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Land Resource Inventory (LRI) for development of sustainable agricultural land use plans using geospatial techniques: A case study of Pata Meghpar village, Jamnagar district, Gujarat

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ABSTRACT

The soil and land resource inventory at village, as basic unit, are providing baseline data on soils, their constraints and potentials for crop production. Considering this fact, Pata Meghpar village ($22^0$13'14'' to $22^0$16'09'' N latitude and $70^0$29'16'' to $70^0$32'59'' E) in Jamnagar district of Gujarat with an area of 1683 hectares was selected for land resource inventory on 1:10000 scale for land use planning activity. The soils developed on Deccan trap geological formations with distinct basaltic landforms appear at an elevation of 100 meters above mean sea level near Und river. The landform analysis of study area was carried out with the visual interpretation of Indian Remote Sensing Satellite P6 LISS-IV data of April 2012 in conjunction with cadastral map. The four basic landforms identified are isolated upland (119.3 ha & 7.1%), ravinous land (409.6 ha & 24.3%), very gently to gently sloping plains (543.9 ha & 32.3%) and nearly level plains (610 ha & 36.2%). The detailed soil survey was carried out and identified seven soil series with 10 phases. The soil series Pata Meghpar-1(Loamy, Lithic Ustorthents) and Patameghpar-2 (loamy-skeletal, Lithic Ustorthents) occurring on isolated upland are very shallow, excessively drained, brown loam (7.5YR 4/4) to dark yellowish brown (10YR 3/4), gravely loam and slightly alkaline (pH 7.2-7.8). The Pata Meghpar-3 (fine-loamy, Typic Ustorthents) on ravinous lands are moderately shallow, excessively drained, strongly calcareous, dark yellowish brown (10YR 3/4), weak fine sub-angular blocky structure, slightly alkaline to moderately alkaline (pH 7.7 to 8.6). The Pata Meghpar - 4 (fine, Typic Haplustepts) and Pata Meghpar-5 (fine, Vertic Haplustepts) occurring on very gently to gently sloping plain are moderately deep (50-75cm), moderately well drained, slight to moderately calcareous, very dark grayish brown (10YR 3/2), moderate, medium, sub angular blocky structures and moderate to strongly alkaline (pH 8.1 to 8.8). The Pata Meghpar - 6 (fine, Leptic Haplusterts) and Pata Meghpar – 7 (fine, Typic Haplusterts) occurring on nearly level plains are deep, clayey, moderately well drained, very dark grayish brown (10YR 3/2) to very dark gray (10YR 3/1), weak fine angular blocky to moderate medium angular blocky structure, moderately calcareous and moderately alkaline (pH 8.0-8.5). The baseline resource data are useful for deriving soil-landscape relationships in basaltic terrain at village and forms the basis for upgrading management packages for sustainable crop production at farm level.

Key words: Land resource inventory, Mapping, Soil suitability evaluation, Land use planning

INTRODUCTION

An evaluation of the suitability of land for alternative kinds of use requires a survey to define and map the land units together with the collection of descriptive data of land characteristics and resources. Land resources inventory (LRI) provides information about morphological and physico-chemical characteristics of soils, its problems and potentials for best utilization under given set of agro-climatic conditions (Sharma *et al*., 2015). It produces maps of the specified location at larger scale with extent and distribution of various soil groups. However, village development is supposed to be more than a just soil and water management. It should be an integrated approach, which aims to improve rural livelihoods including human resource development, pasture development, agriculture development, livestock management and rural energy management. It should aim at the development of all resources for human in existing nature in one ecosystem.

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Various projects have been initiated by National Bureau of Soil Survey and Land Use Planning, Nagpur on land resource inventorization for farm planning in different agro-ecological regions of India (NBSS&LUP, Annual report 2011-12). Recently LRI study is completed for Chikarsinkere Hobli, Maddur taluk, Mandya district of Karnataka, Lakhan Majra block, Rohtak district of Haryana, Katonigaon, Titabar block, Jorhat district of Assam, Chinchura - Mogra and Polba-Dadpur Block, Hugli District of West Bengal, Bhadesar Tehsil, Chittaurgarh district of Rajasthan (NBSS&LUP, Annual report 2011-12). After successful completion of these blocks Bureau has planned to take representative Taluka/block from each Agro-Ecological Sub-Regions (AESR) for LRI study for enhancing productivity and transfer of technology (NBSS&LUP, Annual report 2014-15). In the first phase (2014-2018) a massive programme of LRI of 60 blocks; representative of each AESR has been taken and now, it is in the final/completion stage. The aim of this paper is to understand the way of integration of land resource data with village or Taluka development programmes for better utilization.

The village based evaluation of land resources for land use planning and their sustainable use is very important for intensive agriculture. Providing reliable and accurate information on land resources is the key for taking right decision at right time for right agro-technology transfer in farmer's field. Keeping this in view on the basis of prioritization of *National Initiative on Climate Resilient Agriculture* (NICRA), we have selected village Pata Meghpar in Jamnagar district of Gujarat for LRI study.

MATERIALS AND METHODS

The village Pata Meghpar located in Saurastra or Kathiwar region comprises the south western part of Gujarat state. It is a part of Kalavad Taluka on eastern boundary of Jamnagar district and western boundary of Rajkot district. The total geographical area of the village is 1703 ha. It is situated between 22°13''12' & 22°16''06' N latitudes and 70°29''07' & 70°32''56'E longitudes (Fig.1). Geological formation of village is with Deccan trap, the basic lava flow, is the oldest and the most extensively developed rock formation in the district. The rocks are basaltic in composition and spread over wide areas in the form of horizontal sheets and give rise to a relief typical of Deccan trap topography. Jamnagar district is devoid of any large perennial streams. Most of the rivers are small and flow lazily through the low lying lands. The Und river crosses the village boundary of Pata Meghpar. This river originates near the village Bedia in Rajkot

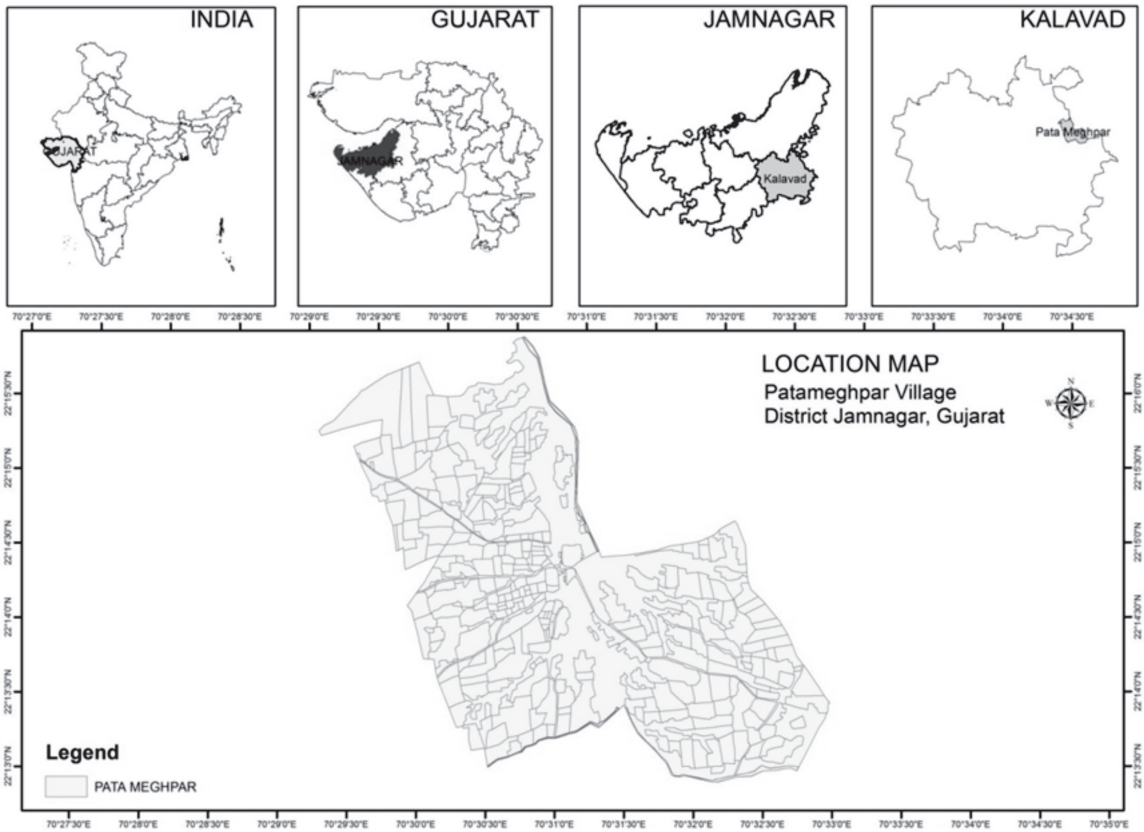

Fig. 1. Location map of Pata Meghpar village

district at a height of 459 feet. The average rainfall from 1993 to 2012 is 739 mm; about 95% of it is received during the south west monsoon. The average annual minimum temperature is 20°C and maximum temperature is 34°C. Important crops grown are groundnut, cotton, sesame, castor, pulses, pearlmillet, sorghum during *Kharif* and wheat, cumin, chickpea during *Rabi.* In the village the natural vegetations are deciduous and mixed tree species and grasses.

The detailed soil survey of the village was carried out using cadastral map as a base map on 1: 4000 scales. Geocoded Remote Sensing satellite data of IRS P6 LISS-IV for the April 2012 in association of Google image were used for image interpretation. Covering the entire area 24 soil profiles were exposed and studied for morphological properties (Soil Survey Division Staff, 2000) and classified as per Soil Taxonomy (Soil Survey Staff, 2014). A total of 60 augur observations were taken for precise delineation of soil boundaries. Soil series were identified and mapped as phases of soil series. Surface texture, slope and erosion classes were considered for soil phase level classification. The soil legend codes were developed to depict the name of the soil series followed by texture, slope, erosion and stoniness (IARI, 1971). Soil samples were collected from representative pedons and analyzed for different physical and chemical properties following standard procedures (Black, 1965; Jackson, 1973). The soils were grouped under different land capability sub-classes (Klingebiel and Montgomery, 1961) and land irrigability sub-classes (IARI, 1971). The soil-site suitability was worked out for cotton, groundnut, rice, wheat, gram, sorghum and guava as per the methodology given in the FAO frame work on land evaluation (FAO, 1976) modified by Sys *et al*. (1991). The soil-site requirements as suggested by Naidu *et al*. (2006) have been used for evaluating the suitability of different mapping units.

RESULTS AND DISCUSSION

Slope

Four slope classes *viz.* level to nearly level (0-1%), very gently sloping (1-3%), gently sloping (3-8%), and moderately sloping (8-15%) lands have been identified (Fig. 2). The major area is under level to nearly level land (32.3% of TGA). Very gently sloping, gently sloping and moderately sloping land occupy 25.5, 15.9, and 26.3 per cent of TGA, respectively.

Landform-soil relationship

Four major landforms, namely, isolated upland, ravenous land, very gently to gently sloping plain and nearly level plain were identified and delineated (Fig. 3). Ravenous land (8-15%) occurs at an elevation of 95 to 110 m above MSL and support degraded forest. These areas are severely eroded by Und river and have very deep drainage channels. The Isolated upland (3-8% slope) occurs at an elevation of 108 to121 m above MSL supported by wasteland with scrubs with scattered cultivation

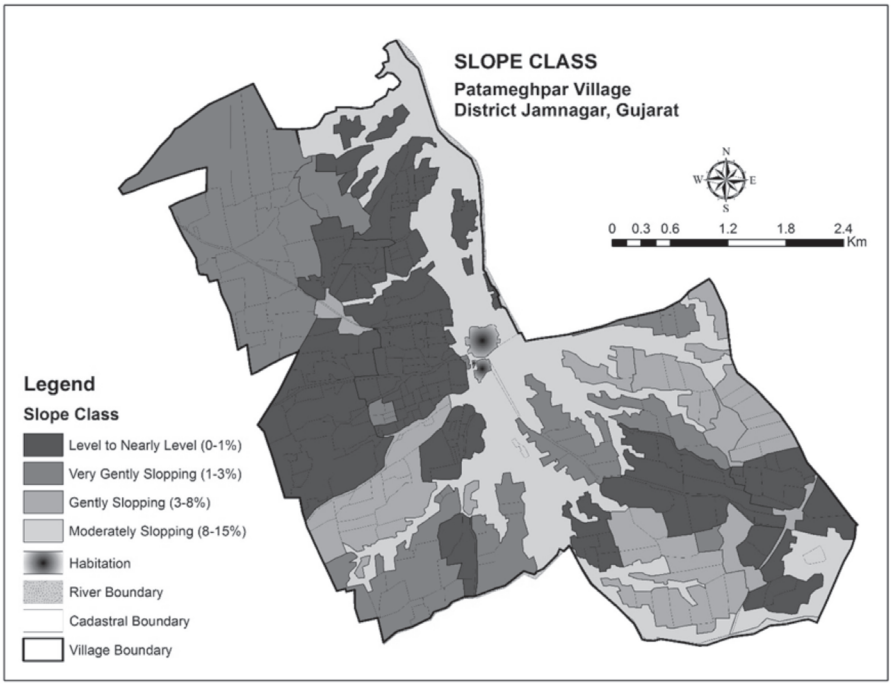

Fig. 2. Slope map of Pata Meghpar village

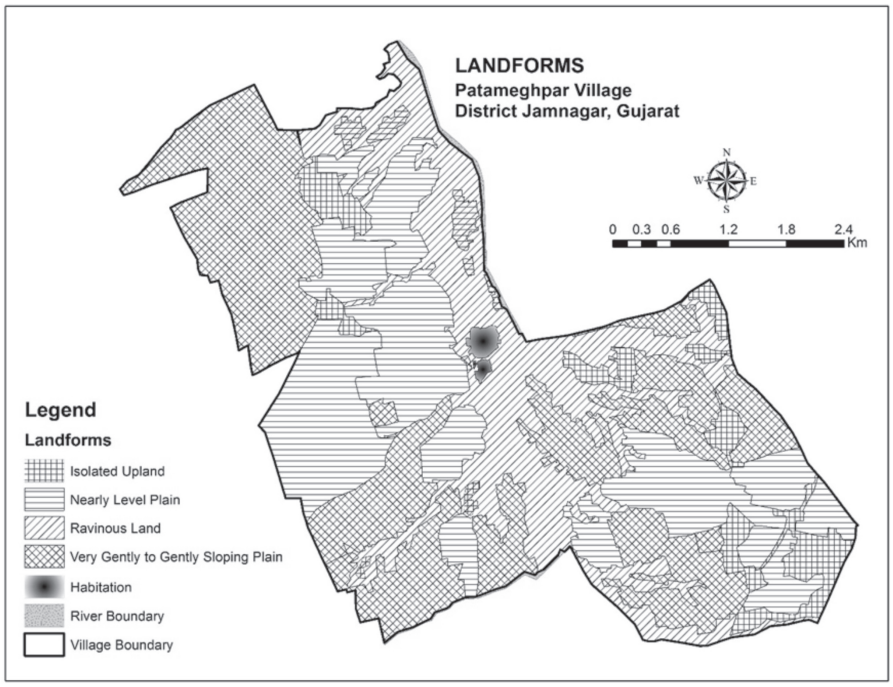

Fig. 3. Landforms map of Pata Meghpar village

of single crop. The Very gently to gently sloping plain (1-3% to 3-8% slope) occur at an elevation of 108 to 116 m above MSL. These areas are cultivated for double crops. Nearly level plain (0-1% slope) are also cultivated for double crops that occur at an elevation of 114 to 115 m above MSL.

Characterization of soils

The four landforms were identified after image interpretationare isolated upland (119.3 ha & 7.1%), ravinous land (409.6 ha & 24.3%), very gently to gently sloping plains (543.9 ha & 32.3%) and nearly level plains (610 ha & 36.2%). The detailed soil survey was carried out and identified seven soil series with 10 phases (Fig. 4).The soil series Pata Meghpar-1 (Loamy, Lithic Ustorthents) and Patameghpar-2 (loamy-skeletal, Lithic Ustorthents) occurring on isolated upland are very shallow, excessively drained, brown loam(7.5YR 4/4) to dark yellowish brown (10YR 3/4), gravely loam and

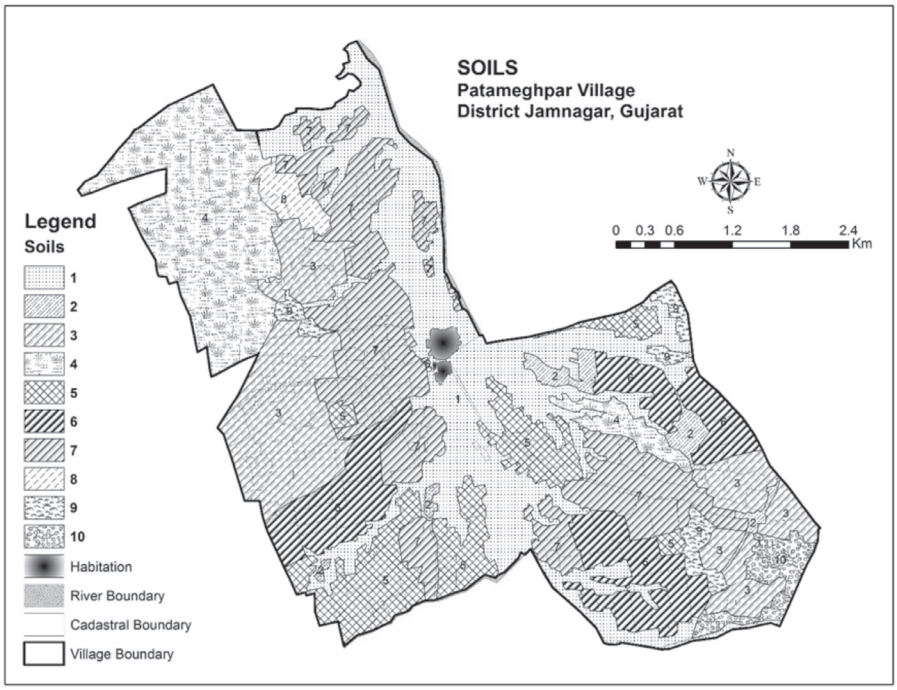

Fig. 4. Soil map of Pata Meghpar village, Jamnagar district

slightly alkaline (pH 7.2-7.8). The Pata Meghpar-3(fine-loamy, Typic Ustorthents) on ravinous lands are moderately shallow, excessively drained, strongly calcareous, dark yellowish brown (10YR 3/4); weak fine sub-angular blocky structure, slightly alkaline to moderately alkaline (pH 7.7 to 8.6). The Pata Meghpar - 4 (fine, Typic Haplustepts) and Pata Meghpar-5 (fine, Vertic Haplustepts) occurring on very gently sloping plain are moderately deep (50-75cm), moderately well drained, slight to moderately calcareous, very dark grayish brown (10YR 3/2), moderate, medium, sub angular blocky structures and moderate to strongly alkaline (pH 8.1 to 8.8). The Pata Meghpar - 6 (fine, Leptic Haplusterts) and Pata Meghpar - 7 (fine, Typic Haplusterts) occurring on nearly level plains are deep, clayey, moderately well drained, very dark grayish brown (10YR 3/2) to very dark gray (10YR 3/1), weak fine angular blocky to moderate medium angular blocky structure, moderately calcareous and moderately alkaline (pH 8.0-8.5). The detailed soil map with phases of soil series is presented in Fig. 4 and the descriptive legend of soil map is presented in Table 1.

Physical and chemical properties of soils

The data (Table 2) indicate that the clay content varied from 13.7 to 61.3 per cent. Higher clay content is noticed in soils of Pata Meghpar-4, Pata Meghpar-5, Pata Meghpar-6 and Pata Meghpar-7

Table 1. Soil Map Legends of Pata Meghpar village, Jamnagar district, Gujarat

Series name	Mapping unit No.	Mapping symbol	Brief description of soil	Area (ha)
Soils of Isolated upland: Pata Meghpar-1series (Ptm-1): Very shallow, excessively drained, brown loam (Lithic Ustorthents)				
Pata Meghpar-1	2	Ptm-1GdC3	Gravely loam (gravels >50 %) on 3-8 % slope with severe erosion	32.9 (1.9%)
	10	Ptm-1GdD4	Gravely loam (gravels >50 %) on 8-15 % slope with very severe erosion	32.5 (1.9%)
Soils of Isolated upland: Pata Meghpar-2 series (Ptm-2): Very shallow, somewhat excessively drained, dark yellowish brown loam (Lithic Ustorthents)				
Pata Meghpar-2	9	Ptm-2GdC3	Gravely loam (gravels > 30 %) on 3-8 % slope with severe erosion	32.7 (71.9%)
	8	Ptm-2GdB2	Gravely loam (gravels > 30 %) on 1-3% slope with moderate erosion	21.1 (1.2%)
Soils of Ravenous land: Pata Meghpar-3 series (Ptm-3): Slightly deep, excessively drained, dark yellowish brown silt loam (Typic Ustorthents)				
Pata Meghpar-3	1	Ptm-3GeD4	Gravely silt loam (gravels > 50 %) on 8-15 % slope with very severe erosion	409.6 (24%)
Soils of Very gently to gently sloping plain: Pata Meghpar-4 series (Ptm-4): Slightly deep, moderately well drained, very dark grayish brown fine (Typic Haplustepts)				
Pata Meghpar-4	4	Ptm-4fB2	Clay loam on 1-3 % slope with moderate erosion	248.1 (14.6%)
Soils of Very gently to gently sloping plain: Pata Meghpar-5 series (Ptm-5): Slightly deep, moderately well drained, very dark grayish brown fine (Vertic Haplustepts)				
Pata Meghpar-5	5	Ptm-5mB2	clayey on 1-3 % slope with moderate erosion	160.5 (9.4%)
	6	Ptm-5mC2	clayey on 3-8 % slope with moderate erosion	201.4 (11.8%)
Soils of Nearly level plain: Pata Meghpar-6 series (Ptm-6): Slightly deep, moderately well drained, very dark gray fine (Leptic Haplusterts)				
Pata Meghpar-6	3	Ptm-6mA2	clayey on 0-1 % slope with moderate erosion	238.4 (14.0%)
Soils of Nearly level plain: Pata Meghpar-7 series (Ptm-7): Deep, moderately well drained, very dark gray fine (Typic Haplusterts)				
Pata Meghpar-7	7	Ptm-7mA2	clayey on 0-1 % slope with moderate erosion	305.5 (17.9%)

Ptm-Patameghpar, G-Gravelly, d-loam, e-silt loam, f-clay loam, m-clay, A- slope 0-1%, B- slope 1-3%, C-slope 3-8%, 2-Moderate erosion, 3-Severe erosion, 4-Very severe erosion.

Table 2. Physical properties of soils

Horizon	Depth (cm)	Particle size class and diameter in mm								Water retention (%)		
		Total (%)			Sand fractions (%)							
		Sand 2.0-0.05	Silt 0.05-0.002	Clay <0.002	Very coarse 2.0-1.0	Coarse 1.0-0.5	Medium 0.5-0.25	Fine 0.25-0.10	Very fine 0.1-0.05	-33 kPa	-1500 kPa	AWC
Pata Meghpar-1: Loamy skeletal, mixed, hyperthermic, Lithic Ustorthents												
A	0-15	41.2	40.2	18.6	7.2	5.5	7.6	7.4	13.5	13.1	8.6	4.5
Pata Meghpar-2: Fine loamy skeletal, mixed, hyperthermic, Lithic Ustorthents												
A	0-25	46.2	37.4	16.4	10.4	8.8	6.8	6.2	14.0	12.2	6.9	5.3
Pata Meghpar-3: Fine loamy, mixed (cal), hyperthermic, Typic Ustorthents												
A1	0-30	46.6	27.8	25.6	23.0	9.3	3.8	3.9	6.6	16.9	10.3	6.6
A2	30-60	45.5	40.8	13.7	3.5	4.1	8.8	10.8	18.3	13.3	8.2	5.1
Pata Meghpar-4: Fine, mixed (cal), hyperthermic, Typic Haplustepts												
Ap	0-10	17.3	26.0	56.7	0.6	1.2	3.0	4.9	7.5	39.0	29.2	9.8
Bw1	10-25	15.2	25.1	59.7	0.8	1.2	2.8	4.2	6.3	43.6	31.9	11.7
Bw2	25-45	17.6	21.1	61.3	1.6	3.3	3.0	3.5	6.2	42.5	32.0	10.5
Bw3	45-60	62.3	13.5	24.2	16.7	17.1	15.5	7.3	5.8	28.4	20.8	7.6
Pata Meghpar-5: Fine, smectitic (cal), hyperthermic, Vertic Haplustepts												
Ap	0-15	35.1	27.2	37.7	7.0	6.7	7.0	5.2	9.2	34.0	20.0	14
Bss1	15-30	20.6	28.4	51.0	5.5	2.5	2.2	3.0	7.4	39.7	28.8	10.9
Bw1	30-55	16.7	40.2	43.1	2.4	2.3	2.1	2.9	7.0	40.6	31.0	9.6
Bw2	55-70	14.7	39.7	45.7	2.3	2.3	2.0	2.2	5.9	39.9	30.5	9.4
Pata Meghpar-6: Fine, smectitic (cal), hyperthermic, Leptic Haplusterts												
Ap	0-15	16.7	32.1	51.3	0.8	1.8	3.7	3.3	7.1	43.4	30.0	13.4
Bss1	15-40	20.4	27.2	52.4	2.3	2.1	3.9	3.6	8.5	39.8	29.2	10.6
Bss2	40-65	17.4	27.2	55.4	2.1	1.9	2.4	3.0	8.0	41.4	31.3	10.1
Bss3	65-75	17.3	41.6	41.1	3.3	3.3	3.0	2.6	5.1	41.6	30.3	11.3
Pata Meghpar-7: Fine, smectitic (cal), hyperthermic, Typic Haplusterts												
Ap	0-15	25.0	27.7	47.4	5.7	3.5	3.5	3.7	8.5	36.7	24.4	12.3
Bss1	15-38	15.6	46.9	37.6	1.2	1.0	2.0	3.2	8.2	35.6	28.6	7.0
Bss2	38-65	15.0	41.3	43.8	3.7	1.4	1.3	2.1	6.4	41.6	31.5	10.1
Bss3	65-85	18.7	30.6	50.7	5.2	2.1	2.0	2.2	7.3	41.9	31.9	10.0
Bss4	85-105	24.0	34.5	41.5	3.5	3.2	5.3	4.3	7.7	38.5	24.9	13.6

developed on very gently to gently sloping plain and nearly level to level plain compared to the soils developed on other landforms. The higher clay content in soils of these plain are associated with higher cation exchange capacities and available water content. The data related to chemical properties (Table 3) indicate that the soils of Pata Meghpar-l, Pata Meghpar-2 and Pata Meghpar-3 are neutral in reaction; soils of Pata Meghpar-4 to Pata Meghpar-7 are slightly alkaline in reaction. The organic carbon (OC) content in these soils is moderate and ranged from 0.3 to 1.5 per cent. The soils of Pata Meghpar-3 series are high in organic carbon content due to presence of grasses and degraded forestry. The soils of Pata Meghpar-5, Pata Meghpar-6 and Pata Meghpar-7 are calcareous (>5% $CaCO_3$). In general, these soils are highly base saturated owing to presence of Ca-Zeolites (Pal *et al*., 2006) which steadily supply the bases. Soils of Pata Meghpar-5 has exchangeable sodium percentage >5 and pH >8.5 whereas other soils are below these critical limits.

Soil fertility

The soils of Pata Meghpar village are low in available nitrogen (118-203 kg ha^{-1}), low to medium in available phosphorus (4.6-19.5 kg ha^{-1}) and medium to high in available potash (213-310 kg ha^{-1}). Soils of isolated upland (Pata Meghpar-1 & Pata Meghpar-2) and ravenous land (Pata Meghpar-3) are relatively less fertile in relation to major nutrients (Table 4). Availability of major nutrients (NPK) is relatively higher in the soils of very gently

Table 3. Chemical characteristics of soils

Horizon	Depth (cm)	pH (H_2O) 1:2.5	EC (dSm^{-1}) 1:2.5	Org. C (%)	$CaCO_3$ (%)	Exchangeable Cations Ca	Mg	Na	K	CEC	ESP (%)
						[cmol(p^+)kg^{-1}]					
Pata Meghpar-1: Loamy skeletal, mixed, hyperthermic, Lithic Ustorthents											
A	0-15	7.4	0.45	0.3	3.65	23.2	11.2	1.2	0.1	38.2	3.4
Pata Meghpar-2: Fine loamy skeletal, mixed, hyperthermic, Lithic Ustorthents											
A	0-25	7.6	0.6	0.3	2.4	26.3	13.5	0.4	0.1	42.1	1.0
Pata Meghpar-3: Fine loamy, mixed (cal), hyperthermic, Typic Ustorthents											
A1	0-30	7.7	0.1	1.5	5.5	33.4	15.6	0.5	0.1	46.2	1.0
A2	30-60	8.6	0.2	0.5	21.7	35.7	17.3	0.5	0.1	49.2	0.9
Pata Meghpar-4: Fine, mixed (cal), hyperthermic, Typic Haplustepts											
Ap	0-10	8.1	0.5	0.5	3.8	44.5	20.0	0.7	0.2	68.2	1.1
Bw1	10-25	8.2	0.5	0.5	4.1	47.7	22.4	2.0	0.1	76.5	2.8
Bw2	25-45	8.3	0.3	0.4	4.6	46.9	21.2	1.7	0.1	74.2	2.4
Bw3	45-60	8.4	0.3	0.3	4.9	21.3	11.2	1.4	0.1	36.8	4.1
Pata Meghpar-5: Fine, smectitic (cal), hyperthermic, Vertic Haplustepts											
Ap	0-15	8.6	0.4	0.7	14.4	32.2	12.2	2.5	0.1	51.2	5.3
Bss1	15-30	8.5	0.4	0.6	11.9	40.8	13.5	2.7	0.1	60.4	4.7
Bw1	30-55	8.7	0.4	0.6	11.2	43.2	12.6	3.5	0.1	63.1	5.9
Bw2	55-70	8.8	0.4	0.6	17.4	44.5	7.8	3.4	0.1	57.6	6.1
Pata Meghpar-6: Fine, smectitic (cal), hyperthermic, Leptic Haplusterts											
Ap	0-15	8.1	0.9	0.8	9.8	40.8	16.7	1.7	0.2	62.8	2.9
Bss1	15-40	8.2	0.7	0.7	11.5	41.6	14.7	2.0	0.2	61.6	3.4
Bss2	40-65	8.2	0.7	0.6	12.1	40.8	15.1	2.3	0.2	61.7	3.9
Bss3	65-75	8.3	0.5	0.7	16.8	36.7	16.7	2.0	0.2	58.6	3.6
Pata Meghpar-7: Fine, smectitic (cal), hyperthermic, Typic Haplusterts											
Ap	0-15	8.4	1.1	0.7	11.9	34.7	19.2	2.3	0.3	58.4	4.1
Bss1	15-38	8.5	0.7	0.7	11.9	42.0	15.5	2.5	0.2	63.2	4.2
Bss2	38-65	8.2	0.6	0.6	12.1	43.7	14.7	2.7	0.2	64.8	4.4
Bss3	65-85	8.3	0.6	0.6	15.7	44.2	16.4	2.1	0.1	66.4	3.3
Bss4	85-105	8.5	0.6	0.4	23.6	31.4	12.6	1.8	0.1	48.1	3.9

to gently sloping plain (Pata Meghpar-4 & Pata Meghpar-5) and level to nearly level plain (Pata Meghpar-6 & Pata Meghpar-7). Saxena (2009) and Ardak *et al*. (2010) reported similar results in soils of basaltic terrain of Nagpur district. The DTPA-extractable micronutrient cations (Fe, Mn, Cu and Zn) of the soils (Table 4) indicates that DTPA-Fe ranged from 3.5 to 8.6 mg kg^{-1} in surface soils and found that intensively cultivated area (mapping unit no. 4 to 7) are lower than the critical level of 4.5 mg kg^{-1} (Lindsay and Norvell, 1978). The DTPA-Zn varied from 0.2 to 2.3 mg kg^{-1} in surface soils and about 93 per cent soils are deficient in available Zn against critical level of 0.6 mg kg^{-1} and remaining soils are marginal (Lindsay and Norvell, 1978). Sharma *et al*. (2003) reported 46% Zn deficiency and 51% Fe deficiency in soils of semi-arid region of Rajasthan. All the soil samples were sufficient in available Mn (5.5 to 11.8 mg kg^{-1}) and Cu (1.5 to 2.1 mg kg^{-1}) considering 1.0 mg kg^{-1} for Mn and 0.2 mg kg^{-1} for Cu as critical limits suggested by Lindsay and Norvell (1978). The micronutrient contents, in general, decreased with depth. The micronutrient fertilizers of Fe and Zn need to be supplemented for healthy growth and higher yield of the crops.

Land capability

The soils are grouped under IIs, IIIes, IVes, Ves and VIes land capability sub-classes (Fig. 5). The lands under IIs are good cultivable lands with minor soil problems such as fairly satisfactory texture and stoniness. The lands under sub class IIIes are moderately good cultivable lands with moderate slope subjected to water erosion and root zone limitation due depth, whereas, the lands under sub-classes IVes are fairly good land with

Table 4. Available major and micronutrient status

Horizon	Depth (cm)	Available major nutrients			Available micronutrients			
		N	P	K	Fe	Mn	Zn	Cu
		(kg ha^{-1})			(mg kg^{-1})			
Pata Meghpar-1 series (Ptm-1): Loamy Skeletal, mixed, hyperthermic, Lithic Ustorthents								
A	0-15	118	4.6	230	8.6	8.3	2.3	1.7
Pata Meghpar-2 series (Ptm-2): Loamy Skeletal, mixed, hyperthermic, Lithic Ustorthents								
A	0-25	126	4.2	213	7.4	15.2	0.7	1.5
Pata Meghpar-3 series (Ptm-3): Fine loamy, mixed (cal), hyperthermic, Typic Ustorthents								
A1	0-30	126	8.5	250	4.3	5.5	0.4	2.0
A2	30-60	113	4.2	290	4.2	8.7	0.3	1.7
Pata Meghpar-4 series (Ptm-4): Fine, mixed (cal), hyperthermic, Typic Haplustepts								
Ap	0-10	163	19.5	229	4.4	11.2	0.6	1.6
Bw1	25-Oct	118	4.1	136	6.8	11.4	1.0	2.1
Bw2	25-45	104	1.8	109	4.9	8.6	0.5	1.8
Bw3	45-60	86	2.4	114	4.7	6.0	0.4	1.0
Pata Meghpar-5 series (Ptm-5): Fine, smectitic (cal), hyperthermic, Vertic Haplustepts								
Ap	0-15	169	17.6	147	3.5	11.3	0.4	2.1
Bss1	15-30	121	8.4	131	4.1	13.4	0.3	1.7
Bw1	30-55	117	4.2	98	4.3	11.9	0.4	2.3
Bw2	55-70	108	3.9	103	4.4	14.2	0.3	2.6
Pata Meghpar-6 series (Ptm-6): Fine, smectitic (cal), hyperthermic, Leptic Haplusterts								
Ap	0-15	195	16.4	201	7.1	11.8	0.2	2.1
Bss1	15-40	137	9.6	218	8.3	8.3	0.1	1.3
Bss2	40-65	123	5.2	234	8.8	7.5	0.1	1.5
Bss3	65-75	116	3.6	163	7.6	7.6	0.1	1.6
Pata Meghpar-7 series (Ptm-7): Fine, smectitic (cal), hyperthermic, Typic Haplusterts								
Ap	0-15	203	15.2	310	4.2	6.4	0.2	1.8
Bss1	15-38	165	8.5	250	5.1	5.6	0.3	1.0
Bss2	38-65	136	5.6	223	5.1	4.2	0.2	1.4
Bss3	65-85	116	3.4	147	4.6	5.6	0.2	1.2
Bss4	85-105	98	3.4	125	4.2	8.1	0.3	1.3

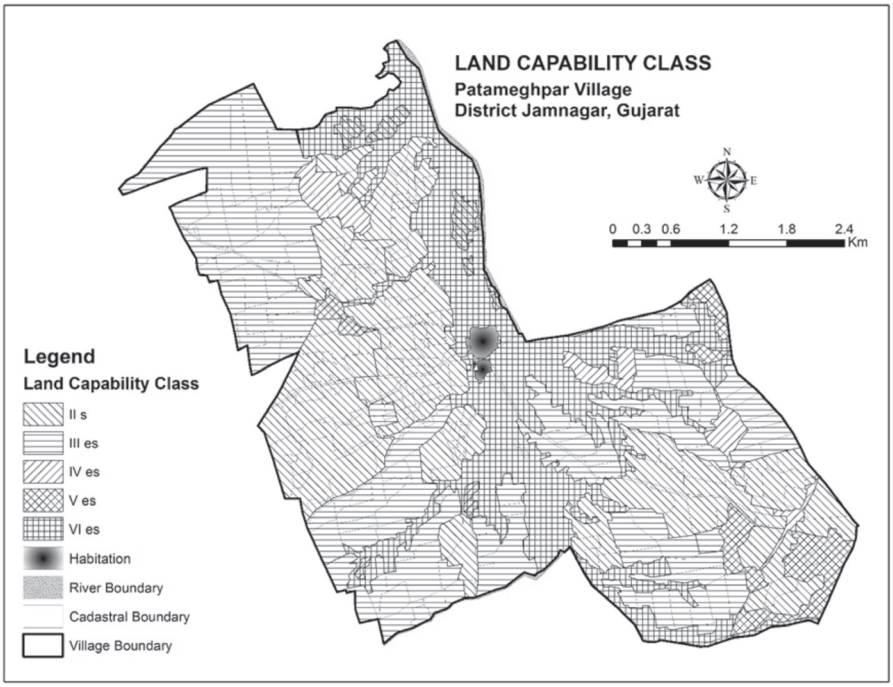

Fig. 5. Land capability subclasses with their extent and distribution in Pata Meghpar village

Table 5. Soil suitability for major crops

Mapping unit no.	Cotton	Wheat	Rice	Sorghum	Gram	Groundnut	Sesame	Guava
1	N1	N1	N1	N1	S3	N1	N1	S2
2	N1	N1	N1	N1	N1	N1	N1	S3
3	S2	S2	S2	S1	S1	S3	S2	S1
4	S3	S3	S3	S2	S1	S2	S1	S2
5	S3	S3	S3	S2	S1	S3	S2	S2
6	S3	S3	S3	S2	S1	S3	S2	S2
7	S1	S2	S2	S1	S1	S3	S2	S1
8	N1	N1	N1	S3	S2	S3	S2	S3
9	N1	N1	N1	N1	N1	N1	N1	S3
10	N1	N1	N1	N1	N1	N1	N1	S3

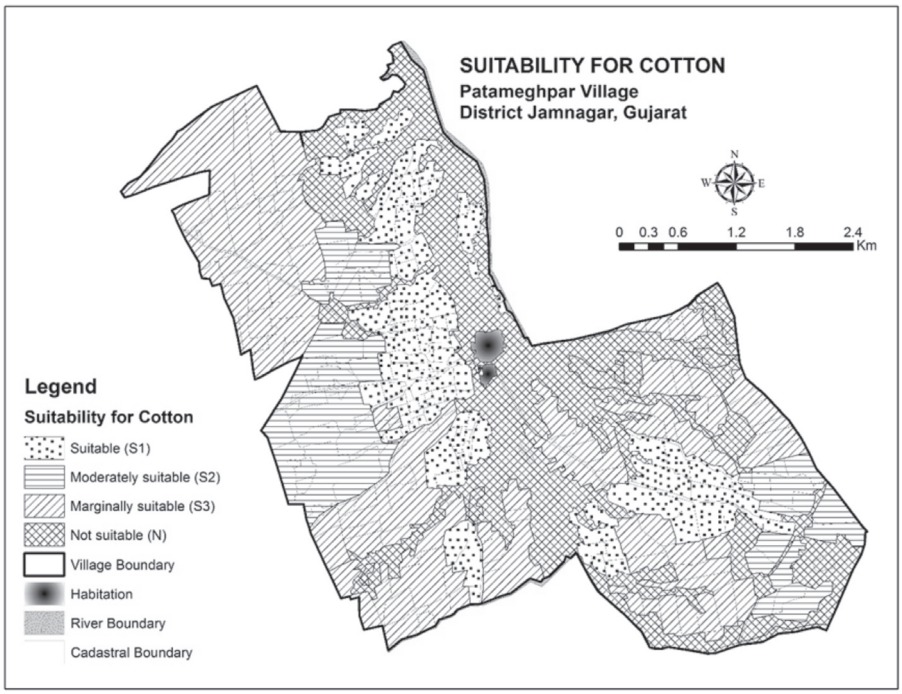

Fig. 6. Soil suitability for cotton in Pata Meghpar village

very shallow depth on very gently to gently sloping land with moderate to severe erosion. The lands under sub-classes Ves and VIes are non arable land well suited for grazing and village forestry, respectively. These are excessively to somewhat excessively drained very shallow soils on gentle to moderate slope with severe to very severe erosion and gravels. Soils of sub-class VIes has strong limitations of gully erosion.

Suitability of soils for crops

Soil site suitability of all the mapping units were assessed for major *Kharif, Rabi* and fruit crops grown in the area. Out of the ten mapping units five units (3, 4, 5, 6 and 7) are suitable to marginally suitable for the major crops grown in the region (Table 5). The mapping units which are not suitable for cultivation of major field crops are 1, 2, 8, 9, and 10. These soils are not suitable due to the severe limitations of topography, depth, stoniness and erosion. Therefore, these soils were assessed for suitability of trees, shrubs and grasses. The mapping units which are not suitable for cultivation of major field crops are marginally suitable for guava cultivation. These soils can easily be developed in the form of community or village forestry. Though the uncultivated area of the village is presently using for grazing of cattle but grass like *Cenchrus cillaris* can easily be grown for forage purposes. Soils of mapping unit covering a vast area (410 ha) of village is under ravenous land. This land can be reclaimed and managed by suitable engineering measures for development of village forestry or grass and leaf foliage purposes. The suitability of soils for cotton (Fig. 6) indicates that

mapping unit no. 7 is suitable (S1), unit no. 3 is moderately suitable (S2), unit no. 4,5,6 are marginally suitable (S3) and reaming units are not suitable for cotton crop as per the suitability assessment criteria proposed by Sys *et al*. (1991) and Naidu *et al*. (2006). In the similar way major crops were evaluated for their suitability in various mapping units and presented in Table 5.

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