



Categorization and delineation of prime and marginal lands of Andhra Pradesh for different uses

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Abstract: The present study delineated prime, moderate prime and marginal lands of Andhra Pradesh based on important soil and climatic parameters *viz.*, soil depth, presence of gravel, slope and length of growing period. The extent of total prime lands in Andhra Pradesh is 51.52 lakh ha (31.9 %) in which Guntur, Nellore and Krishna districts have more area under prime lands, 7.31, 6.82 and 6.67 lakh ha, respectively. The extent of marginal lands in the state is 43.66 lakh ha (27.03 % of TGA). Anantapur district has large area (14.6 lakh ha) followed by Kadapa (6.68 lakh ha) and Chittoor (5.06 lakh ha) district. State government should frame strong land use legislations to restrict use of prime lands for non agricultural purpose. Pressure on marginal lands has to be reduced by evaluating the capability for a present land use and accordingly suitable alternate land use can be suggested.

Key words: *Prime lands, marginal lands, multifunctional uses*

Introduction

Heterogeneity is a basic characteristic of lands and this heterogeneity means the capacity of lands to support various functions simultaneously (Mander 2007). Land use is the key activity which determines the performance of lands such as land based production, infrastructure and housing (Wiggering *et al.* 2003). The recent trend in land use in some areas has resulted in loss of some prime farmland to industrial and urban uses (Sturdevant *et al.* 2001). The loss of prime farmland to other uses puts pressure on marginal lands which generally are more fragile, erodible, less productive and cannot be easily

cultivated. In Andhra Pradesh the area put to non-agricultural use has been steadily increasing over the years (from 15.2 lakh ha in 1956-57 to 27.7 lakh ha in 2010-11) (DES 2011). The conversion of prime cultivable land to non-agricultural use is continuing at alarming rate every year without any check, and hence affecting the prime and fertile lands, particularly the most productive irrigated lands of the state. The significant reduction in the area under culturable waste lands indicates clearly the conversion of even marginal lands for agricultural purposes. In recent times it is a major concern that there is a need for a multi-functionality concept

of agriculture and agricultural water management to retain some element in order to defend environmental and social assets against the extreme consequences of structural change on farms (Wilson 2008). The multi-functionality of crop production system refers to the fact that crop production activity is not limited to produce food and fibre and may also have other functions. For that purpose, land has been classified into different classes according to their potential for rising crops or other purposes. The Natural Resources Conservation Service (NRCS) has defined prime farmland as land that has the best combination of physical and chemical characteristics for producing food, feed, fibre, forage, oilseed, and other agricultural crops with minimum inputs of fertilizer, pesticides and labour, without intolerable soil erosion. These lands have the best combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if these lands are treated and managed according to acceptable farming methods. Marginal lands are those having limitations, which in aggregate, are severe for sustained application of a given use and increased inputs to maintain productivity or benefits will be only marginally justified (CGIAR 1999). The classification will identify the potential to use a given piece of land for different purpose, based on biophysical limitations of the land such as soils, climate and topography that cannot be removed or improved by acceptable level of management. Land with higher capability has more options for use and also likely to have reasonable resilience to adaptation *vis-a-vis* climate change. Further, climatic constraints are also of equal importance for land capability classification by restricting plant growth rate, ploughing, sowing and harvesting. In this paper, length of growing period is added to the land classification first to identify the extent and distribution of prime and marginal lands and second, for different uses and management in the state of Andhra Pradesh.

Material and methods

The soil resource data and soil map (1:250,000) generated for Andhra Pradesh (Reddy *et al.* 1996) was used as a base information. The length of crop growing period (LGP) was assessed of state is used to know the duration of moisture availability for crop production. LGP is the duration in days or months when precipitation exceeds 0.5 PET and ends with utilisation of stored moisture till it reaches 0.25 PET. The LGP for AEZ pockets was worked out and digitised using SPANS GIS and prepared LGP map (Naidu *et al.* 1998) using interpolation techniques. Soil depth, slope, presence of gravels and length of crop growing period are chosen as key parameters based on their importance to crop production and used to group lands into prime and marginal lands (Table 1). Soil depth indicates the potential of soil to hold and supply moisture, nutrients and provide favourable rooting medium. Similarly presence of gravels in sub-soil limits water, nutrient retention and availability to plants. Soil slope, on the other hand facilitate easiness for workability and undertaking cultural operations. LGP denotes duration of moisture availability for growing crops, under rainfed conditions. Therefore, the word prime lands means (soils with depth >75 cm, gravel - no gravel or <15%, slope <5%, LGP >120 days) offers favourable support to grow wide range of agricultural crops successfully under normal situations (Ramamurthy *et al.* 2012). On the contrary, marginal lands (soils with depth <50 cm, gravel >35%, slope >15% with LGP <90 days) limits the choice of crops that can be grown and pose more inherent soil limitations leading to frequent crop failures. However, marginal lands can productively used for non -agricultural uses. Based on the criteria proposed (Table 1), lands of Andhra Pradesh were grouped into three categories by overlaying soil and LGP map of Andhra Pradesh in GIS platform. Finally alternative multifunctional land uses are suggested based on the soil type and inherent limitations and prevailing length of growing season.

Table 1. Classification of prime and marginal lands criteria

Land Category	Soil depth (cm)	Slope (%)	Gravelliness (%)	Length of growing period (LGP)(days)
Prime land	>75	0-5	0-15	>120
Moderate prime land	50-75	5-15	15-35	90-120
Marginal land	<50	>15	>35	<90

Results and discussion

Prime lands

The extent of total prime lands in Andhra Pradesh is 51.52 lakh ha (Table 2 & Fig.1). Guntur, Nellore and Krishna districts have prime lands more than 6 lakh ha followed by West Godavari, Prakasam and Chittoor districts (5-6 lakh ha) and others are having prime lands less than 5 lakh ha area. The proportion of prime lands to total geographical area (TGA) is more in West Godavari (70.6%), Guntur (63.7%) and Nellore (52.3%)

districts and least in Anantapur (2%), Vishakapatnam (9.8%) and Kadapa (11.6 %) districts. The total net irrigated area in the state is 31.05 lakh ha. The irrigated area in Guntur district is 4.52 lakh ha, West Godavari is 3.79 lakh ha and Krishna is 3.23 lakh ha) and together these districts cover a large area under irrigation. About 30% of irrigated prime lands in the state are having minor limitations of salinity/sodicity and drainage problems and predominantly in Krishna and East Godavari districts. Proper land reclamation and provision of drainage are required to keep the problematic soils productive and sustainable for agriculture.

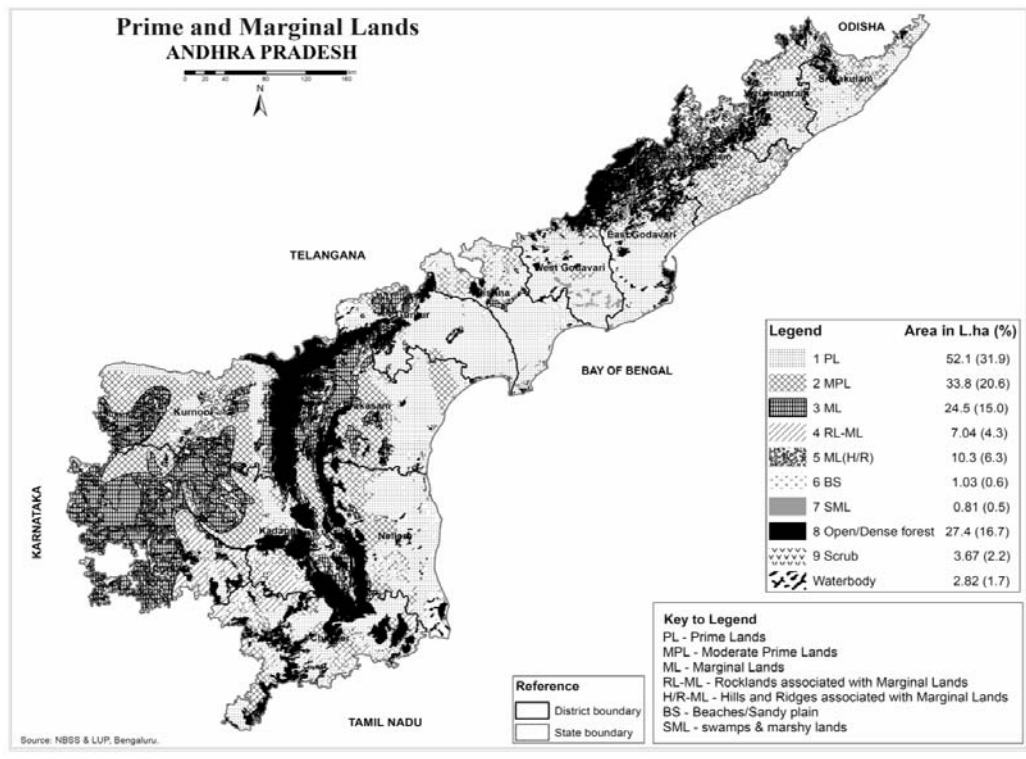


Fig.1. Prime and marginal lands of Andhra Pradesh

Table.2. Extent of different categories of land in Andhra Pradesh

District Name	Prime lands (lakh ha)		Net Irrigated area (lakh ha)	Moderate Prime lands (lakh ha)		Marginal Lands (lakh ha)					Forest (lakh ha)			
	Area	% to TGA		Area	% TGA	ML	RC	HR	SM	Beach	Total	% TGA	Area	% TGA
Anantapur	0.39	2.0	1.42	2.99	15.4	11.66	2.00	0.95	0.00	0.00	14.61	75.39	1.33	6.87
Chittoor	5.01	32.7	1.46	2.70	17.6	0.35	2.12	0.71	0.00	0.00	3.18	20.75	4.41	28.78
East Godavari	4.68	43.7	2.84	1.16	10.8	0.00	0.00	0.87	0.18	0.15	1.2	11.20	3.63	31.59
Guntur	7.31	63.7	4.52	0.94	8.2	1.09	0.07	0.13	0.03	0.05	1.37	11.95	1.14	33.90
Kadapa	1.80	11.6	1.61	3.70	23.9	2.80	1.44	0.82	0.00	0.00	5.06	32.64	4.90	9.96
Krishna	6.67	74.2	3.23	1.05	11.7	0.22	0.13	0.16	0.10	0.17	0.78	8.68	0.41	4.57
Kurnool	2.66	15.0	2.64	5.95	33.4	5.07	0.41	1.19	0.00	0.00	6.67	37.51	2.50	14.04
Nellore	6.82	52.3	2.65	3.14	24.0	0.17	0.22	0.06	0.00	0.24	0.69	5.29	1.44	11.06
Prakasam	5.16	28.9	2.32	4.24	23.7	3.15	0.62	0.71	0.04	0.11	4.63	25.91	3.81	21.32
Srikakulam	2.79	47.7	1.92	1.63	27.7	0.00	0.00	0.36	0.02	0.14	0.52	8.87	0.80	13.59
Visakhapatnam	1.12	9.8	1.17	2.56	22.3	0.00	0.00	3.52	0.13	0.05	3.7	32.16	4.11	35.76
Vizianagaram	1.56	25.1	1.47	2.92	47.0	0.00	0.00	0.68	0.01	0.02	0.71	11.44	1.02	16.39
West Godavari	5.55	70.6	3.79	0.72	9.2	0.00	0.00	0.14	0.30	0.10	0.54	6.86	0.88	11.18
Grand total	51.52	31.90	31.05	33.70	20.9	24.53	7.01	10.28	0.81	1.03	43.66	27.03	30.38	18.8

TGA- Total Geographical Area, ML- Marginal lands, RC- Rock-out crops, HR- Hills & Ridges, SM- Swamps & Marshes

Moderate prime lands

The area under moderate prime lands in Andhra Pradesh is 33.69 lakh ha. Kurnool district has largest area of moderate rainfed prime lands (5.9 lakh ha) followed by Prakasam (4.24 lakh ha) and Kadapa (3.70 lakh ha). The proportion of moderate prime lands to TGA is more in Vizianagaram (47%) followed by Kurnool (33.4%) and Srikakulam (27.7%) districts and least in Guntur (8.2%) and West Godavari (9.2%) districts. The major constraints identified are shallow depth, prolonged dry climate, salinity/sodicity problems and high proportion of sub-soil gravelliness. Perennial horticultural species with strong root penetrating capacity and salt tolerant can be suggested in the above mentioned areas. Optimum and scientific land levelling may be recommended wherever possible. Land resource conservation along with land use diversification should be the priority.

Marginal lands

The extent of marginal lands in Andhra Pradesh is 24.53 lakh ha. Anantapur district has large area (11.6 lakh ha) followed by Kurnool (5.07 lakh ha), Prakasam (3.15 lakh ha) and Kadapa (2.8 lakh ha). The share of marginal lands to TGA is more in Anantapur (60.2%) followed by Kurnool (28.53%) and Kadapa (18.1%) The major limitations in marginal lands are very shallow depth, high subsoil gravelliness and moderate to steep slope. These marginal lands are not suitable for intensive cultivation and can be utilized for urbanisation and development of special economic zones for industries. Because of ever increasing pressure on lands more marginal lands are brought under cultivation and these lands are unable to sustain productivity and lead to ecosystem imbalances. On these lands, land capability based land uses should be promoted so as to preserve land resources in a sustainable manner. These lands can be used for non agricultural purposes like urban/ industrialisation and developing special economic zone (SEZ) in addition to less resource demanding crops and multipurpose trees, hardy grasses, pasture lands and forest species. Marginal lands are further categorised into rocky lands associated with marginal lands (RC-ML), Hill and ridges associated with

marginal lands (HR-ML), swamps and marshes and beaches and discussed below.

a. Rocky lands associated with marginal lands

The extent of rocky lands is 7.0 lakh ha in the state. Large area of rocky lands are occurring in Chittoor (2.12 lakh ha), Anantapur (2.0 lakh ha) and Kadapa (1.44 lakh ha) districts. The rock-out crops associated marginal lands are shallow in depth with poor soil conditions (low fertility, rocky substrata, and steep slopes), high erosion potential and are less productive. These lands can be utilized for cultivation of biofuel crops. These lands cause high runoff potential during intensive rainy days. Efforts should be efforts create water harvesting ponds/ storage tanks in the downstream side, store and efficiently utilize for multi-purpose with land use diversification for higher water productivity and income.

b. Hills & Ridges associated with marginal lands

The extent of hills and ridges associated with marginal lands is 10.28 lakh ha. The extent of hills and ridges is higher in Vishakapatnam (3.52 lakh ha), Kurnool (1.19 lakh ha) and Anantapur (0.95 lakh ha) districts. Horti-silvi- pastoral system (combination of fruit trees and pasture or legume) or Slope Agricultural Land Technology (SALT) (method of growing seasonal and perennial crops in 3 m to 5 m wide bands between contour rows of N fixing trees) and forest species to improve not only the soil organic matter and other physico-chemical properties in the hilly lands and to conserve the soil moisture minimise soil erosion in those areas are recommended. Afforestation with suitable multipurpose forest species should be developed. Illegal tree felling on hills and ridges should be restricted so that hills and ridges become green belts.

c. Swamps / Marshes

Swamps and marshes are valuable source of biodiversity and have variety of wildlife including many endangered species (flora/fauna) which may be seasonal or annual or perennial. The extent of swamps and marshes in Andhra Pradesh is 0.81 lakh ha and are spread in East

Godavari, West Godavari, Vishakapatnam, Vizianagaram, Krishna, Prakasam and Guntur districts. The destruction of marshes/ swamps often causes serious problems such as increased flooding, ground water depletion and loss of wildlife. Marshes and swamps offer sites for recreational activities such as fishing and bird-watching. They are to be conserved and protected for ecological balance. Special eco system exists all along coastal districts of Srikakulam, Vishakapatnam, East Godavari, Krishna, Guntur, Prakasam and Nellore which should be protected for maintenance of natural flora and fauna. Aquaculture, both freshwater and brackish water, and eco-tourism can be developed at suitable sites in the coastal districts.

Beaches/sandy plain

The extent of beaches and sandy plains is 1.03 lakh ha and spread all along coastal districts of Andhra Pradesh. These lands can also be used for tourism development, afforestation, *etc.* however, sand mining is to be restricted. These beaches and sandy plains have to be protected from sea and wind erosion. Developing vegetative cover with block plantations of cashew, simarauba, casurina *etc.* with appropriate vegetative cover in the alleys of the plantations with a purpose to restrict sand movement and minimize erosion. Transplanting of mar-ram grass (*Ammophila arenaria*) to the face of eroded dunes will enhance natural development of vegetative cover and reduce direct wave attack. Sand couch grass (*Elymus factas*) or lime grass (*Leynus arenarius*) are tolerant to inundation by sea water and also act as surface cover to reduce the speed across the surface by trapping and holding the sand intact.

Forest

The state has a total forest cover of 30.38 lakh ha accounting for 18.8 % of TGA of the state. The extent of forest area is high in Kadapa (4.9 lakh ha) followed by Chittoor (4.4 lakh ha), Visakhapatnam (4.1 lakh ha) and Prakasam (3.8 lakh ha). The proportion of forest area to TGA is more than 30 % of TGA in Visakhapatnam, East Godavari and Guntur districts, 20-30% of TGA in Prakasam and Chittoor districts, 10-20% of TGA in Vizianagaram, Kurnool, Srikakulam, West Godavari and

Nellore districts and less than <10% of TGA in Krishna, Anantapur, and Kurnool districts) Out of total area of 30.38 lakh ha, nearly 3.66 lakh ha (12.05 %) is scrub forest. It is found that currently at some places, degraded/ scrub forest are observed even though the existing soil and climatic conditions are favourable. Such soil agro-environment are found to occurs in the following mandals of the state *viz.*, Narayanavanam, Sathyavedu (Chittoor), Tallarevu (East Godavari), Bellamkonda (Guntur) , Ibrahimpatnam (Krishna), Balaihpalli, Kavali (Nellore), Gudlur (Prakasam), Kotturu, Santabommali (Srikakulam), Bheemavaram, Chintalapudi (West Godavari). These areas have better soil and favourable climatic conditions for the development of good forest cover.

Sustainable land management

Land resources at present are suffering from different forms of degradation, processes like erosion, multiple nutrient deficiencies, and chemical degradation (salinity and sodicity) problems. The general soil health status is critical. Therefore, concerted efforts are needed by research and development organizations/ institutes (central/state) to generate site specific agro-technologies to overcome the unabated land degradation problems. State line departments *viz.* agriculture, watershed, horticulture *etc.* in turn implement site specific nutrient management (SSNM) and integrated nutrient management (INM) strategies through central/ state sponsored agricultural developmental schemes. Crop intensification and diversification should be attempted on prime lands (irrigated/rainfed) to maximize the productivity per unit area without deteriorating the soil quality to meet food, fibre, and fodder requirements of growing population. For food security of the state, Krishna, East Godavari and West Godavari, Nellore and Guntur are more productive for rice production therefore, the state government should focus strategies in these districts to address the food security through National Food Security Mission (NFSM). Likewise, Vizianagaram, Chittoor and Kurnool districts are productivity efficient zones for groundnut, Kurnool, Vizianagaram and Srikakulam are productivity efficient zones for millet production (Naidu

et al., 2005). So state government should prioritize these districts under oilseed mission and ICDP (Integrated Cereal Development Programmes). Krishna, East and West Godavari, Chittoor and Vizianagaram districts are better suited for mango, Nellore and Anantapur for citrus, Guntur, East and West Godavari for banana, East Godavari, West Godavari, Srikakulam and Vizianagaram for cashew and these districts have to be promoted for development of horticulture in suitable lands through National Horticultural Mission. Cotton can be promoted in Guntur and Kurnool districts through Technology Mission on Cotton. Kadapa, Visakhapatnam, East Godavari,

Chittoor, Anantapur and Vizianagaram districts are more prone for extremely severe erosion. The lands in these districts need priority for treatment under Integrated Watershed Management programme (IWMP). Local government should promote agricultural policies aiming to converge existing schemes such as RKVY, IWMP, and NFSM, ISOPOM, NHM in efficient cropping zones to maximize production and maintain land resources of the state / country free from land degradation problems (Naidu *et al.* 2010). District wise suggested land use plan for different categories of land has been suggested based on soil, land characteristics and length of growing period prevailing in the area as given in table. 3.

Table 3. Suggested land use plan for prime and marginal lands in different districts of Andhra Pradesh

Districts	Irrigated prime lands	Prime lands	Moderate lands	Marginal lands
Anantapur	Rice, maize, groundnut, vegetables, mulberry, fodder cotton, sweet orange, papaya	Groundnut, red gram, black gram, sunflower	Sorghum, millets, castor, cluster bean, cowpea, sapota, pomegranate	Horse gram, custard apple, ber, soapnut, multi-purpose tree species, neem, acacia, pongamia
Kurnool	Rice-rice, groundnut, cotton, vegetables, fodder crops, chillies, banana, papaya	Cotton, gram, Sorghum, sunflower, ground nut, maize, green gram, black gram, red gram, mango	Sorghum, millets, castor, green gram, groundnut	Horse gram, custard apple, neem, pongamia, tamarind, multi-purpose tree species
Kadapa	Rice, turmeric, groundnut, cotton, acid lime, sweet orange, banana, vegetable crops, fodder crops, papaya	Groundnut, red gram, sunflower, sesame, cotton	Sorghum, bajra, green gram, black gram, coriander, castor	Horse gram, aromatic grasses, custard apple, neem, Acacia, pongamia, tamarind, Soapnut
Chittoor	Rice, sugarcane, groundnut, vegetable crops, fodder crops, floriculture, ragi	Groundnut, red gram, black gram, mango, rainfed vegetables	Sorghum (F), bajra, green gram, Ragi	Horse gram, custard apple, subabul, neem, pongamia, Soapnut
Coastal Nellore	Rice-rice-rice, groundnut, cotton, sugarcane, banana, vegetables, fodder crops, acid lime	Groundnut, maize, green gram, black gram, cotton, gingelly, tobacco, rainfed vegetables, mango	Green gram, black gram, sesame, sunflower	Horse gram, custard apple, multi-purpose tree species, subabul, acacia

Prakasam	Rice-rice-pulses cotton, maize, fodder crops, chillies, acid lime, pulses, vegetable crops	Cotton, green gram, black gram, red gram, groundnut, chillies, rainfed vegetable crops, sunflower. maize, mango, sapota	Sorghum, bajra. green gram, castor, Aonla	Horse gram, custard apple, Aonla, multi-purpose tree species, aromatic grasses, soapnut, styloxanthus legume (forage)
Guntur	Rice-rice-pulses cotton, maize, turmeric, fodder crops, vegetable crops, cotton, chillies, sugarcane, black gram, banana, flower crops	Cotton, chillies, red gram, green gram, groundnut, rainfed vegetable crops, tobacco, Sorghum, sesame	Sorghum, green gram, castor, fodder crops, sapota, pomegranate	Horse gram, custard apple, Aonla, multi-purpose tree species,
Krishna	Rice-rice, pulses, maize, black gram, sugarcane, banana, cotton, fodder crops, vegetable crops, flower crops	Red gram, black gram, green gram, sesame, cotton, chillies, rainfed vegetables, mango, sapota, tobacco	black gram, green gram, sesame, Sorghum (F), groundnut	Horse gram, custard apple, multi-purpose tree species, agri-silvi-pasture system
East Godavari	Rice-rice-pulses, maize, black gram, green gram, coconut, fodder crops, vegetable crops, flower crops, sugarcane, banana, oilpalm	Cotton, tobacco, cashew, mango, chillies, black gram, green gram, rainfed vegetable crops	green gram, black gram, sapota, tobacco, rainfed vegetables, cashew	-
West Godavari	Rice-rice-pulses, maize, black gram, green gram, coconut, fodder crops, vegetable crops, flower crops, sugarcane, banana, oilpalm	Cotton, tobacco, cashew, mango, chillies, black gram, green gram, rainfed vegetable crops	green gram, black gram, sapota, tobacco, rainfed vegetables, cashew	-
Visakhapatnam	Rice-rice-pulses, maize, sugarcane, sugarcane (R), coconut, fodder crops, ragi, banana, vegetable crops	Upland paddy, tapioca, sweet potato, rainfed sugarcane, turmeric, ragi, green gram, black gram, red gram, groundnut, rainfed vegetable crops, sesame, mango, cashew	Green gram, black gram, niger, bajra, ragi, cashew, mango, tapioca, sweet potato	-
Vizia-nagaram	Rice-rice-pulses, maize, coconut, vegetable crops, sugarcane-sugarcane (R), fodder crops	Maize, green gram, black gram, red gram, groundnut, sesame, sugarcane (rainfed), mango, cashew, rainfed vegetable crops	Green gram, black gram, cashew, mango, mesta, bajra, ragi, sesame, sunflower, multi-purpose tree species	-
Srikakulam	Rice-rice-pulses, maize, coconut, vegetable crops, sugarcane-sugarcane (R), fodder crops	Bajra, green gram, black gram, red gram, groundnut, sesame, mango, cashew, cotton, mesta, tobacco, rainfed vegetable crops	Green gram, mesta, ragi, bajra, cashew, custard apple, multipurpose tree species	-

Note: Location specific soil and water conservations measures are needed both in prime and marginal lands.

Conclusion

This study revealed the occurrence of different kind and extent of prime, moderate and marginal lands and their distribution in different districts of Andhra Pradesh. State government should frame strong land use legislations to restrict use of prime lands for non agricultural purpose. Similarly the pressure on marginal lands has to be reduced by evaluating the capability for the present land use and accordingly suitable alternate land use options can be suggested. In the same way ecologically sensitive areas such as swamps and marshes and beaches are to be protected for their conservation. In degraded forest areas/scrub forest areas, new forest plantations can be taken up through afforestation. Land reclamation, soil and water conservation and provision of drainage measures are to be planned in areas where salinity/sodicity and drainage problems occur to improve and maintain the sustainability of prime lands.

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