Karnataka J. Agric. Sci.,22(1) : (77-80) 2009

Identification of soil fertility constraints of a pilot site in coastal agro eco system of Karnataka by geographic information systems technique*

DHANYA V. MATHEWS, P. L. PATIL AND G. S. DASOG

Department of Soil Science and Agricultural Chemistry
University of Agricultural Sciences, Dharwad - 580 005, Karnataka, India
E-mail : plpatiluasd@yahoo.com

(Received : March, 2008)

Abstract: A study was undertaken to map the nutrient status of Mirjan village under the coastal agro eco system of Karnataka. The soil analysis showed the deficiency of N, P, K and Zn in the study area. From the soil fertility maps it was observed that in the study area 247.39 ha low (69.5% of the study area), 86.50 ha medium and 22.14 ha high in available nitrogen. An area of 249.30 ha was low (70.0% of the study area), 88.40 ha was medium and 18.32 ha was high in available phosphorus. In the case of potassium, 159.15 ha was low (44.7% of the study area), 131.71 ha medium and 65.39 ha high in available potassium. Zinc deficiency was observed in 201.21 ha (56.5% of the study area).

Key words : Soil fertility constraints, coastal agro eco system, geographic information systems

Introduction

Karnataka has a coastline of 310 km on the Arabian Sea. Three major groups of soils namely laterites, red and alluvial soils are met with in this area. Many of the soils in this ecosystem are fragile and miss-management can rapidly erode whatever capability they have for sustained productivity. Therefore it is critical that we increase our understanding of the soil nutrient status and relationships in the soil-plant atmosphere continuum that control nutrient availability. An attempt has been made to study the nutrient status for identifying nutrient constraints in Mirjan village under coastal agro eco system of Karnataka.

Material and methods

Mirjan village (Fig. 1) has a geographical area of 653.92ha with cultivated area of 356.02ha including plantations and remaining is forest and prawn cultivation area. Soil samples (100 No.) from cultivated area at 0-30 cm and 30-60 cm depth were collected under different land uses at random during summer 2005. The exact sample location was recorded using a GPS. Processed soil samples were analysed for pH, EC, organic carbon and available nutrients (N, P and K) by following standard analytical techniques (Jackson, 1967). Available Zinc status of soils was estimated by following the method explained by Lindsay and Norwell (1978).

Results and discussion

The soils were acidic and non-saline (Table 1) due to the acidic parent material (granite or granite gneiss).High rainfall in this area induces leaching of soluble salts (Mini, 2003). The organic carbon content of the soil was in the range of 0.5 to 35.0 g/kg at the surface, while it ranged from 0.3 to 27.3 g/kg at lower depth (Table 1). In most of the samples organic carbon content was high at the surface than in the sub surface. The high organic carbon status in the soil can be attributed to good vegetative growth and consequent addition of organic matter to soil in this heavy rainfall area (Patil and Ananthanarayana, 1990 and Powar and Mehta, 1999).

Available nitrogen (kg/ha): Available nitrogen content in the paddy soils ranged from 211 to 518 kg/ha with a mean of 343 kg/ha and standard deviation of 78. In the subsurface soils it ranged between 160 and 465 kg/ha with a mean of 293 kg/ha and standard deviation of 73. In the soils under plantations, the available N content varied from 101 to 460 kg/ha with a mean of 306 kg/ha and standard deviation of 96. In the subsurface soils, the value ranged between 171 kg/ha to 400 kg/ha with a mean of 259 kg/ha and standard deviation of 64. Soils under cashew showed variation in available nitrogen content in the range of 115 to 479 kg/ha with a mean of 288 kg/ha and standard deviation of 84, whereas in the subsurface it ranged from 142 to 470 kg/ha with a mean of 252 kg/ha and standard deviation of 73 (Table 1). Higher Available nitrogen content in the paddy soils is due to application of fertilizers, where as plantations and cashew receive nutrients only in organic form.

Available nitrogen map (Fig. 2) of the village showed an area of 247.39 ha as low, 86.50 ha medium and 22.14 ha high in available N. Exceptionally high N-content in some sites is due to indiscriminate use of fertilizers. Available N-content decreased with depth as also observed by Powar and Patil, 1995. Even with high organic carbon status of the soils under study, low to medium nitrogen status of the soil may be due to the low mineralization of organic matter as the soils are acidic. It is a fact that the area receives very high rainfall (3500 mm) which results in loss of N due to leaching and denitrification in the soils. Therefore the soils could retain only a limited quantity of

*Part of M. Sc. thesis submitted by the senior author to the University of Agricultural Sciences, Dharwad-580 005, India

Table 1. pH, EC, organic carbon and available N content of soil samples of Mirjan village

Sl. No.	pH		EC (dS/m)		Organic carbon (g/kg)		Available N (kg/ha)	
	Surface	Sub-surface	Surface	Sub-surface	Surface	Sub-surface	Surface	Sub-surface
				Paddy				
Range	3.92-5.91	4.01-5.54	0.011-0.520	0.010-0.258	2.0-35.0	0.33-27.30	211-518	160-465
AVE	4.64	4.68	0.077	0.071	15.5	9.3	343	293
SD	0.44	0.38	0.089	0.061	8.1	5.8	78	73
				Plantations				
Range	4.18-5.80	4.25-5.75	0.02-0.17	0.017-0.161	0.5-25.0	0.4-17.0	101-460	171-400
AVE	4.93	5.06	0.061	0.054	10.3	6.1	306	259
SD	0.44	0.38	0.036	0.033	6.8	4.4	96	64
				Cashew				
Range	4.10-5.35	4.10-5.47	0.017-0.297	0.010-0.247	1.4-23.0	1.3-23.0	115-479	142-470
AVE	4.59	4.82	0.072	0.061	9.7	9.0	288	252
SD	0.34	0.41	0.058	0.047	7.1	5.3	84	73
				Total				
Range	3.92-5.91	4.01-5.75	0.011-0.520	0.010-0.258	0.5-35	0.3-27.3	101-518	142-470
AVE	4.70	4.82	0.071	0.063	12.2	8.3	315	270
SD	0.43	0.42	0.068	0.050	7.9	5.4	88	72

* AVE.- Average ** SD- Standard Deviation

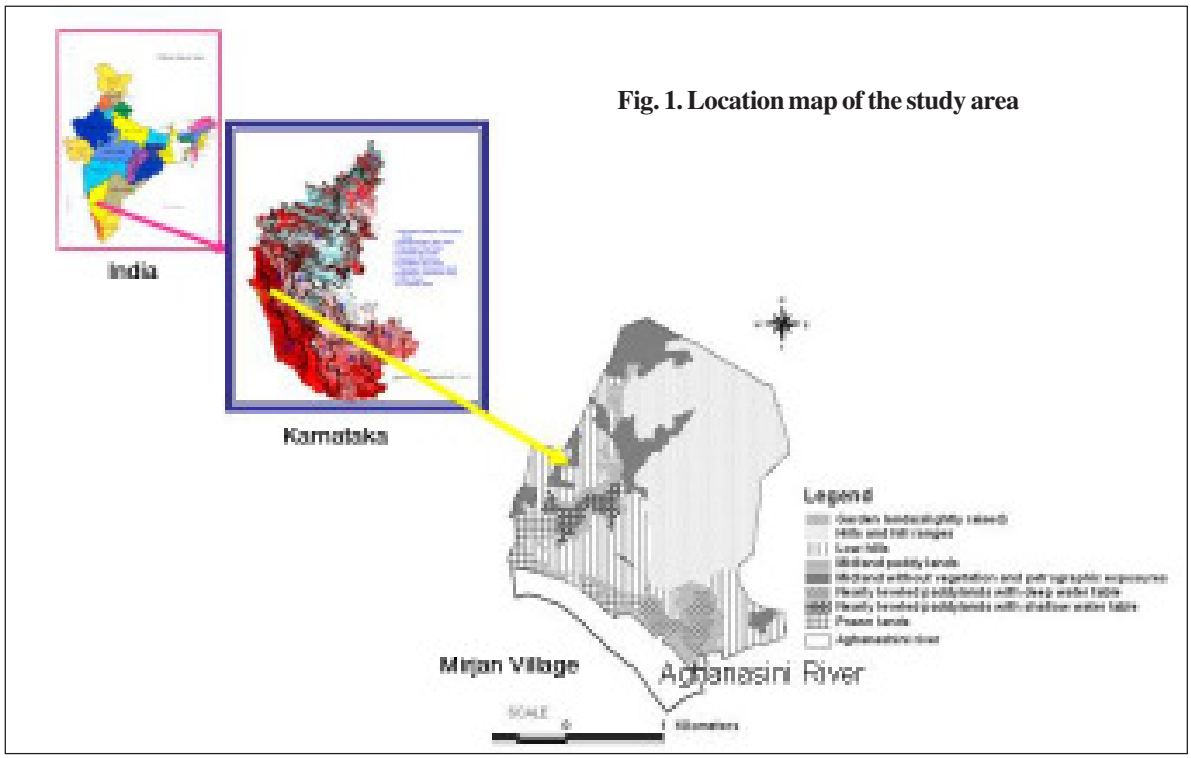

Fig. 1. Location map of the study area

mineralized N. The results are in confirmation with those of Usha and Jose (1983) in *laterite* soils of Kerala.

Available phosphorus (kg/ha): The available P in the surface soils ranged from 1.00 to 47.20 kg/ha and in the lower layers, it ranged from 1.00 to 17.80 kg/ha. In the lower layers P content was low compared to surface layers. Available P content of paddy soils ranged from 1.6 to 46.1 kg/ha with a mean of 6.7 kg/ha and standard deviation of 7.6. In the lower layers, P content was in the range of 1.1 to 17.2 kg/ha with a mean of 4.9 kg/ha and standard deviation of 4.1. In the soils under plantation available P content was in the range of 1.0 to 16.9 kg/ha with a mean of 5.9 kg/ha and standard deviation of 4.2. In the subsurface, the available P ranged between 1.0 and 17.4 kg/ha with a mean of 5.6 kg/ha and standard deviation of 4.6. Soils under cashew showed variation in available P from 1.6 to 17.8 kg/ha with a mean of 6.8 kg/ha and standard deviation of 4.3. In the subsurface the P content ranged from 1.6 to 17.8 kg/ha with a mean of 5.8 kg/ha and standard deviation of 4.0 (Table 2).

An area of 249.30 ha was low, 88.40 ha medium and 18.32 ha high in available P (Fig. 3). Since the soils are rich in

Table 2. Available P, K and Zn content of soil samples of Mirjan village

Sl. No.	Available P (kg/ha)		Available K (kg/ ha)		Available zinc (mg/kg)	
	Surface	Sub-surface	Surface	Sub-surface	Surface	Sub-surface
			Paddy			
Range	1.6 - 46.1	1.1 - 17.2	50.0 - 385.0	46.0 - 340.0	0.245 -1.081	0.119-0.888
AVE	6.7	4.9	129.6	117.6	0.535	0.282
SD	7.6	4.1	71.0	54.6	0.249	0.082
			Plantations			
Range	1.0 - 16.9	1.0 - 17.4	67.0 - 340.0	67.0 - 277.0	0.163-1.013	0.121-0.993
AVE	5.9	5.6	121.9	116.4	0.504	0.360
SD	4.2	4.6	67.5	52.3	0.192	0.183
			Cashew			
Range	1.6-17.8	1.6-17.8	63.0-289.0	47.0-192.0	0.276-0.711	0.141-0.385
AVE	6.8	5.8	123.5	97.4	0.458	0.282
SD	4.3	4.0	60.8	29.3	0.138	0.082
			Total			
Range	1.0-47.2	1.0-17.8	47.0-385	46.0-340.0	0.163-1.081	0.119-0.993
AVE	6.8	5.4	120.7	115.7	0.502	0.331
SD	7.0	4.2	59.7	56.7	0.204	0.168

AVE.- Average SD- Standard Deviation

hydrated as well as amorphous oxides of Fe and Al, the potent source of 'P' immobilization, P content is very low in these soils (Mini, 2003 and Badrinath *et al*., 1986). Available P content was medium at some sites in the study area where pH was neutral. The near neutral pH have a significant role in enhancing the P availability. Available P increases with pH and decreases with organic carbon. The increase in available phosphorus due to increase in pH may be due to lowering of activities of Fe^{3+} and Al^{3+} which increases the solubility of strengite and variscite and increases electro-negativity of colloidal complex with a consequent decrease in sorption of P.At some locations P was exceptionally high, which may be due to different nutrient management practices among the farmers.

Available potassium (kg/ha): Data pertaining to available potassium is presented in table 2. The potassium content of the surface soils ranged from 47 to 385 kg/ha and in subsurface samples it ranged from 46 to 340 kg/ha. Surface soils under paddy showed variation from 50.0 to 385.0 kg/ha and in lower layers it ranged from 46.0 to 340.0 kg/ha. Available K content in the surface soils under plantation ranged from 67.0 to 340.0 kg/ha and in the subsurface soils, it ranged from 67.0 to 277.0 kg/ha. Under cashew, available K content in the surface soils ranged from 63.0 to 289 kg/ha with a mean of 123.5 kg/ha and a standard deviation of 60.8. In the subsurface soils it ranged from 47 to 192 kg/ha with a mean of 97.4 kg/ha and standard deviation of 29.3.

An area of 159.55 ha was low 131.71 ha medium and 65.39 ha was high in available potassium (Fig.4). Ranganathan and Satyanarayana (1980) observed low content of K in coastal soils due to low pH. Available K-content was more at the surface than at lower depth. The action of plants in transporting the 'K' to the surface probably is responsible for this. In highly weathered soils, strong weathering had reduced the K-content of the entire profile to a low level. (Sekhon and Bansal, 1982).

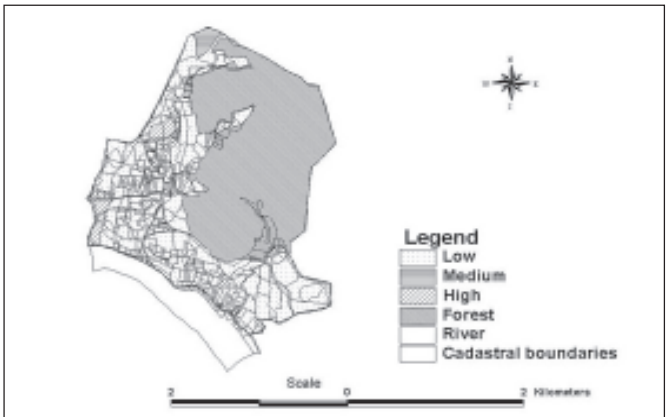

Fig.2. Available nitrogen status of Mirjan village

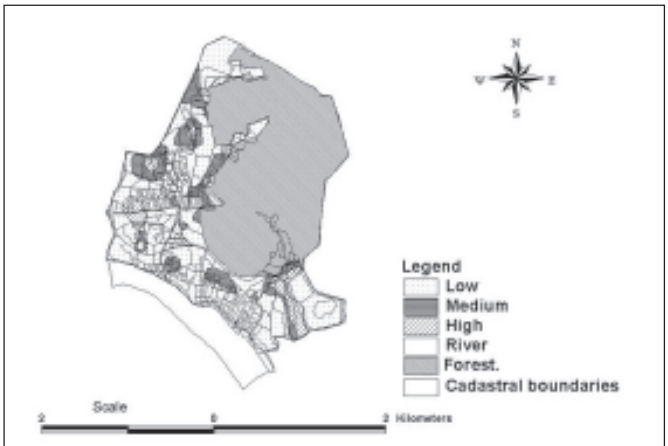

Fig.3. Available phosphorus status of Mirjan village

Available zinc (mg/kg): The available zinc content of the surface soils ranged from 0.163 mg/g to 1.081 mg/kg and in the subsurface soils it ranged between 0.119 mg/kg to 0.993 mg/kg, with a mean of 0.331 mg/kg and standard deviation of 0.168. The

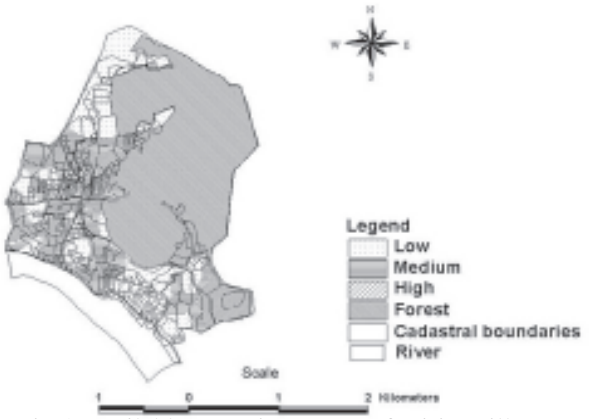

Fig.4. Available potassium status of Mirjan village

surface soils under paddy showed variation in available zinc from 0.245 mg/kg to 1.081 mg/kg and in the lower layers it ranged from 0.119 to 0.888 mg/g. In the surface soils under plantations, the available Zn varied from 0.163 mg/g to 1.013 mg/kg and in the subsurface soils it ranged from 0.121 mg/kg to 0.993 mg/kg. Available zinc in the surface soils under cashew, ranged between 0.276 mg/kg to 0.711 mg/kg and in the subsurface it ranged between 0.141 mg/kg to 0.385 mg/kg with a mean of 0.282 mg/kg and standard deviation of 0.082 (Table 2).

In the study area, 201.21 ha was deficient and 154.91 ha sufficient in available zinc (Fig. 5). The very high rainfall (3500 mm) in the study area of coastal agro ecosystem resulted in heavy leaching of nutrients which also resulted in zinc deficiency. Similar results were also observed by Eswarappa *et al.* (1969) in red and lateritic soils.

Conclusion: Based on the soil analysis and nutrient maps it was observed that N, P, K and Zn were deficient in Mirjan village located in the coastal agro ecosystem of Karnataka. From the soil fertility maps it was observed that in the study area N, P, K and Zn were observed deficient in 69.5% 70.0%, 44.7% and 56.5% of the study area (Table 3). The study emphasizes on soil test based site specific nutrient recommendations.

Table 3. Area indicating available nutrient status of Mirjan village

Nutrient	Fertility status	Area (ha)	Percentage of total area
Nitrogen	Low	247.39	69.5
	Medium	86.50	24.3
	High	22.14	6.2
Phosphorus	Low	249.30	70.0
	Medium	88.40	24.8
	High	18.32	5.2
Potassium	Low	159.15	44.7
	Medium	131.71	36.9
	High	65.39	18.4
Zinc	Deficient	201.21	56.5
	Sufficient	154.91	43.5
	Excess	-	-

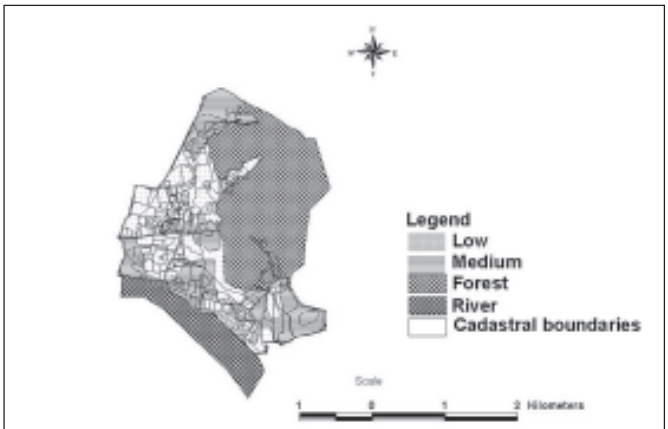

Fig.5. Available zinc status of Mirjan village

References

Badrinath., Krishnappa,A.N., Patil,B. N. ,Kenchaiah, K. and Balakrishnarao, K., 1986, Fertility status of some typical soils of coastal Karnataka. J. Indian Soc. Soil Sci., 34: 436-438.

Eswarappa, H., Naik, M.S. and Das, N.B., 1969, Study of microbiological and chemical methods for the status of available P and Zn in tropical soils. Indian J. Agric. Sci., 39: 716-769.

Jackson, M. L., 1967, Soil Chemical Analysis. Prentice Hall of India Private Limited, New Delhi.

Lindsay, W.L. and Norwell, W.A.,1978, Development of DTPA soil test for Zn, Fe, Mn and Cu. American J. Soil Sci., 42: 421-428.

Mini, V., 2003,Characterization and monitoring of soil and water resources in Mirjan village of coastal agroecosystems of Karnatkaa. *M.Sc.(Agri.) Thesis*, Univ. Agric. Sci., Dharwad (India).

Patil, P. L. and Ananthanarayana, R., 1990, Determination of lime requirement of some acid soils of Uttara Kannada district, Karnataka. Karnataka J. Agric. Sci., 3 : 161-170.

Powar, S. L. and Mehta, V. B., 1999,Characterization of soils of the Konkan coast. J. Indian Soc. Soil Sci., 47: 334-337.

Powar, S. L. and Patil, V. S., 1995, Characterization of the coastal coconut growing soils of the Konkan in relation to soil fertility. J. Indian Soc. Coastal Agric. Res., 13: 11-17.

Ranganathan, A. and Satyanarayana, T., 1980, Studies on potassium status of soils of Karnataka. J. Indian Soc. Soil Sci., 28: 148-153.

Tomar, N.K. and Chand, T., 1992, Effect of soil properties on the transformation of phosphours in acid soils. J. Indian Soc. Soil Sci., 40 : 257-261.

Usha, P. B. and Jose, A. I.., 1983,Carbon-Nitrogen relationship in laterite soils of Kerala. Agric. Res. J. Kerala, 21: 15-22.