Biological Forum – An International Journal **15(11): 586-590(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Soil Characterization and Classification of Biofuel Park, Tinthani, Yadgiri District, Karnataka by using Geospatial Techniques

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(Received: 15 September 2023; Revised: 13 October 2023; Accepted: 23 October 2023; Published: 15 November 2023)
(Published by Research Trend)

ABSTRACT: A study was conducted to assess the soil characterization of Biofuel park, Tinthani, Yadgiri district, Karnataka, India. Satellite imageries were downloaded from Arc GIS base map and delineated block boundaries using Arc GIS 10.8. Five soil profiles were opened to study the morphological, physical and chemical properties of soil profiles. The entire Biofuel park had gentle sloping (3-5 %) and the soil depth was shallow (25-50 cm) to moderately shallow (50-70 cm) with sandy clay loamy texture. The consistency was slightly hard, frim, non-sticky and non-plastic in surface while it was hard, firm, non-sticky and non-plastic in sub surface horizons.

Keywords: Soil characterization, Biofuel Park, GIS.

INTRODUCTION

Land is a dynamic physiographical natural resource that supports both living and non-living things at given space and time. Land is also regarded as factor of production in agricultural economic process, situation, capital and property. Land resources include climate, soil, air, water, vegetation, rocks, minerals and topography and are helpful for human society. Soil is therefore, a part of the land which is non-renewable natural resource and has comparatively a narrow defined concept. Soils are considered as the integral part of the landscape and their characteristics are largely governed by landforms on which they are developed. Soil characterization provides an insight into the potentialities and limitation of soil for its effective exploitation and interpretation for multifarious land uses. Understanding the soil distribution patterns in relation to landscape attributes is seen as a step to improve the accuracy of soil mapping in remote locations (Soil Survey Division Staff, 1993). Soil characterization provides site-specific database needed for planning and implementation of all development programme. The land parcels are grouped into management units based on similarity in soil and site characteristics. It will provide necessary scientific databases for adopting suitable soil conservation measures to prevent soil erosion, enhance ground water recharge and to synergise agricultural sector through enhancing productivity (Hegde *et al*., 2015).

MATERIAL AND METHODS

The project entitled "Establishment of Bio-fuel Park at Tinthani in Yadgiri District of Karnataka" was initiated during 2012-13 working under UAS, Raichur covering an area of 42 acres of land. The project was initiated with the funding assistance of Karnataka State Bio-energy development board, Bangalore and in collaboration with the University of Agricultural Sciences. The Biofuel Park with a geographical area of 42 acres of land located in the north east part of the Karnataka state in India (Fig. 1). It lies between 16° 22′52″0400 N latitude and 76° 39′52″4131 E longitudes. At the selected site profiles were opened upto the parent material. Morphological characteristics were studied horizon wise for each profile. The characteristics studied were depth of soil, boundary characteristics, consistency and soil colour. Analysis of soil physical properties (soil texture, soil colour, soil consistency, bulk density (Mg m^{-3}) and maximum water holding capacity), physico-chemical properties (soil reaction and soluble salts EC (dS m^{-1}), chemical properties, (organic carbon (g kg^{-1}), exchangeable Ca and Mg (cmol (p^+) kg^{-1}), available nutrients (N, P, K, and S), micronutrients (Fe, Cu, Zn and Mn), exchangeable sodium percentage (%) and cation exchange capacity cmol (p^+) kg^{-1})) were analyzed.

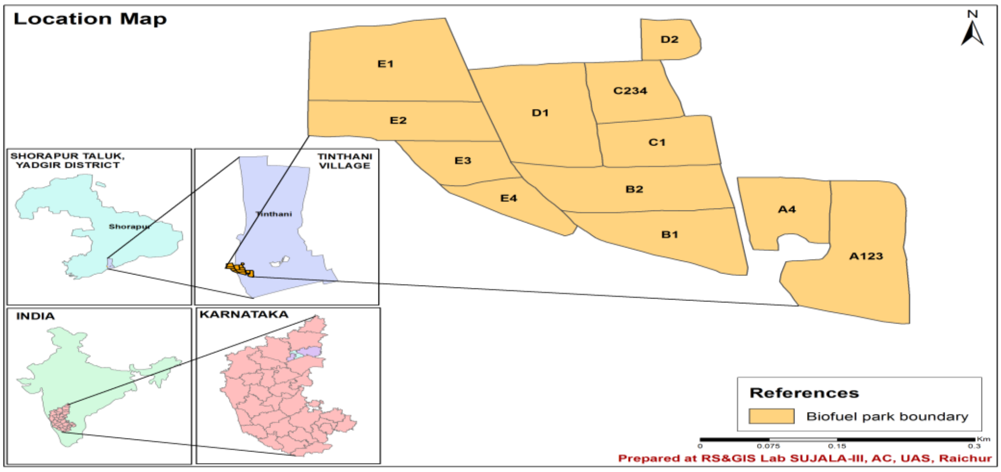

Fig. 1. Location map of Biofuel park, Tinthani.

RESULTS AND DISCUSSION

Morphological characteristics. Data pertaining to morphological characteristics of profiles are given in Table 1.

All the profiles in study area revealed that consistency of soil under dry, moist and wet conditions found slightly hard, firm, non-sticky, and non-plastic, whereas in the subsurface layers it was hard, extremely firm, non-sticky, and non-plastic. The qualitative variations in physical behaviour of soils influenced textural make up and type of clay minerals present in these soils. Similar results were reported by Pramod and Patil (2015). The soil series showed hue of 2.5YR throughout the profile and the dominant colour of dark red to reddish brown as the soils were well drained and occurring on gently sloping uplands derived from granite/gneiss, characterized by occurrence of gravels with sandy clay loam texture. Similar results were reported by Chikkaramappa *et al.* (2020).

Physico-chemical characteristics. Data pertaining to physico-chemical characteristics of profiles are given in Table 2-4.

The soils of the study area were sandy clay loams and the amount of sand in surface horizons was higher compared to that of the sub surface horizons. The higher silt & clay were noticed in sub-surface horizons. Similar findings were reported by Pulakeshi *et al.* (2014). In all five profiles, the solum weighted average (SWA) of bulk density ranged from 1.38 to 1.45 Mg m^{-3}. Down the solum, the bulk density of the soil increased in each of the profiles this may be due to reduction in organic carbon with depth. In all of the profiles, the SWA of MWHC of the soils ranged from 40.74 to 41.89 percent. The MWHC of soil was increased with increase in depth which may be due to increase in clay content with depth. These results were in line with those of Thangasamy *et al.* (2005). The SWA of soil reaction (pH) ranged from 7.19 to 8.14 and was neutral to moderately alkaline in reaction and EC ranged from 0.17 to 0.22 dS m^{-1} because with increasing the depth of profile, pH and EC of soil increased in all the profiles. Similar findings were given by Nagendra and Patil (2015). The SWA of organic carbon (OC) ranged from 4.44 to 6.24 g kg^{-1}. The surface soil horizons recorded higher organic carbon content than underlying layers due to the addition of plant residues to surface horizons. Similar findings were reported by Thejaswini *et al.* (2019). The SWA of exchangeable calcium and magnesium ranged from 9.09 to 12.46 and 5.16 to 8.30 cmol (p^+) kg^{-1} respectively. Mg was present in low amount than Ca because of its higher mobility. These results are in conformity with findings of Thangasamy *et al.* (2005). The cation exchange capacity (SWA) ranged from 19.50 to 24.72 cmol (p^+) kg^{-1}. Soil CEC increased as profile depth increased as it follows the trend of clay content in the profile. Similar findings were reported by Basavaraju *et al.* (2005). The ESP (SWA) ranged from 5.58 to 8.93 percent. In all the profiles, the soil ESP does not follow any definite trend with increasing profile depth. The study area had low levels of available N, ranging from 155.94 to 218.89 kg ha^{-1} (SWA) and high levels of available P_2O_5, ranging from 54.36 to 68.06 kg ha^{-1} (SWA). The available N and P_2O_5 content was decreasing with the depth in most of the profiles this could be attributed to low organic carbon status of soil in lower horizons and due to higher phosphorous fixation capacity.

Similar findings were reported by Dasog and Patil (2011). The available K_2O (SWA) ranged from 70.90 to 110.78 kg ha^{-1} and available S (SWA) ranged from 16.66 to 17.94 kg ha^{-1}. The available K_2O and S content was decreasing with the depth this could be attributed due to more intense weathering, release of labile potassium from organic residues and due to higher amounts of organic matter in surface layers. Similar findings were reported by Rajesh *et al.* (2018). The sufficient extractable manganese and copper content in soil was attributed due to granite/gneiss parent material. The DTPA extractable Zn was deficient due to precipitation of Zn as hydroxides as a result their solubility and mobility might have decreased and reduced the availability similar findings was obtained by Thangasamy *et al.* (2005). The surface horizons contained more available Fe than sub-surface horizons. It might be due to accumulation of organic carbon in the surface horizons. Similar result was observed by Chandra sekhar *et al.* (2014).

Table 1: Morphological features of the soils of Biofuel park, Tinthani.

Mapping unit	Geology	Colour		Soil depth (cm)		Slope (%)	Landform	Texture		Consistency	
		Surface	Subsurface	Surface	Sub surface			Surface	Sub surface	Surface	Sub surface
Block A	Granite	2.5YR 4/4 (D) & 2.5YR 3/4 (M)	2.5YR 4/6 (D) & 2.5YR 3/4 (M)	0-6	15-24	3-5	Upland	SCL	SCL	sh, fi, so, po	h, vfi, so, po
Block B	Granite	2.5YR 4/4 (D) & 2.5YR 3/4 (M)	2.5YR 3/4 (D) & 2.5YR 3/6 (M)	0-12	38-56	3-5	Upland	SCL	SCL	sh, fi, so, po	h, vfi, so, po
Block C	Granite	2.5YR 4/6 (D) & 2.5YR 3/6 (M)	2.5YR 3/4 (D) & 2.5YR 3/4 (M)	0-7	28-37	3-5	Upland	SCL	SCL	sh, fi, so, po	h, vfi, so, po
Block D	Granite	2.5YR 4/4 (D) & 2.5YR 3/4 (M)	2.5YR 4/4 (D) & 2.5YR 3/4 (M)	0-8	32-42	3-5	Upland	SCL	SCL	sh, fi, so, po	h, vfi, so, po
Block E	Granite	2.5YR 4/4 (D) & 2.5YR 3/4 (M)	2.5YR 4/4 (D) & 2.5YR 3/4 (M)	0-12	25-36	3-5	Upland	SCL	SCL	sh, fi, so, po	h, vfi, so, po

Note: sh – slightly hard, fi – firm, so – non sticky, po – non plastic, h – hard, vfi – very firm

Table 2: Physical properties of the profiles of Biofuel park, Tinthani.

Profile	Depth (cm)	Horizon	Coarse sand	Fine sand	Total sand	Silt	Clay	Textural class	Bulk density (Mg m^{-3})	Soil color	MWHC %
Block A	0-6	A_p	35.80	26.54	62.34	16.39	21.27	Sandy clay loam	1.33	2.5YR 4/4	40.10
	6-15	B_w	34.56	25.91	60.47	17.28	22.25	Sandy clay loam	1.37	2.5YR 4/4	40.70
	15-24	B_{w1}	32.96	24.40	57.36	19.54	23.10	Sandy clay loam	1.41	2.5YR 4/6	41.60
Solum weighted average	**0-24**	**A_p-B_{w1}**	**34.27**	**25.50**	**59.77**	**17.91**	**22.32**		**1.38**		**40.89**
Block B	0-12	A_p	36.05	26.84	62.89	15.46	21.65	Sandy clay loam	1.32	2.5YR 4/4	40.40
	12-24	B_w	34.96	24.52	59.48	17.35	23.17	Sandy clay loam	1.36	2.5YR 3/4	41.10
	24-38	B_{w1}	33.53	23.50	57.03	18.79	24.18	Sandy clay loam	1.42	2.5YR 3/4	41.70
	38-56	B_{w2}	32.86	22.83	55.69	19.05	25.26	Sandy clay loam	1.47	2.5YR 3/4	40.20
Solum weighted average	**0-56**	**A_p-B_{w2}**	**34.16**	**24.22**	**58.38**	**17.85**	**23.77**		**1.40**		**40.81**
Block C	0-7	A_p	35.73	26.06	61.79	16.88	21.33	Sandy clay loam	1.37	2.5YR 4/6	40.80
	7-13	B_w	34.08	25.97	60.05	17.33	22.62	Sandy clay loam	1.39	2.5YR 3/3	39.90
	13-28	B_{w1}	33.03	25.66	58.69	18.06	23.25	Sandy clay loam	1.45	2.5YR 3/4	42.60
	28-37	B_{w2}	32.43	24.78	57.21	19.12	23.67	Sandy clay loam	1.49	2.5YR 3/4	42.90
Solum weighted average	**0-37**	**A_p-B_{w2}**	**33.57**	**25.57**	**59.14**	**17.98**	**22.88**		**1.43**		**41.89**
Block D	0-8	A_p	35.67	26.86	62.53	15.32	22.15	Sandy clay loam	1.38	2.5YR 4/4	40.60
	8-17	B_w	34.26	25.03	59.29	17.03	23.68	Sandy clay loam	1.44	2.5YR 4/4	39.60
	17-32	B_{w1}	33.81	23.29	57.10	18.58	24.32	Sandy clay loam	1.46	2.5YR 4/4	41.50
	32-42	B_{w2}	32.73	22.70	55.43	19.58	24.99	Sandy clay loam	1.49	2.5YR 4/4	41.10
Solum weighted average	**0-41**	**A_p-B_{w2}**	**34.00**	**24.20**	**58.21**	**17.87**	**23.92**		**1.45**		**40.83**
Block E	0-12	A_p	35.09	26.94	62.03	16.23	21.74	Sandy clay loam	1.37	2.5YR 4/4	41.10
	12-25	B_w	34.02	26.36	60.38	17.43	22.19	Sandy clay loam	1.39	2.5YR 4/4	39.10
	25-36	B_{w1}	32.83	24.70	57.53	19.42	23.05	Sandy clay loam	1.44	2.5YR 4/4	42.30
Solum weighted average	**0-36**	**A_p-B_{w1}**	**34.01**	**26.05**	**60.06**	**17.64**	**22.30**		**1.40**		**40.74**

Table 3: Chemical properties of the profiles of Biofuel park, Tinthani.

Sr. No.	Profile	Depth (cm)	pH	EC (dS m^{-1})	OC (g kg^{-1})	Ca (cmol (p^+) kg^{-1})	Mg (cmol (p^+) kg^{-1})	CEC (cmol (p^+) kg^{-1})	ESP (%)
1.	Block A	0-6	7.20	0.11	6.80	8.50	4.50	18.94	9.71
		6-15	7.40	0.18	5.10	11.2	5.30	21.39	8.78
		15-24	7.50	0.24	3.90	11.9	5.60	23.65	8.49
Solum weighted average		**0-24**	**7.39**	**0.19**	**5.08**	**10.79**	**5.21**	**21.63**	**8.90**
2.	Block B	0-12	7.53	0.13	5.30	7.80	4.80	17.28	8.44
		12-24	7.62	0.16	5.10	8.60	5.30	18.74	9.01
		24-38	7.80	0.19	4.10	10.5	4.90	21.54	8.58
		38-56	7.80	0.21	3.70	12.3	5.50	22.02	9.49
Solum weighted average		**0-56**	**7.70**	**0.18**	**4.44**	**10.09**	**5.16**	**20.18**	**8.93**
3.	Block C	0-7	7.01	0.10	6.50	10.7	5.80	20.80	6.29
		7-13	7.17	0.17	5.90	8.40	8.50	21.46	6.94
		13-28	7.22	0.19	4.70	11.3	6.30	23.65	7.01
		28-37	7.29	0.21	3.80	11.6	6.80	23.99	7.62
Solum weighted average		**0-37**	**7.19**	**0.17**	**5.02**	**10.79**	**6.68**	**22.84**	**7.01**
4.	Block D	0-8	7.69	0.18	7.70	7.60	11.0	21.91	5.52
		8-17	7.80	0.19	6.80	10.9	8.50	23.89	5.81
		17-32	7.94	0.22	5.20	15.1	6.40	24.99	5.64
		32-42	7.99	0.26	4.10	13.8	8.80	27.32	5.34
Solum weighted average		**0-42**	**7.87**	**0.22**	**5.76**	**12.46**	**8.30**	**24.72**	**5.58**
5.	Block E	0-12	8.01	0.13	7.10	7.40	6.30	17.77	5.57
		12-25	8.18	0.19	6.40	9.20	5.80	19.34	5.32
		25-36	8.23	0.20	5.10	10.8	6.00	21.56	7.14
Solum weighted average		**0-36**	**8.14**	**0.17**	**6.24**	**9.09**	**6.03**	**19.50**	**5.96**

Table 4: Available nutrients in different profiles of Biofuel park, Tinthani.

Sr. nNo.	Profile	Depth (cm)	Available major nutrients				DTPA extractable micronutrients			
			N	P_2O_5	K_2O	S	Cu	Zn	Mn	Fe
			(kg ha^{-1})				(mg kg^{-1})			
1.	Block A	0-6	238.68	65.34	112.09	19.30	3.87	0.39	5.06	4.23
		6-15	179.01	59.34	111.61	16.60	3.19	0.25	5.15	3.12
		15-24	136.89	51.56	108.91	15.90	2.94	0.22	4.02	3.89
Solum weighted average		**0-24**	**178.13**	**57.92**	**110.78**	**17.01**	**3.27**	**0.27**	**4.70**	**3.69**
2.	Block B	0-12	186.03	75.32	107.16	18.80	4.14	0.49	4.92	4.02
		12-24	179.01	69.65	105.87	17.10	3.75	0.32	5.09	3.12
		24-38	143.91	58.02	105.62	16.70	3.95	0.41	4.75	3.78
		38-56	129.87	51.07	86.98	14.90	3.02	0.29	3.59	2.08
Solum weighted average		**0-56**	**155.94**	**61.99**	**100.01**	**16.66**	**3.65**	**0.37**	**4.49**	**3.14**
3.	Block C	0-7	228.15	63.38	89.98	19.10	3.51	0.48	5.81	4.67
		7-13	207.09	57.60	89.78	18.50	3.34	0.41	5.02	4.13
		13-28	164.97	51.49	84.96	16.80	1.94	0.37	4.83	2.68
		28-37	133.38	49.98	74.42	15.80	2.91	0.28	3.72	3.83
Solum weighted average		**0-37**	**176.07**	**54.36**	**84.12**	**17.27**	**2.70**	**0.38**	**4.78**	**3.57**
4.	Block D	0-8	270.27	70.45	75.62	19.80	4.03	0.33	5.58	3.98
		8-17	238.68	66.91	73.87	19.10	3.95	0.46	5.21	3.73
		17-32	182.52	60.37	71.46	17.80	3.89	0.31	3.69	2.68
		32-42	143.91	55.03	63.45	15.30	3.92	0.29	4.73	3.07
Solum weighted average		**0-42**	**202.08**	**62.42**	**70.90**	**17.86**	**3.94**	**0.34**	**4.62**	**3.25**
5.	Block E	0-12	249.21	75.92	76.36	19.60	3.49	0.33	4.92	4.79
		12-25	224.64	68.06	74.26	18.40	3.19	0.30	3.78	4.01
		25-36	179.01	59.48	64.86	15.60	3.02	0.28	3.74	2.89
Solum weighted average		**0-36**	**218.89**	**68.06**	**72.15**	**17.94**	**3.24**	**0.30**	**4.15**	**3.93**

CONCLUSIONS

Spatial interpretation of satellite imagery for generation of soil physiography units which will facilitate identifying profile locations in the study area. This had improved the accuracy of soil classification considering slope, parent material and colour of the soil as properties. The permanent GIS data base with soil information will be a base for strategic crop plan and to update and map the changes in the Biofuel park.

FUTURE SCOPE

To assess the impact of different systems like Agri-Silvi-Pasture or Agri-Silviculture for the development of geo- morphological processes in Biofuel park area.

Acknowledgement. I would like to express my heartfelt gratitude to my mentor, [Dr. K Narayana Rao], for their invaluable guidance, expertise, and support throughout the research. Their extensive knowledge, insightful feedback, and unwavering encouragement have been instrumental in shaping the direction and quality of this study. I would also like to express my sincere gratitude to UAS, Raichur for their unwavering support and provision of resources throughout the research.

Conflict of Interest. None.

REFERENCES

Basavaraju, D., Naidu, M. V. S., Ramavatharam, N., Venkaiah, K., Rama Rao, G. and Reddy, K. S. (2005). Characterization, classification and evaluation of soils in Chandragiri mandal of Chittoor district Andhra Pradesh. *Agropedology*, *15*, 55–62.

Chandra Sekhar, C. H., Balaguravaiah, D. and Naidu, M. V. S. (2014). Studies on genesis, characterization and classification of soils in central and eastern parts of Prakasam district in Andhra Pradesh. *Agropedology*, *24*(02), 125-137.

Chikkaramappa, T., Kadalli, G. G., Prakash, S. S., Dhumgond, P., Shruti, Y., Chaithra, M. C. and Patel, G. M. (2020). Land suitability classification for agricultural crops in bidanagere micro-watershed, Tumkur district, Karnataka using geospatial techniques. *J. Indian Soc. Soil Sci., 68*(2), 128-137.

Dasog, G. S. and Patil, P. L. (2011). Genesis and classification of black, red and lateritic soils of North Karnataka. Soil science research in North Karnataka, Dharwad Chapter of ISSS (Ed.), *76th Annual Convention of ISSS*, 1-10.

Hegde, R., Natarajan, A., Meena, R. S., Niranjana, K. V., Thayalan, S. and Singh, S. K. (2015). Status of soil degradation in an irrigated command area in Chikkarasinakere Hobli, Mandya district, Karnataka. *Curr. Sci.*, *108*(8), 1501-1511.

Nagendra, B. R. and Patil, P. L. (2015). Characterization and classification of soil resources of Shirol West-1 micro-watershed. *Karnataka J. Agric. Sci*., *28*(4), 504-509.

Pramod, T. and Patil, P. L. (2015). Characterization and classification of soil resources of Balapur micro-watershed. *Karnataka J. Agric. Sci*., *28*(4), 510-517.

Pulakeshi, H. B. P., Patil, P. L. and Dasog, G. S. (2014). Characterization and classification of soil resources derived from chlorite schist in northern transition zone of Karnataka. *Karnataka J. Agric. Sci*., *2*(1), 14-21.

Rajesh, N. L., Satishkumar, U., Shankergouda, I., Bhat, S. N., Basavaraj, K., Rudramurthy, H. V., Rao, K. N., Rajesh, V. and Bai, R. M. (2018). Detailed LRI for assessment of land capability and land suitability of Amarapura-2 micro-watershed using RS and GIS. *Int. J. Curr. Microbiol. Appl. Sci.*, *7*(10), 2370-2381.

Thangasamy, A., Naidu, M. V. S., Ramavatharam, N. and Raghava Reddy, C. (2005). Characterization, classification and evaluation of soil resources in Sivagiri micro-watershed of Chittoor district in Andhra Pradesh for sustainable land use planning. *J. Indian Soc. Soil Sci*., *53*, 11–21.

Thejaswini, C., Ashok, S. A., Shivanna, M., Anil, K. S., Prashanth, S. J., Dhannanjaya, B. N. and Praveen, K. B. N. (2019). Land resource inventory and soil mapping for fertility status of Humnabad sub-watershed. *Int. J. Curr. Microbiol. Appl. Sci.*, *8*, 02.

How to cite this article: Sowjanya T., Narayana Rao K., Rajesh N. L., Sharan Bhoopal Reddy and Shyam Rao Kulkarni (2023). Soil Characterization and Classification of Biofuel Park, Tinthani, Yadgiri District, Karnataka by using Geospatial Techniques. *Biological Forum – An International Journal, 15*(11): 586-590.