9.8	0.38	1.58
8	--do--	7.60	0.44	0.42	7	140	7	596	1.42	4.94	8.5	0.24	1.84
9	--do--	7.40	0.45	0.23	6	112	7.05	886	2.58	4.84	9.4	0.37	1.68
10	--do--	7.15	0.31	0.22	5	110	11.75	540	1.88	9.02	10.2	0.49	1.53
	Average	**7.36**	**0.42**	**0.28**	**6.8**	**133.2**	**12.13**	**732.2**	**1.942**	**5.518**	**9.72**	**0.36**	**1.6**
	Range	**7.1-7.6**	**0.31-0.51**	**0.2-0.4**	**5-10**	**110-174**	**7-21.7**	**540-898**	**1.42-2.5**	**3.8-9.02**	**8.5-10.7**	**0.2-0.4**	**1.3-1.84**
11	**Purna**	7.16	0.36	0.22	7	130	7	490	1.54	5.1	10.23	0.64	2.28
12	--do--	7.45	0.35	0.12	5	145	16.32	480	2.17	1.15	10.4	0.84	3.52
13	--do--	7.70	0.33	0.31	6	146	17.68	449	2.3	1.32	10.7	0.292	2.5
14	--do--	7.70	0.32	0.32	7	142	24.01	602	1	1.28	12.6	0.59	3.8
15	--do--	7.50	0.25	0.32	5.5	148	22.8	540	3	5.6	11.8	0.5	1.76
	Average	**7.5**	**0.32**	**0.25**	**6.1**	**142.2**	**17.56**	**512.2**	**2.002**	**2.89**	**11.14**	**12.25**	**2.77**
	Range	**7.1-7.7**	**0.25-0.36**	**0.12-0.32**	**5-7**	**130-148**	**7-24.01**	**449-602**	**01-03**	**1.15-5.6**	**10.2-12.6**	**0.29-0.59**	**1.76-3.8**
16	**Goar**	7.49	0.22	0.34	6	105	20.11	549	4.5	5.6	10.65	0.8	2.56
17	--do--	7.50	0.18	0.22	7	180	7.5	920	3.1	4.6	10.7	0.84	2.6
18	--do--	7.40	0.29	0.32	6	158	12.59	984	2.78	3.6	10.9	0.99	3.1
	--do--	7.41	0.21	0.37	5	162	6.34	944	1.8	1.5	10.7	0.51	2.78
19	--do--	7.42	0.33	0.25	5.5	92.2	5.12	540	1.7	1.33	10.9	0.77	2.56
20	**Average**	**7.44**	**0.24**	**0.3**	**5.9**	**139.44**	**10.33**	**787.4**	**2.776**	**3.326**	**10.77**	**0.78**	**2.72**
	Range	**7.4-7.5**	**0.18-0.33**	**0.22-0.37**	**5-7**	**92.2-180**	**5.12-20**	**540-984**	**1.7-4.5**	**1.33-5.6**	**10.6-10.9**	**0.51-0.99**	**2.5-3.1**

Villages of Purna Tahsil													
Sr.No	**Village**	**pH**	**EC dSm-1**	**OC %**	**$CaCO_3$ %**	**N (kg ha^{-1})**	**P (kg ha^{-1})**	K (kg ha^{-1})	**S (mg kg^{-1})**	**Cu (mg kg^{-1})**	**Fe (mg kg^{-1})**	**Mn (mg kg^{-1})**	**Zn (mg kg^{-1})**
21	**Dhanora**	7.54	0.42	0.26	5.5	82.6	9.65	760	1.76	2.63	12.8	0.97	3.14
22	--do--	7.46	0.21	0.43	5	179	23.75	1176	2.1	1.58	12.5	0.28	1.93
23	--do--	7.47	0.39	0.45	7	119	23.05	1373	2.4	1.4	12.9	0.36	3.58
24	--do--	7.48	0.42	0.32	7	156	10.5	120	2.5	2.22	10.7	0.38	2.32
25	--do--	7.55	0.43	0.52	8	107	23.75	1000	1.7	2.3	10.7	0.83	1.14
	Average	**7.5**	**0.37**	**0.39**	**6.5**	**128.72**	**18.14**	**885.8**	**2.092**	**2.026**	**11.92**	**0.56**	**2.42**
	Range	**7.4-7.5**	**0.21-0.43**	**0.26-0.52**	**5-8**	**82.6-17.9**	**9.6-23.75**	**120-1373**	**1.7-2.5**	**1.4-2.63**	**10.7-12.9**	**0.28-0.97**	**1.1-3.58**
26	**Changephal**	7.65	0.39	0.15	7.5	97.2	7.26	956.26	1.36	4.1	9.41	3.86	1.45
27	--do--	7.60	0.25	0.45	8	120	20.68	895	2.4	5.6	10.08	0.34	2.4
28	--do--	7.55	0.38	0.3	6	105	23.7	784	1.49	9.7	8.45	0.76	1.77
29	--do--	7.40	0.29	0.6	6.8	130	20.96	563	2.07	4.56	8.24	0.16	2.61
30	--do--	7.5	0.33	0.3	9.2	656	21.7	374	1.7	4.5	8.1	0.76	2.14
	Average	**7.54**	**0.32**	**0.36**	**7.5**	**221.64**	**18.86**	**714.45**	**1.804**	**5.692**	**8.856**	**1.17**	**2.07**
	Range	**7.4-7.65**	**0.25-0.39**	**0.15-0.60**	**6-9.2**	**97.2-656**	**7.26-23.7**	**374-956**	**1.36-2.4**	**4.1-9.7**	**8.1-10**	**0.16-3.86**	**1.45-2.61**
31	**Kawlgoan**	7.8	0.47	0.15	5	79.6	21.85	652	1.84	1.05	8.9	0.94	2.61
32	--do--	7.7	0.45	0.32	5	142	15.38	658	2.39	6	9.45	0.42	3.1
33	--do--	8.1	0.59	0.33	6	105	19.23	641	1.76	6.7	10.7	0.99	3.41
34	--do--	8.2	0.63	0.45	7	140	6.15	576	2.53	5.7	10.7	1.91	1.68
35	--do--	8.3	0.42	0.57	8	161	9.7	440	1.13	6.4	8.9	1.29	1.46
	Average	**8.02**	**0.51**	**0.36**	**6.2**	**125.52**	**14.46**	**593.4**	**1.93**	**5.17**	**9.73**	**1.11**	**2.45**
	Range	**7.7-8.3**	**0.42-0.63**	**0.15-0.57**	**5-8**	**79.6-161**	**6.15-21**	**440-658**	**1.13-2.53**	**1.05-6.7**	**8.9-10**	**0.42-1.91**	**1.46-3.41**
36	**Dhanora Kale**	7.45	0.54	0.37	6	150	20.53	956	1.1	6.8	10.78	1.74	1.34
37	--do--	7.44	0.56	0.45	7	158	14.8	900	1.63	6.9	10.9	1.19	1.08
38	--do--	7.50	0.49	0.43	5.3	140	18.8	984	2.4	7.4	10.7	1.66	1.24
39	--do--	7.55	0.47	0.36	6.4	158	12.92	840	1.22	6.8	12.3	1.53	1.062
40	--do--	7.6	0.45	0.31	7.2	150	5.87	990	2.09	2.374	10.7	0.21	1.07
	Average	**7.5**	**0.5**	**0.38**	**6.3**	**151.2**	**14.58**	**934**	**1.688**	**6.0548**	**11.076**	**1.27**	**1.15**
	Range	**7.4-7.6**	**0.45-0.56**	**0.31-0.45**	**5.3-7.2**	**140-158**	**14.8-20**	**840-990**	**1.1-2.4**	**2.3-7.4**	**10.7-12.3**	**0.21-1.74**	**1.07-1.34**

Villages of Purna Tahsil													
Sr.No	**Village**	**pH**	**EC dSm^{-1}**	**OC %**	**$CaCO_3$ %**	**N ($kg\ ha^{-1}$)**	**P ($kg\ ha^{-1}$)**	K ($kg\ ha^{-1}$)	**S ($mg\ kg^{-1}$)**	**Cu ($mg\ kg^{-1}$)**	**Fe ($mg\ kg^{-1}$)**	**Mn (mg kg^{-1})**	**Zn ($mg\ kg^{-1}$)**
41	**Regaon**	7.72	0.41	0.75	5.9	258	17.11	480	2.3	8.1	10.7	0.31	1.53
42	--do--	7.72	0.42	0.45	7	149	18.01	980	1.98	4.658	15.7	0.72	4.77
43	--do--	7.70	0.47	0.45	6	150	5.17	794	1.7	6.7	15.7	0.16	2.89
44	--do--	7.90	0.48	0.22	8	167	9.87	571	1.64	1.342	15.7	0.57	1.5
45	--do--	8.2	0.51	0.28	5	156	4.74	580	2.7	5.4	15.9	1.72	2.17
	Average	**7.84**	**0.45**	**0.43**	**6.3**	**176**	**10.98**	**681**	**2.064**	**5.24**	**14.74**	**0.7**	**2.57**
	Range	**7.7-8.2**	**0.41-0.51**	**0.22-0.75**	**5-8**	**149-258**	**4.7-18**	**480-980**	**1.6-2.7**	**1.3-8.1**	**10.7-15**	**0.16-1.72**	**1.5-4.76**
46	**Tadkalas**	7.9	0.34	0.23	9	147	10.03	1209	3.6	6.7	14.7	0.99	1.38
47	--do--	7.8	0.31	0.75	10	205	4.6	707	1.61	6.9	16.7	0.7	1.28
48	--do--	7.50	0.32	0.51	6	180	4.93	845	1	8.06	14.7	0.21	1.2
49	--do--	7.63	0.24	0.24	7	160	5.4	740	2.7	3.7	19.7	0.34	3.1
50	--do--	7.60	0.34	0.23	7.5	182	7.79	540	2.1	1.76	17.9	0.64	2.14
	Average	**7.68**	**0.31**	**0.39**	**7.9**	**174.8**	**6.55**	**808.2**	**2.202**	**5.424**	**16.74**	**0.57**	**1.81**
	Range	**7.5-7.9**	**0.24-0.34**	**0.23-0.75**	**6-10**	**147-205**	**4.6-10**	**540-1209**	**1.0-3.6**	**1.7-8.06**	**14.7-19.7**	**0.21-0.99**	**1.2-3.1**
51	**Shirkalas**	7.6	0.42	0.62	5	180	22.7	996	3.7	5.7	16.1	0.57	3.1
52	--do--	7.70	0.47	0.23	8	98.2	9.3	570	1.7	3.998	17.8	0.17	2.5
53	--do--	7.76	0.48	0.22	7	97.2	19.7	580	3.7	1.53	16.9	0.77	1.3
54	--do--	7.70	0.45	0.65	5.7	150	20.37	680	3.8	1.16	16.8	0.72	2.1
55	--do--	7.60	0.46	0.22	5.5	120	7.8	790	2.62	3.2	17.1	0.6	3.4
	Average	**7.67**	**0.45**	**0.38**	**6.2**	**129.08**	**15.97**	**723.2**	**3.104**	**3.1176**	**16.94**	**0.56**	**2.48**
	Range	**7.6-7.7**	**0.42-0.48**	**0.22-0.62**	**5-8**	**97.2-180**	**7.8-22**	**580-996**	**1.7-3.8**	**1.16-5.7**	**16.1-17.8**	**0.57-0.77**	**1.3-3.4**
56	**Balsa**	7.6	0.29	0.11	9	90.6	11.28	1020	1.9	2.5	14.68	0.6	3.1
57	--do--	7.66	0.28	0.22	9.3	180	6.48	998	3	3.6	14.5	0.28	3.4
58	--do--	7.60	0.35	0.23	7	150	26.08	300	1	4.7	18.4	0.72	1.26
59	--do--	8.1	0.38	0.23	6.5	170	7.3	352	2.7	5.6	15.7	0.84	1.14
60	--do--	8.3	0.37	0.3	4.4	168	20.5	380	1.56	3.4	14.7	0.68	2.4
	Average	**7.85**	**0.33**	**0.21**	**7.2**	**151.72**	**14.32**	**610**	**2.032**	**3.96**	**15.596**	**0.62**	**2.26**

Villages of Purna Tahsil													
Sr.No	**Village**	**pH**	**EC dSm^{-1}**	**OC %**	**$CaCO_3$ %**	**N ($kg\ ha^{-1}$)**	**P ($kg\ ha^{-1}$)**	**K ($kg\ ha^{-1}$)**	**S ($mg\ kg^{-1}$)**	**Cu ($mg\ kg^{-1}$)**	**Fe ($mg\ kg^{-1}$)**	**Mn ($mg\ kg^{-1}$)**	**Zn ($mg\ kg^{-1}$)**
	Range	**7.6-8.3**	**0.28-0.38**	**0.11-0.3**	**4.4-9.3**	**90.6-180**	**6.48-26.08**	**300-1020**	**01-Mar**	**2.5-5.6**	**14.5-18.4**	**0.28-0.84**	**1.14-3.4**
61	**Limbla**	7.9	0.28	0.4	6.5	170	22.8	480	2.2	1.504	20.1	0.94	1.2
62	--do--	7.40	0.35	0.41	9.3	189	21.5	400	3.09	2.7	20.8	0.67	1.3
63	--do--	7.5	0.48	0.5	7	150	17.26	570	2.6	2.608	21.7	0.28	1.3
64	--do--	7.6	0.29	0.7	8.2	140	15.33	552	1.38	3.38	21.9	0.7	4.1
65	--do--	7.7	0.41	0.9	6.6	156	18.9	480	2.6	5.7	21.4	0.5	5.4
	Average	**7.62**	**0.36**	**0.58**	**7.5**	**161**	**19.15**	**496.4**	**2.374**	**3.1784**	**21.18**	**0.61**	**2.66**
	Range	**7.4-7.9**	**0.28-0.48**	**0.40-0.90**	**6.5-9.3**	**140-189**	**15.3-22.8**	**400-570**	**1.3-3.09**	**1.5-5.7**	**20.1-21.9**	**0.28-0.94**	**1.2-5.4**
66	**Yerendeshwar**	7.49	0.35	0.1	7.4	168	20	475	1.61	1.243	23.8	0.67	3.8
67	--do--	7.50	0.31	0.11	8.5	165	16.7	571	1.42	5.8	23.7	1.07	2.9
68	--do--	7.51	0.51	0.22	7.2	142	11.36	470	1.76	6.7	24.7	2.37	3.4
69	--do--	7.52	0.42	0.23	8.2	182	16.08	590	1.76	5.7	25.5	0.94	2.6
70	--do--	7.6	0.48	0.24	6.4	126	20	400	2.4	1.308	27.8	0.37	3.1
	Average	**7.52**	**0.41**	**0.18**	**7.5**	**156.6**	**16.82**	**501.2**	**1.79**	**4.1502**	**25.1**	**1.07**	**3.16**
	Range	**7.4-7.6**	**0.31-0.51**	**0.1-0.24**	**6.4-8.5**	**126-182**	**11.3-20**	**400-590**	**1.4-2.4**	**1.2-6.7**	**23.7-27.8**	**0.3-2.37**	**2.6-3.8**
71	**Chudwa**	7.2	0.47	0.25	7	144	19.7	340	1.98	3.2	27.1	0.37	1.68
72	--do--	7.3	0.49	0.31	5.3	112	16.5	890	1.57	1.75	25.6	0.86	1.84
73	--do--	7.5	0.52	0.22	6.7	155	11.28	850	2.03	2.7	20.7	0.74	2.17
74	--do--	7.8	0.56	0.4	7.2	174	12.37	840	1.48	5.7	25.7	0.71	2.8
75	--do--	7.9	0.65	0.41	6.5	105	20.8	571	2.7	2.7	26.7	0.84	1.2
	Average	**7.54**	**0.53**	**0.31**	**18**	**138**	**16.13**	**698.2**	**1.952**	**3.21**	**25.16**	**0.7**	**1.93**
	Range	**7.2-7.9**	**0.47-0.65**	**0.22-0.41**	**5.3-6.5**	**105-174**	**11.2-20.8**	**340-890**	**1.4-2.7**	**1.7-5.7**	**20.7-27**	**0.37-0.86**	**1.2-2.8**

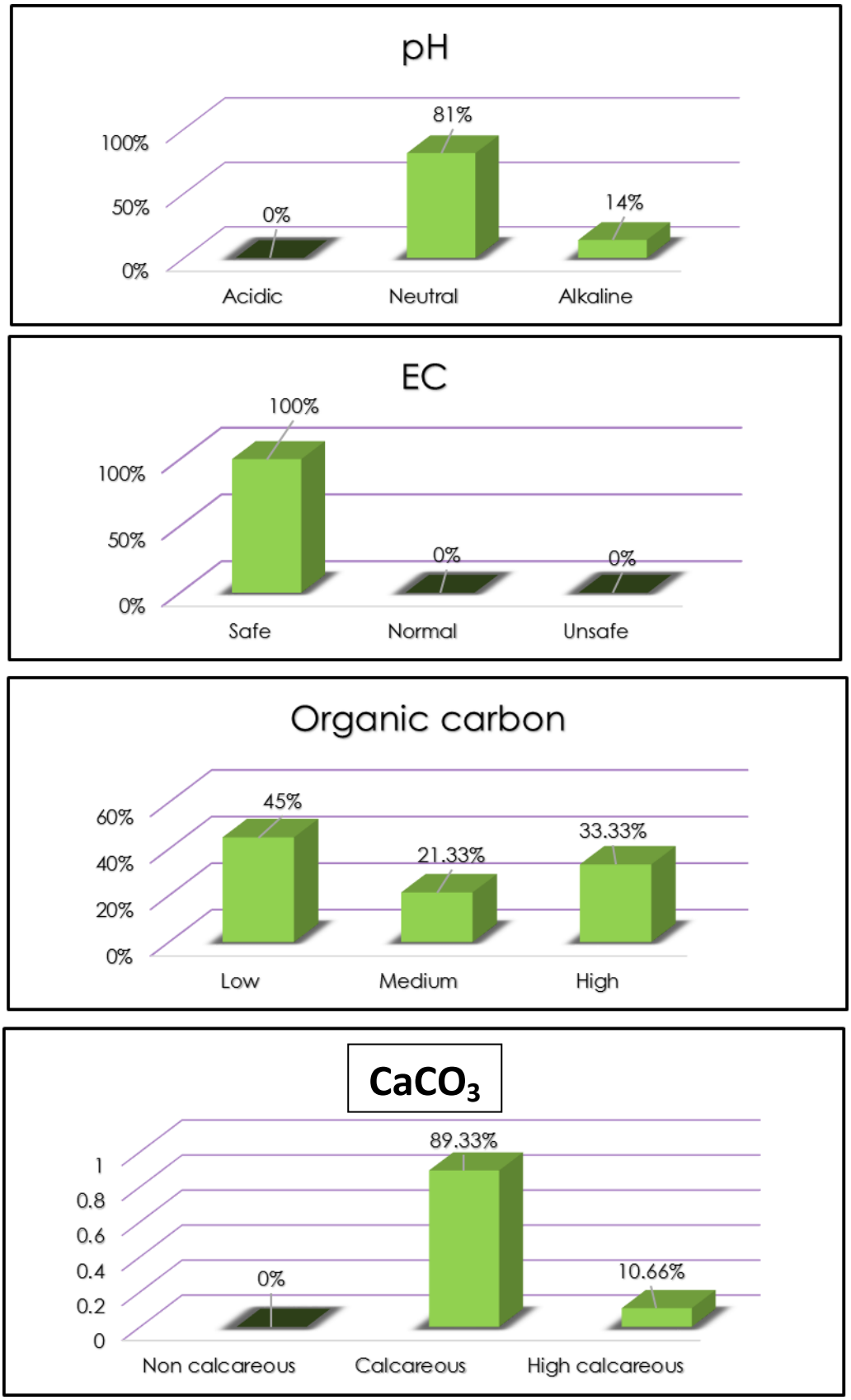

Fig .1. Categorization of soil samples of manwat tahsil on the basis of pH, EC, Organic carbon and $Caco_3$

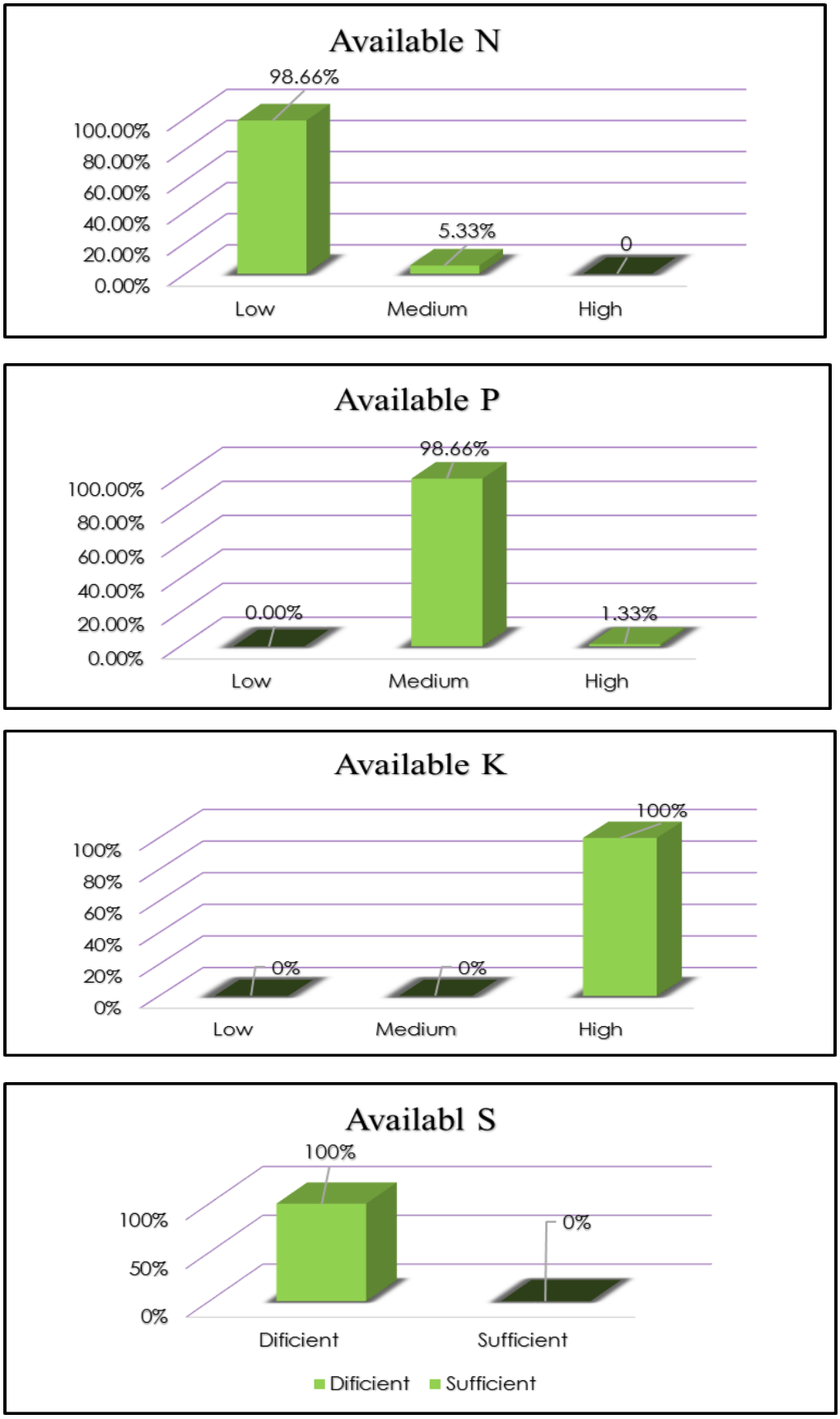

Fig .2. Categorization of soil samples of manwat tahsil on the basis of available N, P, K and S

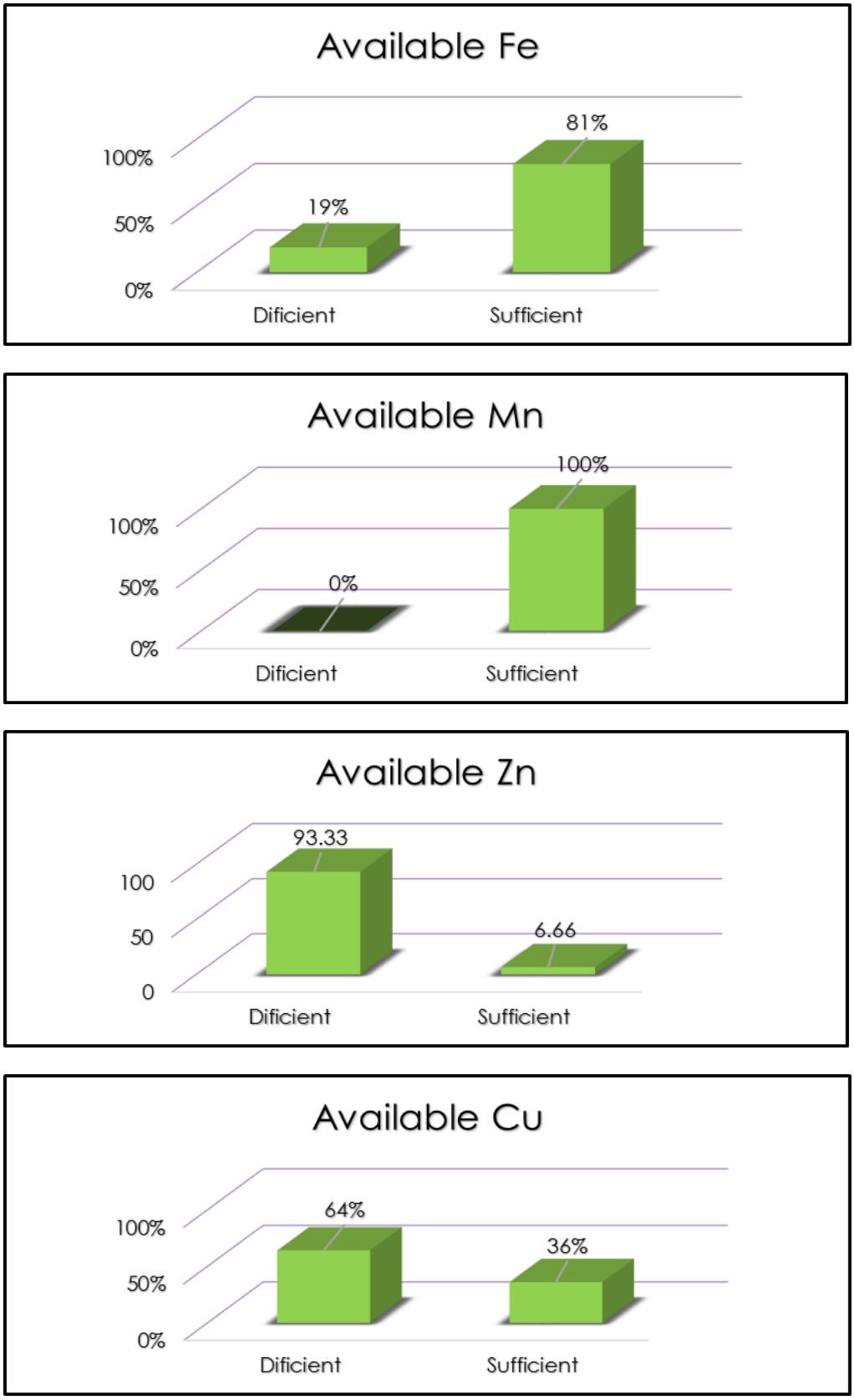

Fig .3. Categorization of soil samples of manwat tahsil on the basis of micronutrient content

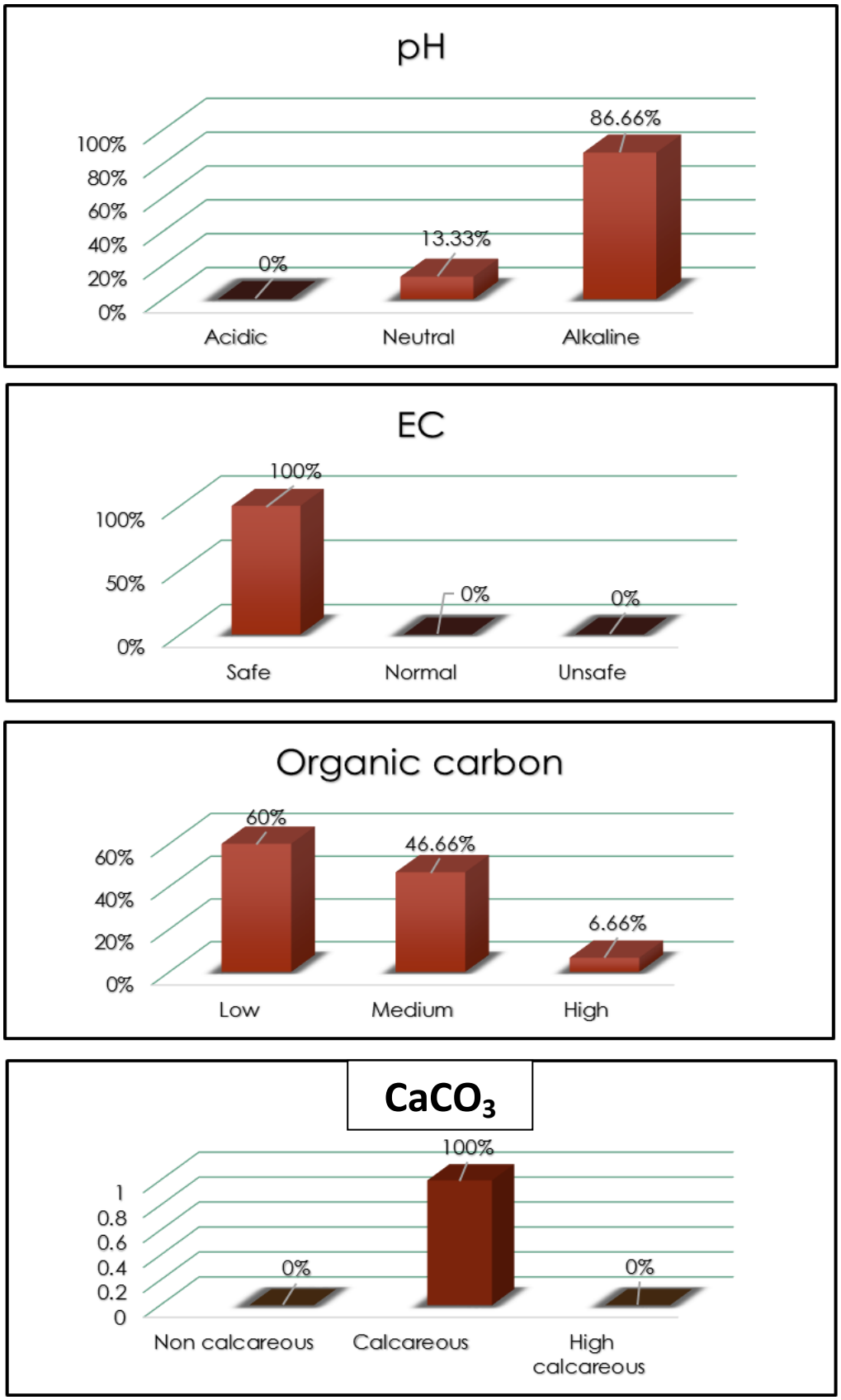

Fig .4. Categorization of soil samples of Parbhani tahsil on the basis of pH, EC, Organic carbon and $Caco_3$

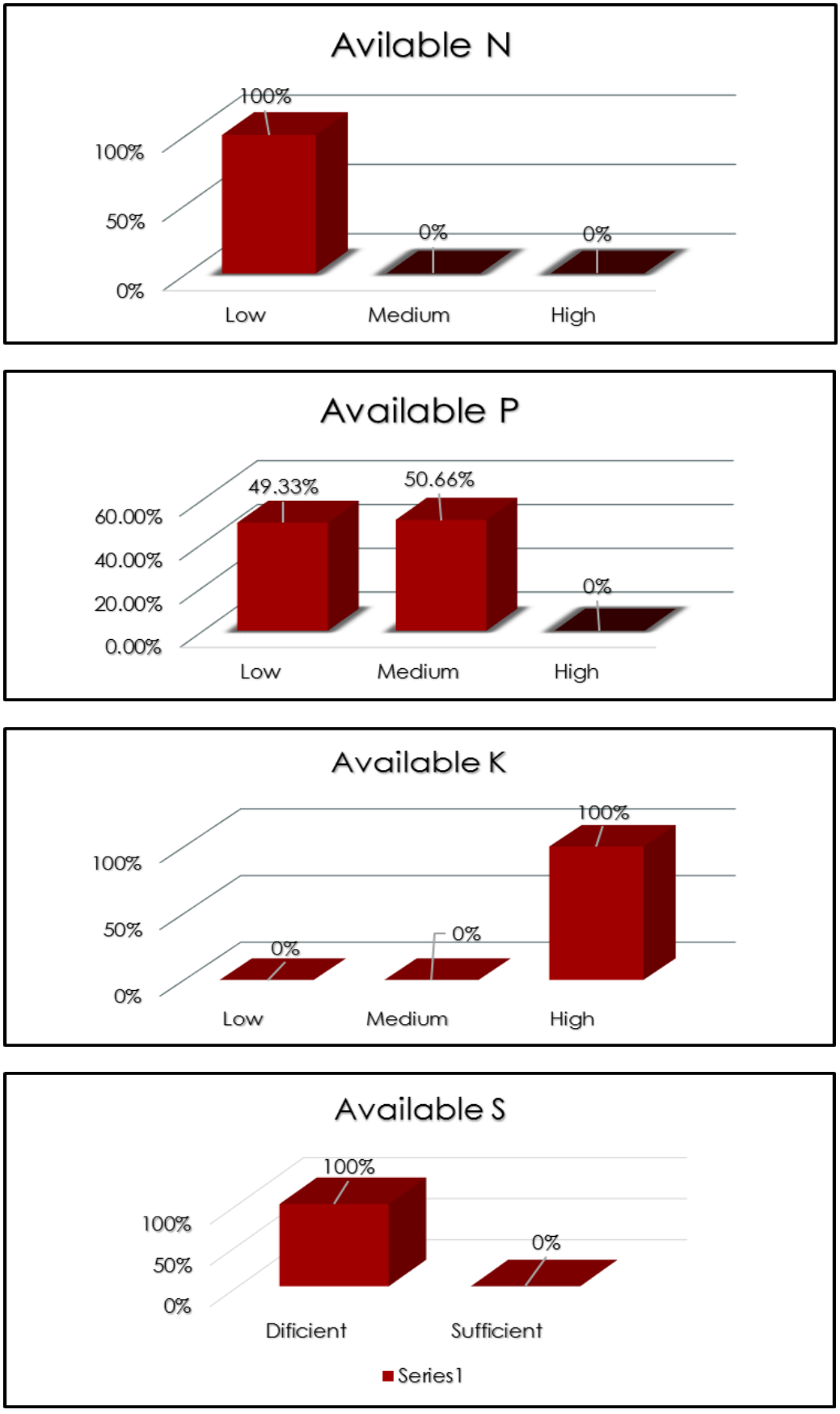

Fig .5. Categorization of soil samples of Parbhani tahsil on the basis of available N, P, K and S

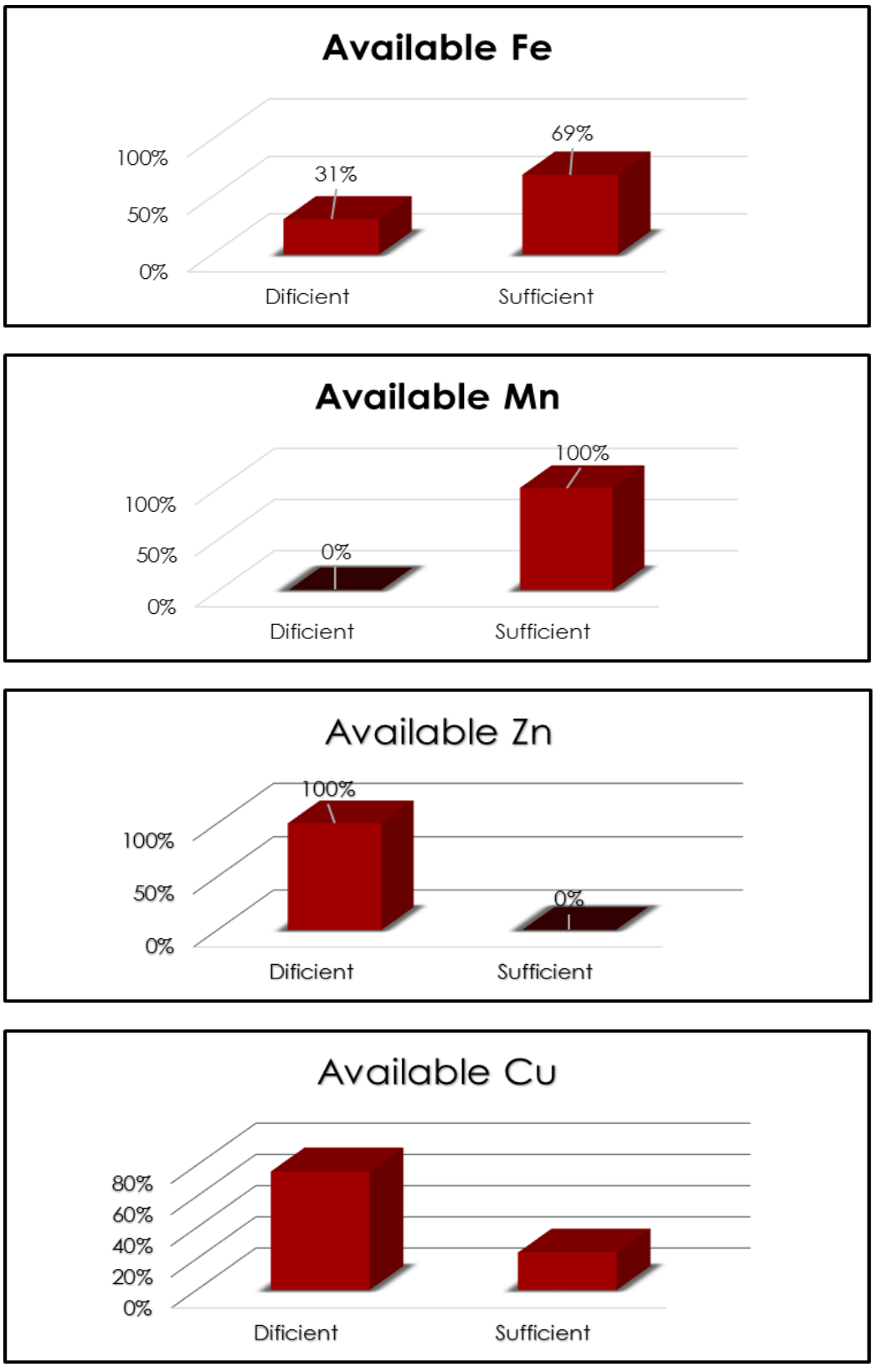

Fig .6. Categorization of soil samples of Parbhani tahsil on the basis of micronutrient content

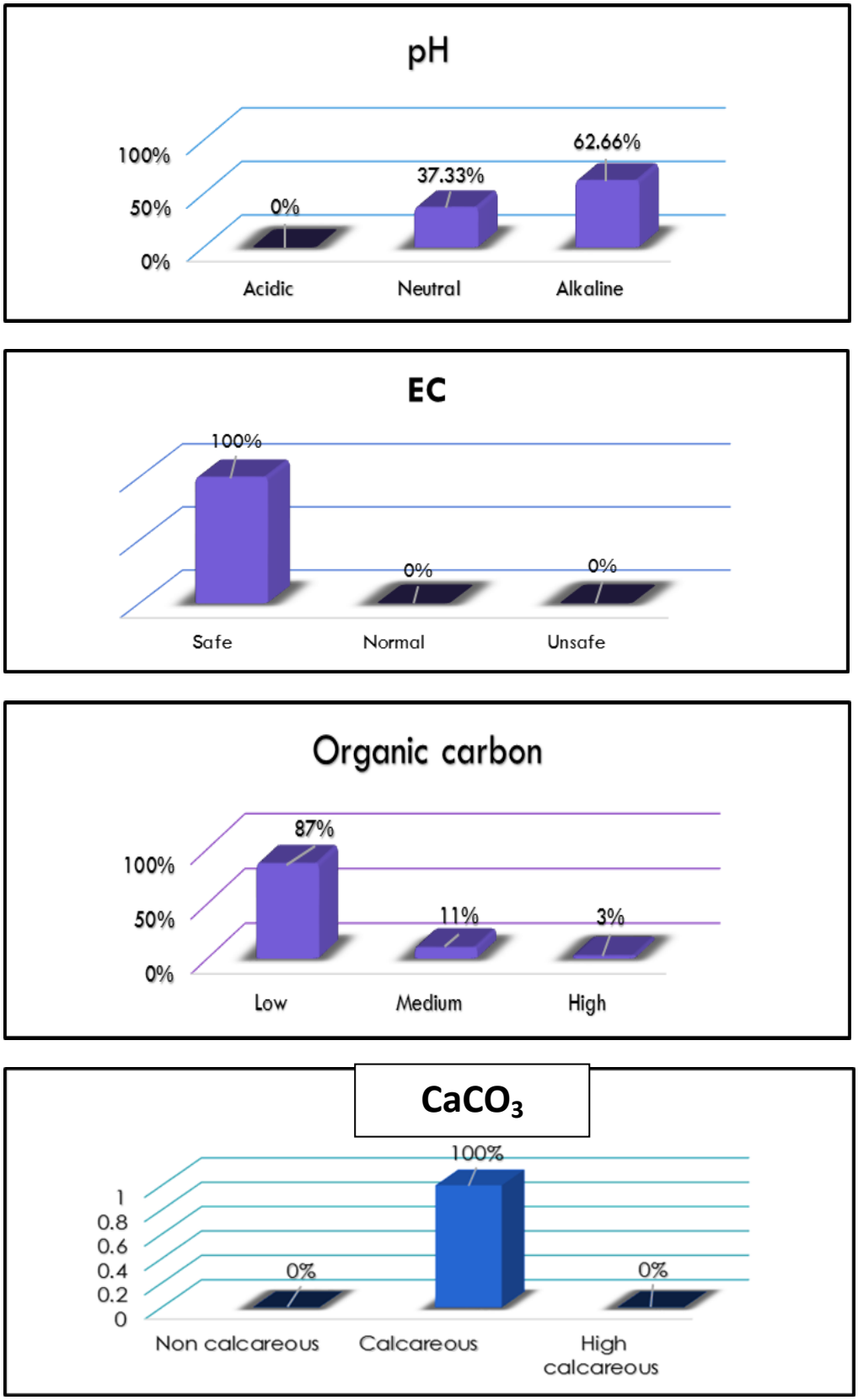

Fig .7. Categorization of soil samples of Purna tahsil on the basis of pH, EC, Organic carbon and $Caco_3$

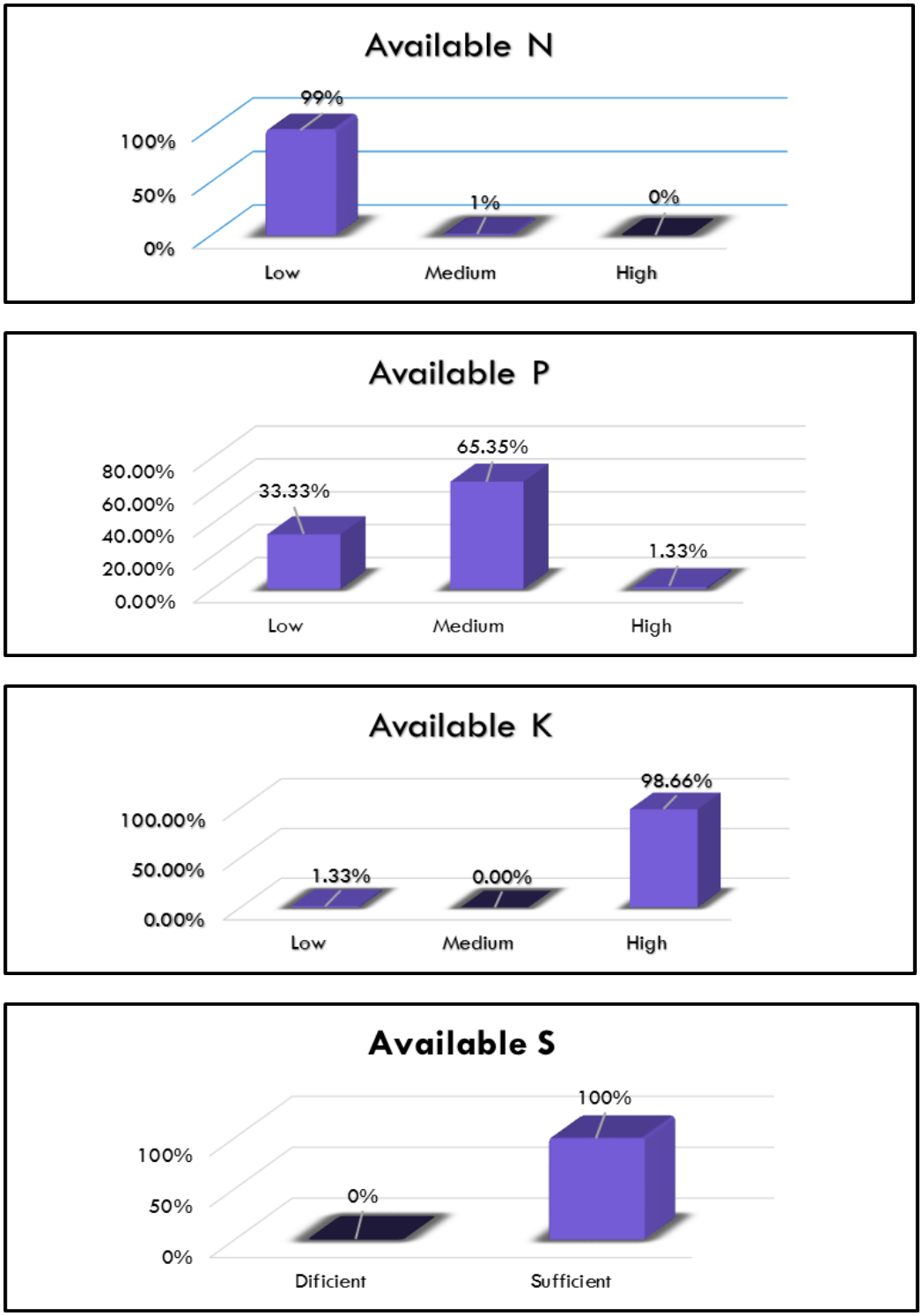

Fig .8. Categorization of soil samples of Purna tahsil on the basis of available N, P, K and S

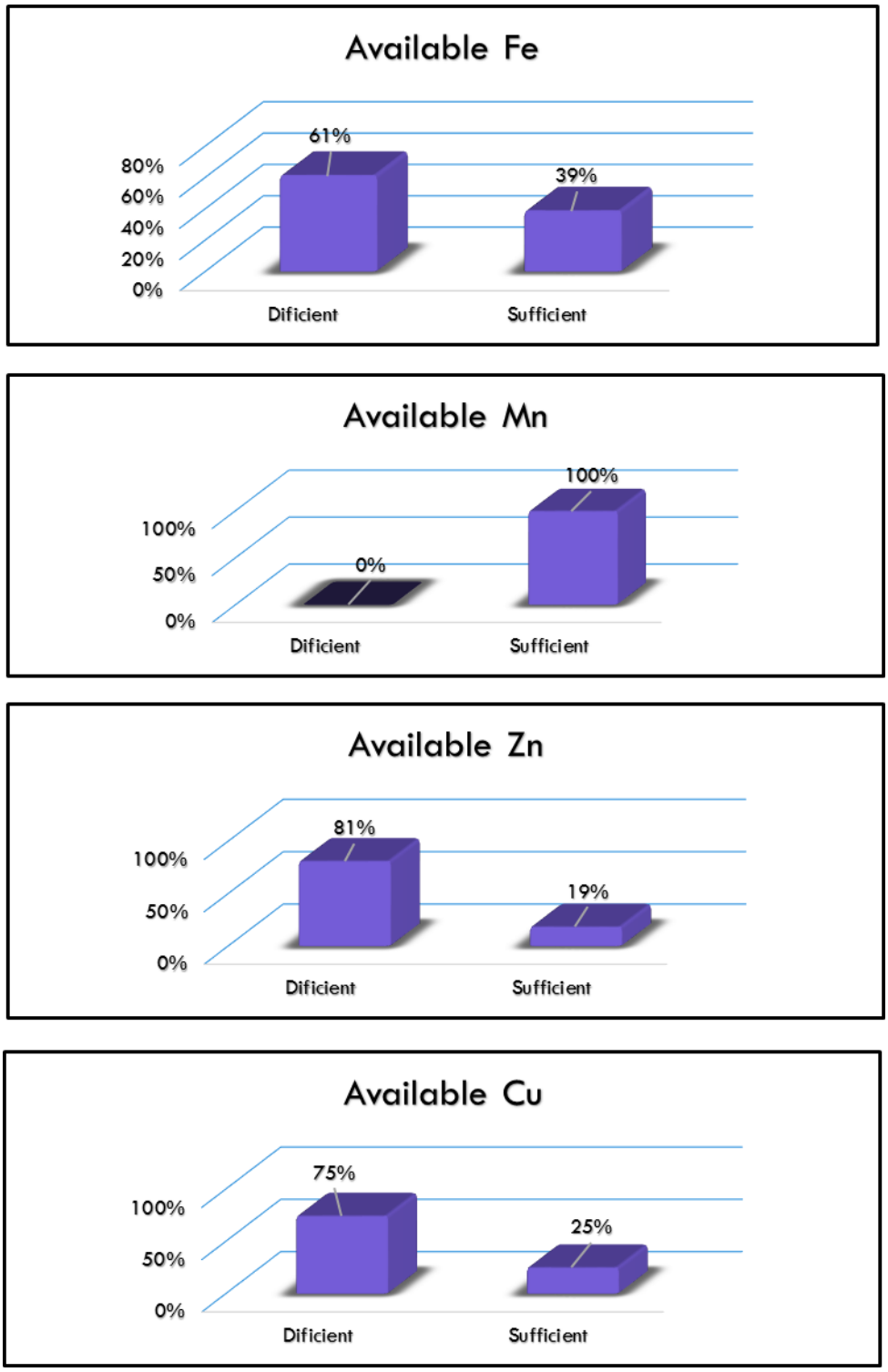

Fig .9. Categorization of soil samples of Purna tahsil on the basis of micronutrient content

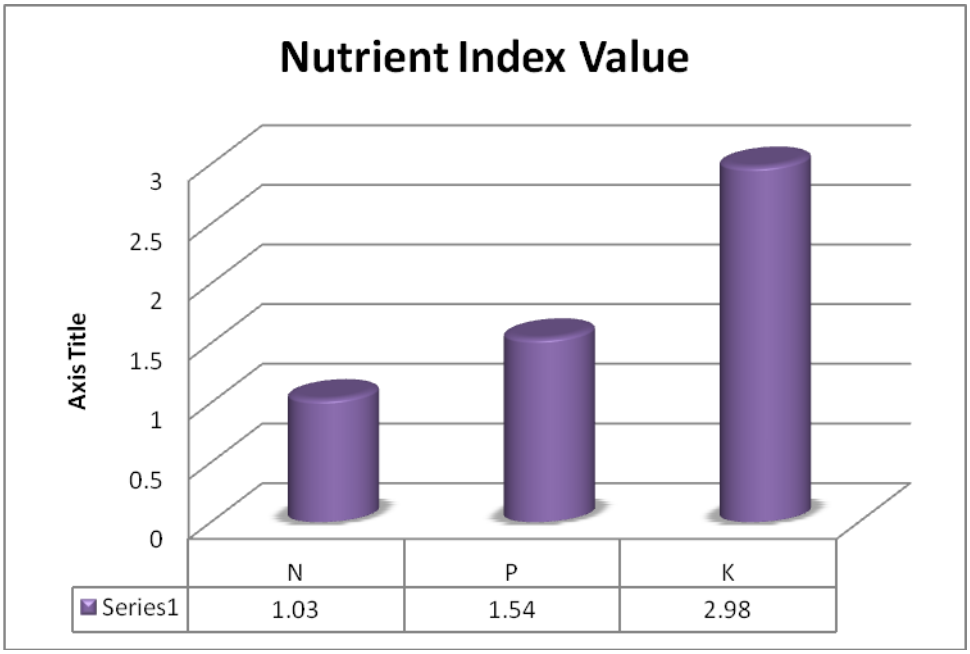

Fig. 10 Soil fertility index value of central tahsils of Parbhani district

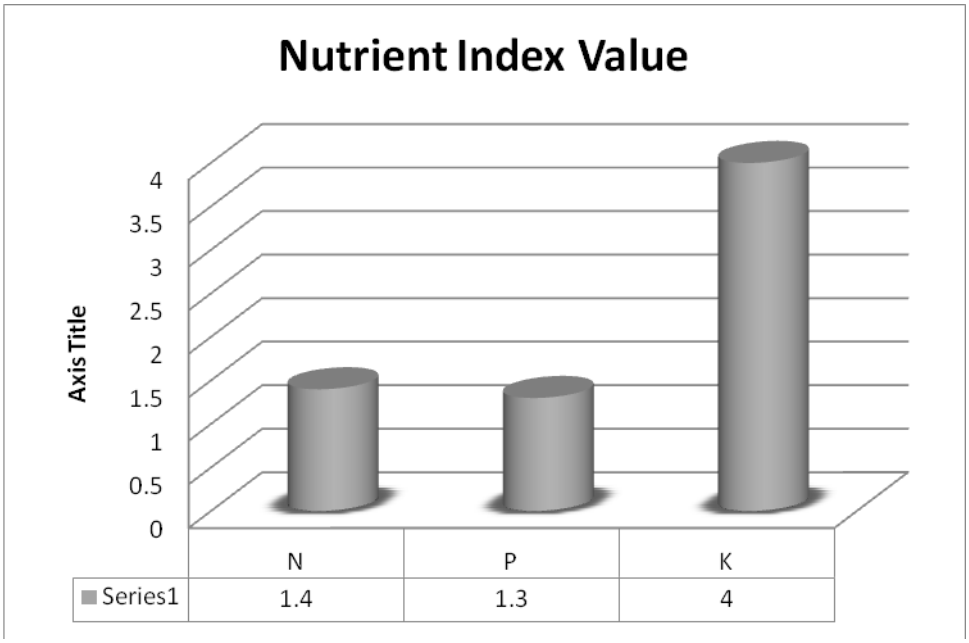

Fig. 11 Soil fertility index value of Manwat tahsils of Parbhani district

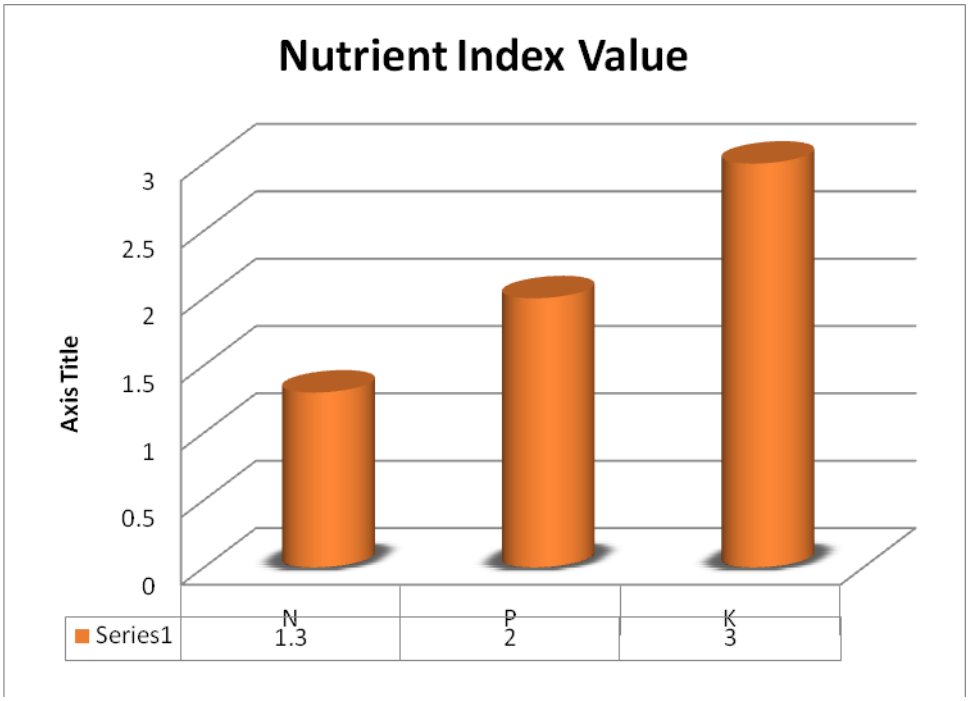

Fig. 12 Soil fertility index value of Parbhani tahsils of Parbhani district

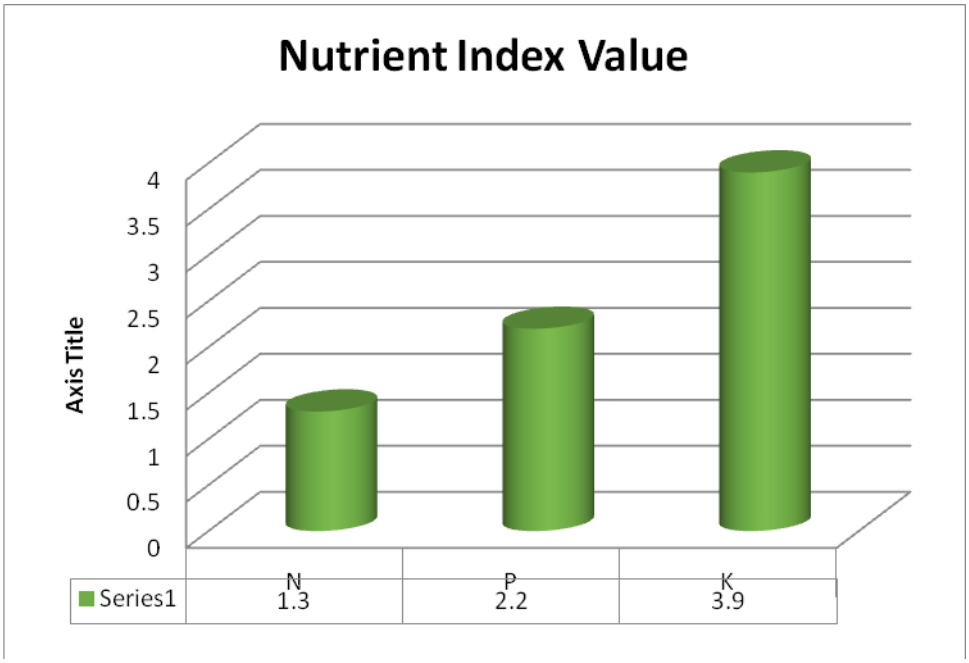

Fig. 13 Soil fertility index value of Purna tahsils of Parbhani district

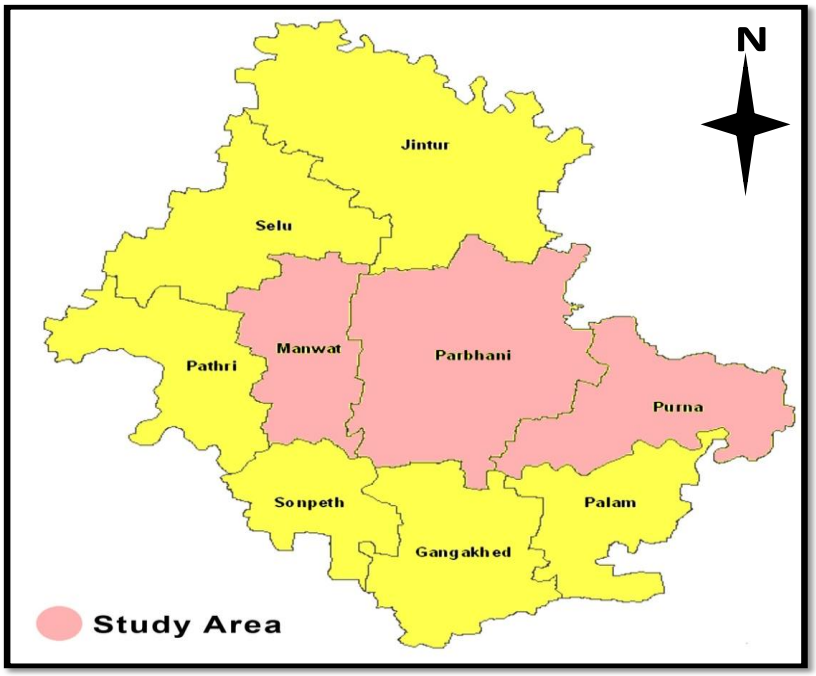

Plate 1 . Parbhani district map.

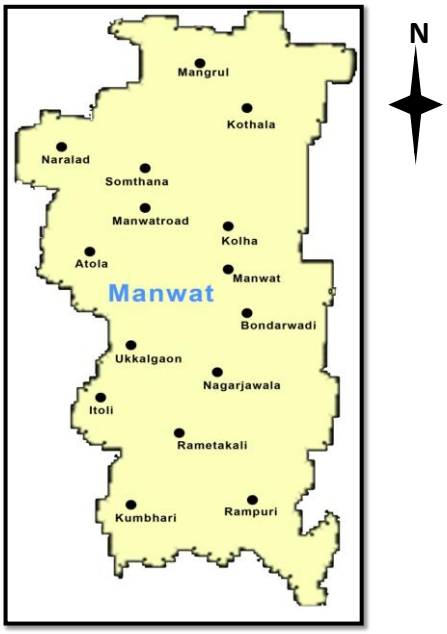

Plate 2. Manwat tahsil map.

Plate 3 . Parbhani tahsil map.

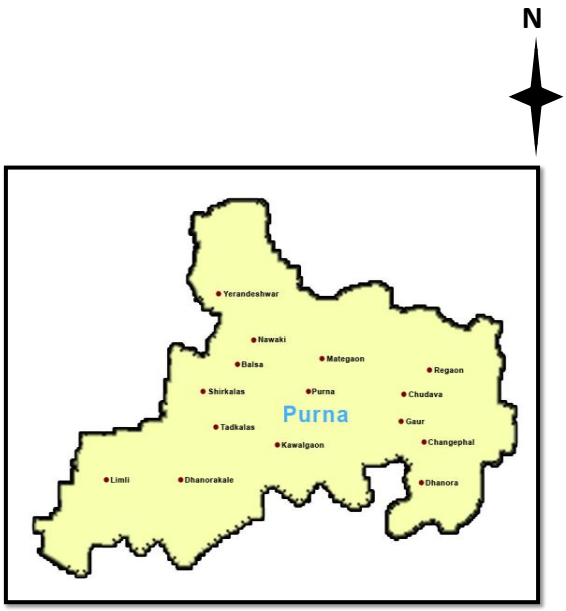

Plate 4 . Purna tahsil map.

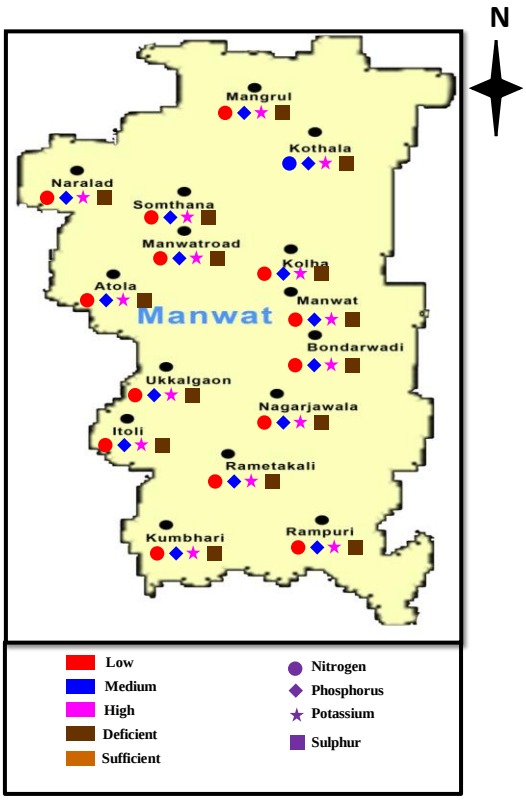

Plate 5. Fertility map of Macronutrient of Manwat tahsil.

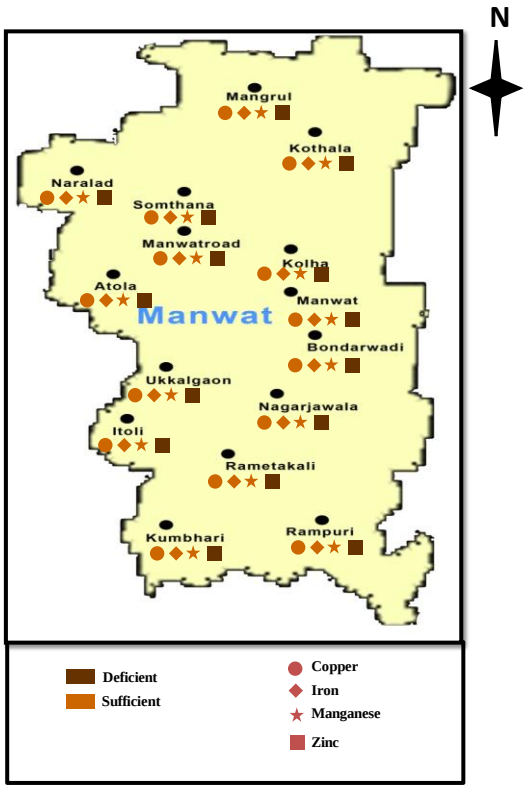

Plate 6. Fertility map of Micronutrient of Manwat tahsil

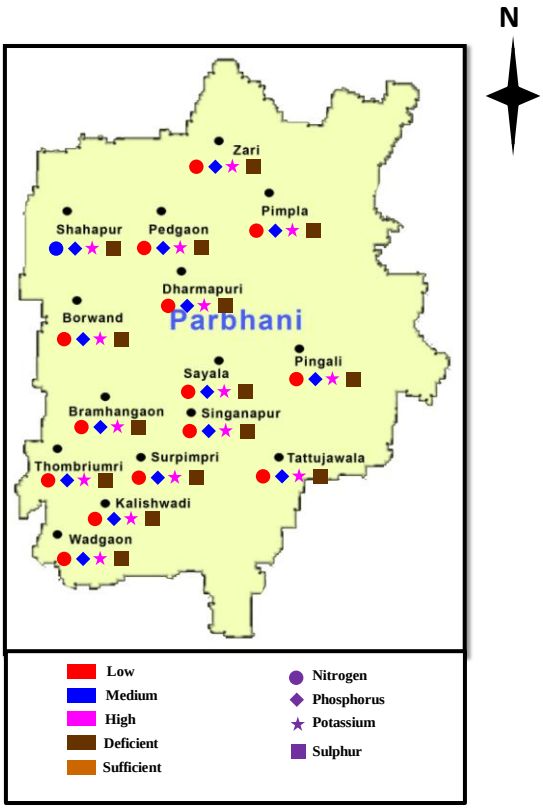

Plate 7. Fertility map of Macronutrient of Parbhani tahsil

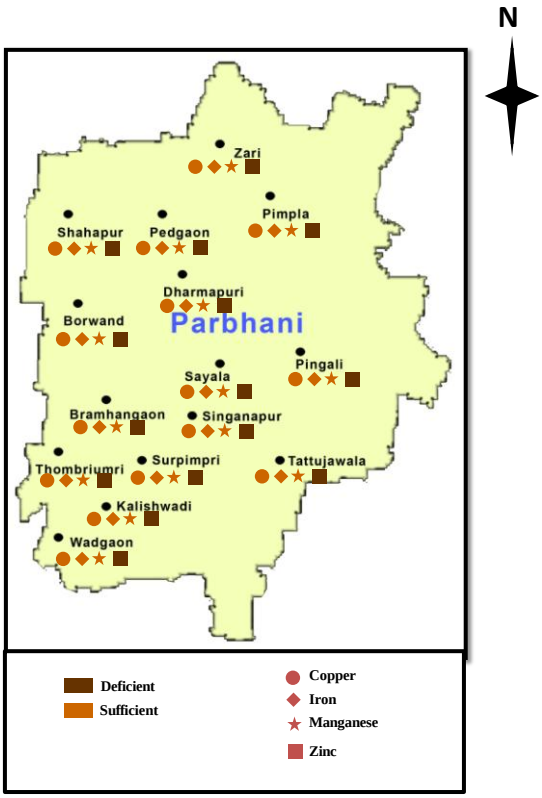

Plate 8. Fertility map of Micronutrient of Parbhani tahsils.

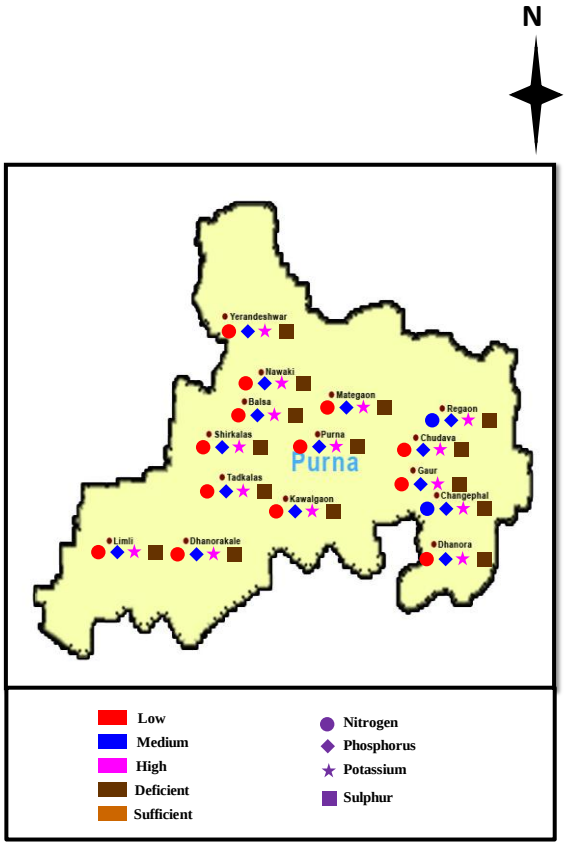

Plate 9. Fertility map of Macronutrient of Purna tahsils.

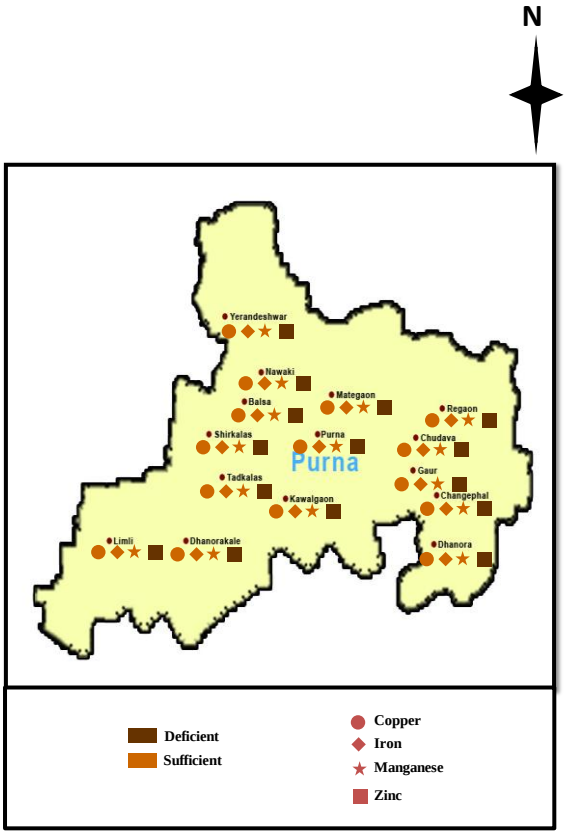

Plate 10. Fertility map of Micronutrient of Purna tahsil