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Land capability classification of Mahanandi mandal, Kurnool district, Andhra Pradesh

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Abstract
A reconnaissance soil survey was undertaken in Mahanandi mandal of Kurnool district, Andhra Pradesh to evaluate the land capability classification. The soil belongs to the order Inceptisols and Entisol. About ten pedons were taken from the Mahanandi mandal. Horizon-wise samples were collected from profiles and their morphological properties, soil texture and organic carbon were analyzed. Considering limitations and potentials of the soils, land capability classification was evaluated up to sub-class level and based on that a suitable land use plan has also been suggested. Pedons 1, 4, 9 and 10 were placed under capability sub-class IIs, which were good cultivable. Pedon 2 was placed under capability sub-class IIes. Pedons 7 and 8 were placed under capability sub-class IIe. Pedons 3 and 5 were placed under capability sub-class IIIe whereas Pedon 6 was placed under the capability sub-class IIIs. By using *Arc* GIS software these land capability sub-classes are mapped. The soils of the Mahanandi mandal revealed that soils were good to moderately cultivable lands.

Keywords: Land suitability, *ARC* GIS, organic carbon, pedons, land capability map

Introduction
The capability classification is one of a number of interpretive groupings made primarily for agricultural purposes. As with all interpretive groupings the capability classification begins with the individual soil-mapping units, which are building stones of the system. In this classification the arable soils are grouped according to their potentialities and limitations for sustained production of the common cultivated crops that do not require specialized site conditioning or site treatment. Nonarable soils are grouped according to their potentialities and limitations for the production of permanent vegetation and according to their risks of soil damage if mismanaged. The individual mapping units on soil maps show the location and extent of the different kinds of soil. One can make the greatest number of precise statements and predictions about the use and management of the individual mapping units shown on the soil map. The capability classification provides three major categories of soil groupings: (1) Capability unit, (2) capability subclass, and (3) capability class. The first category, capability unit, is a grouping of soils that have about the same responses to systems of management of common cultivated crops and pasture plants. The second category, the subclass, is a grouping of capability units having similar kinds of limitations and hazards *viz.*, Erosion hazard, wetness, rooting zone limitations, and climate. The third and broadest category in the capability classification places all the soils in eight capability classes I to VIII. Soils in the first four classes under good management are capable of producing adapted plants, such as forest trees or range plants, and the common cultivated field crops and pasture plants. Soils in classes V, VI, and VII are suited to the use of adapted native plants. The grouping of soils into capability units, subclasses, and classes is done primarily on the basis of their capability to produce common cultivated crops and pasture plants without deterioration over a long period of time.

Material and Methods
A reconnaissance soil survey was conducted in Mahanandi mandal located in semiarid agro-ecological region using top sheet with 1:50,00 scale as per procedure outlined by AIS & LUS (1970) [2]. The location of the study area was given in Fig.1. About ten pedons were taken from the Mahanandi mandal. The detailed morphological descriptions of these ten pedons were studied in the field as per the procedure outlined in Soil Survey Manual (Soil Survey Division Staff, 2000). Horizon-wise samples were collected from profiles and soil texture and organic carbon were analyzed using standard procedures. Considering limitations and potentials of the soils, land capability classification was evaluated up to sub-class level (Klingebiel and Montgomery, 1966) [3] and based on that a suitable land use plan has also been suggested.

By using *Arc* GIS software these land capability sub-classes are mapped.

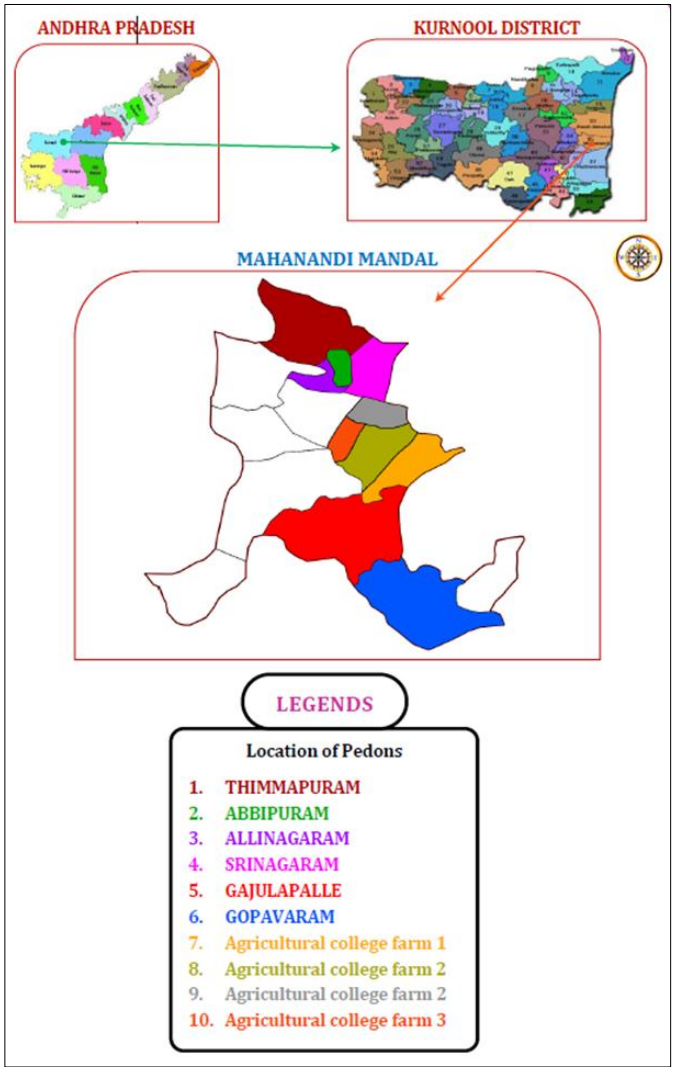

Fig 1: Location map of Mahanandi mandal

Results and Discussion

In all the pedons horizon wise soil samples were taken and estimated for organic carbon and soil texture where, the organic carbon was found to be less than 1 percent and the surface texture of the pedons is considered for evaluating land capability. The details of the particle size analysis and organic carbon were given in the Table 1. Land capability sub-classes were assigned for the soils based on the kind and severity of limitations *viz.*, erosion risk (e), wetness (w), rooting zone (soils) limitations (s) and climatic limitations (c). Based on these criteria the soils of Mahanandi mandal have been classified into different capability sub-classes such as:

IIs: Good cultivable lands (Pedons 1, 4, 9 and 10)
IIe: Good cultivable lands (Pedons 7 and 8)
IIes: Good cultivable lands (Pedon 2)
IIIes: Moderately cultivable lands (Pedons 3, 5)
IIIs: Moderately good cultivable lands (Pedon 6)

The details of land capability classes and sub-classes assigned to the soils of Mahanandi mandal are given in the Table 2.

Pedons 1, 4, 9 and 10 were placed under capability sub-class IIs which were good cultivable lands for sustainable agriculture with slight limitations of coarse texture and low organic carbon. The management practices suggested for these pedons were double cropping including legumes in rotation with the addition of manures and fertilizers and need moderate soil and water management practices. Groundnut, rice, red gram and sugarcane crops can be grown in these soils. Further, similar land capability classification was suggested to the soils developed from basaltic terrain (Sharma *et al.*, 1996) [5]. The interpretation of soils were given in the Table 3.

Pedon 2 was placed under capability sub-class IIes which was a good cultivable land for sustainable agriculture with slight limitations of slight erosion, poor drainage and low organic carbon. The management practices suggested for this pedon were double cropping including legumes in rotation with the addition of fertilizers and manures. Crops like groundnut and rice could be grown.

Pedons 7 and 8 were placed under capability sub-class IIe which were good cultivable lands for sustainable agriculture with slight limitations of slight erosion, moderately well drained and low organic carbon. The management practices suggested for these pedons were double cropping includes legumes in rotation with the addition of fertilizers, FYM and manures. Crops like sugarcane and red gram can be grown.

Pedons 3 and 5 were placed under capability sub-class IIIes which were moderately good cultivable lands for sustainable agriculture with slight limitations of slight erosion, moderately shallow depth, sandy texture in surface, low water holding capacity, low organic carbon and poor nutrient holding capacity. The management practices suggested for these pedons were growing of leguminous crops in rotation. Horticultural crops like sapota, guava, custard apple, pomegranate, vegetables, sugarcane and oil seeds can be grown with proper management practices. Sireesha and Naidu (2013) [6] reported that soils of Banaganapalle mandal in Kurnool district of Andhra Pradesh were placed under land capability sub-class IIIes.

Pedon 6 was placed under the capability sub-class IIIs, which was a moderately cultivable land for sustainable agriculture with slight limitations of coarse texture in surface, low organic carbon and poor nutrient status. The management practices suggested for this pedon were growing of leguminous crop in rotation. Horticultural crops like mango, sapota, guava and custard apple, vegetables, sugarcane and oil seeds can be grown with proper management practices. Nasre *et al.*, (2013) [4] reported that soils of Karanji watershed in Yavatmal district of Maharashtra were placed under land capability sub-class IIIs.

Table 1: Particle size analysis of soils

Pedon No. & Horizon	Depth (m)	Sand	Silt	Clay	Textural class	% OC
		(%)				
Pedon 1						
Ap	0.00 – 0.25	66.00	8.00	26.00	scl	0.70
2Bw1	0.25 – 0.52	41.43	30.00	28.57	cl	0.45
2Bw2	0.52 – 0.67	39.47	26.32	34.21	cl	0.60
2Bw3	0.67 – 1.00	31.08	36.49	32.43	cl	0.56
Cr	1.00					
Pedon 2						
Ap	0.00 – 0.22	74.58	10.17	15.25	sl	0.72
2Bw1	0.22 – 0.42	38.67	28.00	33.33	cl	0.56
2Bw2	0.42 – 0.80	33.77	31.17	35.06	cl	0.60
2Bw3	0.80 – 1.10	37.18	26.92	35.90	cl	0.53
Cr	1.10					
Pedon 3						
Ap	0.00 – 0.20	83.33	9.26	7.41	ls	0.71
A1	0.20 – 0.44	81.13	13.21	5.66	ls	0.47
A2	0.44 – 0.69	77.19	10.53	12.28	sl	0.36
R	0.69					
Pedon 4						
Ap	0.00 – 0.17	34.33	40.30	25.37	l	0.62
2Bw1	0.17 – 0.50	38.57	32.86	28.57	cl	0.45
2Bw2	0.50 – 0.79	33.33	36.11	30.56	cl	0.51
2Bw3	7.90 – 1.04	34.67	32.00	33.33	cl	0.45
2Bw4	1.04 – 1.25	29.11	34.18	36.71	cl	0.23
R	1.25					
Pedon 5						
Ap	0.00 – 0.24	14.06	64.06	21.88	sil	0.23
A1	0.24 – 0.58	70.73	13.87	15.40	sl	0.15
A2	0.58 – 1.02	10.14	62.32	27.54	sicl	0.05
A3	1.02 – 1.32	94.23	1.92	3.85	s	0.05
A4	1.32 – 1.55	6.76	60.81	32.43	sicl	0.03
R	1.55					
Pedon 6						
Ap	0.00 – 0.16	73.81	14.06	12.13	sl	0.71
2Bw1	0.16 – 0.41	41.79	32.84	25.37	l	0.20
3Bw2	0.41 – 0.74	75.00	14.29	10.71	sl	0.03
4Bw3	0.74 – 1.14	20.00	51.43	28.57	sicl	0.02
5Bw4	1.14 – 1.62	37.29	31.77	30.94	cl	0.30
6Bw5	1.62 – 2.00	45.31	32.81	21.88	l	0.03
Cr	2.00					
Pedon 7						
Ap	0.00 – 0.22	74.14	12.07	13.79	sl	0.45
Bw1	0.22 – 0.62	18.67	48.00	33.33	sicl	0.27
Bw2	0.62 – 0.98	42.25	28.17	29.58	cl	0.26
Bw3	0.98 – 1.28	41.90	27.93	30.17	cl	0.18
Bw4	1.28 – 1.70	27.56	38.06	34.38	cl	0.12
Bw5	1.70 – 2.00	39.03	28.26	32.71	cl	0.03
Cr	2.00					
Pedon 8						
Ap	0.00 – 0.16	64.18	10.45	25.37	scl	0.75
2A1	0.16 – 0.45	60.87	11.59	27.54	scl	0.45
3Bw1	0.45 – 0.86	40.21	24.64	35.15	cl	0.66
3Bw2	0.86 – 1.29	39.22	30.81	29.97	cl	0.54
3Bw3	1.29 – 1.59	27.67	38.21	34.12	cl	0.30
3Bw4	1.59 – 2.00	36.11	33.33	30.56	cl	0.08
Cr	2.00					
Pedon 9						
Ap	0.00 – 0.20	70.00	13.33	16.67	sl	0.65
Bw1	0.20 – 0.50	67.65	5.88	26.47	scl	0.45
Bw2	0.50 – 0.79	62.23	10.13	27.64	scl	0.38
Bw3	0.79 – 1.09	62.50	11.90	25.60	scl	0.45
Bw4	1.09 – 1.33	65.15	10.61	24.24	scl	0.38
Bw5	1.33 – 1.60	64.06	14.06	21.88	scl	0.08
Cr	1.60					
Pedon 10						
Ap	0.00 – 0.20	73.68	14.04	12.28	sl	0.75
A1	0.20 – 0.50	60.78	11.58	27.64	scl	0.57
Bw1	0.50 – 0.80	35.90	30.59	33.51	cl	0.42
Bw2	0.80 – 1.12	34.35	31.70	33.95	cl	0.30
Bw3	1.12 – 1.41	33.66	36.47	29.87	cl	0.38
Bw4	1.41 – 2.00	31.90	37.45	30.65	cl	0.33
Cr	2.00					

Table 2: Land capability classification of soils of Mahanandi mandal

Pedon No.	Tentative soil series	Soil characteristics										Land capability class with limitations
		Surface texture	Solum depth (m)	Drainage	Slope (%)	Erosion	Organic carbon (%)	Gravelliness	Stoniness	Salinity	Alkalinity	
1.	Thimmapuram	scl	1.00	Moderately well drained	0 – 1	Nil	< 1	–	–	–	–	II
2.	Abbipuram	cl	1.10	Poorly drained	1 – 3	Slight	< 1	–	–	–	–	IIes
3.	Allinagaram	ls	0.69	Well drained	1 – 3	Slight	< 1	–	–	–	–	IIes
4.	Srinagaram	l	1.25	Well drained	0 – 1	Nil	< 1	–	–	–	–	IIs
5.	Gajulapalle	sil	1.55	well drained	1 – 3	Slight	< 1	–	–	–	–	IIIes
6.	Gopavaram	sl	2.00	well drained	0 – 1	Nil	< 1	–	–	–	–	IIIs
7.	Agricultural college farm 1	sl	2.00	Well drained	1 – 3	Slight	< 1	–	–	–	–	IIe
8.	Agricultural college farm 2	scl	2.00	Moderately well drained	1 – 3	Slight	< 1	–	–	–	–	IIe
9.	Agricultural college farm 3	sl	1.60	Well drained	0 – 1	Nil	< 1	–	–	–	–	IIs
10.	Agricultural college farm 4	sl	2.00	Well drained	0 – 1	Nil	< 1	–	–	–	–	IIs

Table 3: Interpretation of soils of Mahanandi Mandal

Pedon No.	Tentative soil series	Land capability class with limitations	Description	Major limitations	Suggested land use
1.	Thimmapuram	IIs	Good cultivable land for sustainable agriculture	Did not have any major limitations except the soils are slightly alkaline in nature.	Double cropping including legumes in rotation with the addition of fertilizers and manures. Groundnut, rice and pulses could be grown.
2.	Abbipuram	IIes	Good cultivable land for sustainable agriculture	Slight erosion, gentle slope, poor drainage, low organic carbon and low hydraulic conductivity.	Double cropping including legumes in rotation with the addition of fertilizers and manures. Groundnut and rice could be grown.
3.	Allinagaram	IIIes	Moderately good cultivable land for sustainable agriculture	Slight erosion, moderately shallow depth, sandy texture in surface, low water holding capacity, low organic carbon and poor nutrient holding capacity.	Growing of leguminous crops in rotation, horticultural crops like sapota, guava, custard apple, pomegranate, vegetables and oil seeds can be grown with proper management practices.
4.	Srinagaram	IIs	Good cultivable land for sustainable agriculture	Coarse texture in surface, excessively drained, low organic carbon and poor nutrient holding capacity.	Double cropping including legumes in rotation with special soil and water management practices. Rice and sugarcane could be grown.
5.	Gajulapalle	IIIes	Moderately good cultivable land for sustainable agriculture	Gentle slope, slight erosion, moderate run-off, low organic carbon and poor nutrient status.	Growing of leguminous crop in rotation, horticultural crops like mango, sapota, guava, custard apple, vegetables, sugarcane and oil seeds can be grown with proper management practices.

Table 3: Contd…

Pedon No.	Tentative soil series	Land capability class with limitations	Description	Major limitations	Suggested land use
6.	Gopavaram	IIIs	Moderately good cultivable land for sustainable agriculture	Coarse texture in surface, low organic carbon and poor nutrient status.	Growing of leguminous crops in rotation, horticultural crops like mango, sapota, guava, custard apple, vegetables, sugarcane and oil seeds can be grown with proper management practices.
7.	Agricultural college farm1	IIe	Good cultivable land for sustainable agriculture	Slight erosion, moderate permeability, slight runoff and low organic carbon.	Double cropping including legumes in rotation with the addition of fertilizers and manures. Sugarcane and redgram can be grown.
8.	Agricultural college farm 2	IIe	Good cultivable land for sustainable agriculture	Slight erosion, slight runoff, moderately well drained and low organic carbon.	Double cropping including legumes in rotation with the addition of fertilizers, FYM and manures. Crops like Sugarcane and red gram can be grown.
9.	Agricultural college farm 3	IIs	Good cultivable land for sustainable agriculture	Coarse texture in surface and low organic carbon.	Double cropping including legumes in rotation with the addition of fertilizers and manures. Crops like rice, red gram and sugarcane could be grown.
10.	Agricultural college farm 4	IIs	Good cultivable land for sustainable agriculture	Coarse texture in surface and low organic carbon.	Double cropping including legumes in rotation with special soil and water management practices. rice and sugarcane could be grown.

Land capability map

The pedons 7, 8, 9 and 10 arranged in Agricultural college farm were classified into two land capability sub-classes *viz.*, IIs and IIe. Pedons 7 and 8 were classified under IIe land capability sub-class whereas pedons 9 and 10 were classified under IIs land capability sub-class. By using *Arc*GIS software these land capability sub-classes are mapped (Fig.2). Similarly Abdelrahman (2016) [1] prepared land capability maps by using GIS for Chamarajanagar district in Karnataka.

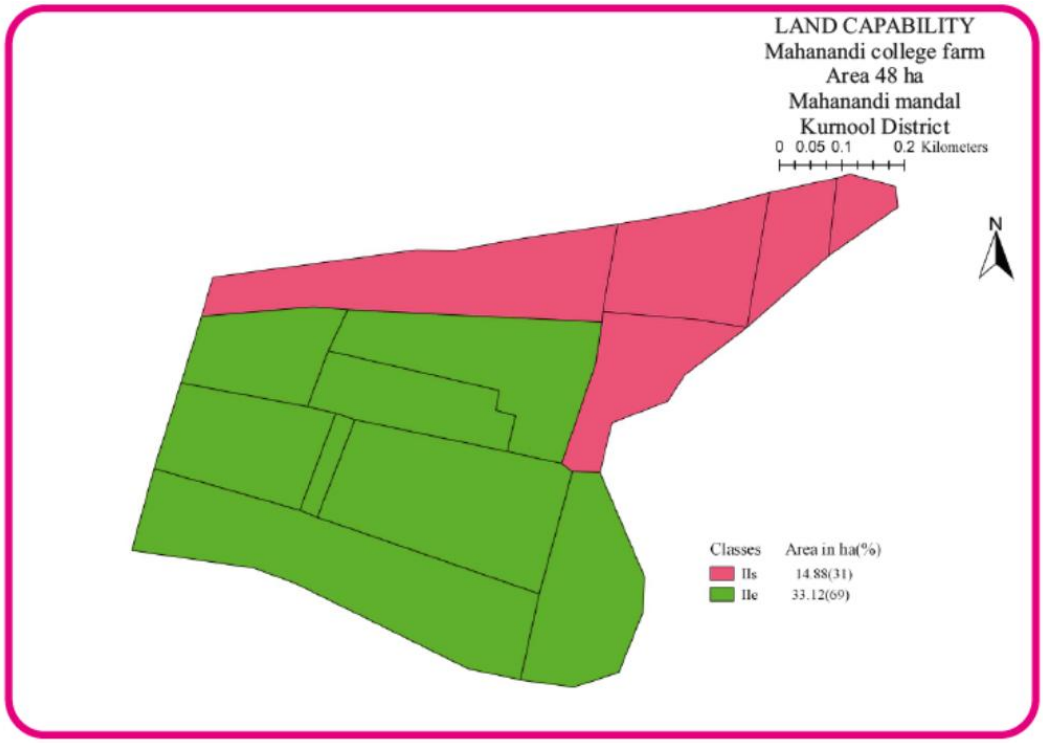

Fig 2: Land capability Map of Mahanandi college farm

Conclusion

Pedons 1, 4, 9 and 10 were placed under capability sub-class IIs, which were good cultivable lands for sustainable agriculture with slight limitations of coarse texture and low organic carbon. Pedon 2 was placed under capability sub-class IIes which was a good cultivable land for sustainable agriculture with slight limitations of slight erosion, poor drainage and low organic carbon. Pedons 7 and 8 were placed under capability sub-class IIe which were good cultivable lands for sustainable agriculture with slight limitations of slight erosion, moderately well drained and low organic carbon.

Pedons 3 and 5 were placed under capability sub-class IIIes, which were moderately good cultivable lands for sustainable agriculture with slight limitations of slight erosion, moderately shallow depth, sandy texture in surface, low water holding capacity, low organic carbon and poor nutrient holding capacity. Pedon 6 was placed under the capability sub-class IIIs, which was a moderately cultivable land for sustainable agriculture with slight limitations of coarse texture in surface, low organic carbon and poor nutrient status. In conclusion, the analysis of soils of the Mahanandi mandal revealed that soils were good to moderately good cultivable lands.

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