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Identification and delineation of suitable areas for mango, banana, citrus and cashew crops in Andhra Pradesh

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Abstract : Andhra Pradesh is one of the important states contributing to the major share in production of mango, banana, citrus and cashew crops in the country. Soils and climatic conditions of major fruit crop-growing districts were evaluated for their suitability using FAO guidelines to identify and delineate potential areas for these crops. Based on the suitability assessment, parts of West Godavari, Khammam, East Godavari, Chittoor, Krishna and Vizianagaram districts are found as the most potential areas for mango, Nellore for acid lime, Anantapur and Nalgonda for sweet orange, Guntur, West Godavari and East Godavari for banana, and West and East Godavari districts as suitable areas for cashew production. Suitable areas for expansion of mango, banana, sweet orange, acid lime and cashew crops in major districts have been demarcated. Shorter growing period, poor fertility status, poor drainage, presence of calcium carbonate and gravels in the subsoils are identified as major constraints.

Additional key words: *Land suitability, potential areas, horticultural crops, soil constraints*

Introduction

The **National Horticulture Mission** was launched in the country as a centrally sponsored programme in 2005 to promote horticulture development in different states. The programme aims at increasing the production and productivity of horticultural crops through adoption of improved technologies and area expansion of regionally adapted crops. The task was given to the horticultural departments of different states to promote area expansion, provide drip irrigation schemes and develop processing/ cold storage facilities for horticulture development in potential areas till 2012. Horticultural crops, in general, are perennial in nature. Therefore, site selection plays an important role in their cultivation and sustained production. Plant nutrients, irrigation, plant protection and high labour costs demand high investments necessitating proper land suitability assessment so that returns for rupee invested are high, economical and profitable.

Delineation of suitable areas and identification of soil and climatic constraints for better management were attempted through the present study so that the information can serve as a base material for implementing the horticulture developmental programmes.

Materials and Methods

The soil resource inventory generated during execution of soil resource mapping of Andhra Pradesh (Reddy *et al.* 1996) has been used as base information. The districts with maximum cultivation of mango, citrus, banana and cashew crops were selected for land suitability assessment following FAO guidelines (FAO

1976). Soil-site suitability criteria developed for these crops (Naidu *et al.* 2006) were used to categorise lands as highly suitable (S1), moderately suitable (S2), marginally suitable (S3) and unsuitable (N) for production of these crops. Available climatic information with regard to temperature (IMD 1973), rainfall (1969-93) and length of growing period assessed for Andhra Pradesh (Naidu *et al.* 1998) were used for crop suitability assessment. Suitable (highly and moderately suitable) areas for these crops were delineated for crop area expansion.

Results and Discussion

The climatic and soil site suitability for different fruit crop-growing tracts are discussed separately below.

Climatic conditions across major fruit crop-growing districts

The general climatic conditions prevailing in the study area (Table 1) were interpreted for suitability assessment of these crops. The mean maximum temperature ranges from 34.7°C (Guntur) to 30.0°C (Chittoor). The minimum temperature varies from 19.8°C (Chittoor) to 24.4°C (Nellore). All other districts were found to have intermediate temperature conditions. Annual rainfall and length of growing period (LGP) are the two parameters found to vary widely across the districts. High rainfall (>1000mm) and longer crop growing periods (150-180 days and > 180 days) are observed in Vizianagaram, Khammam, East and West Godavari districts. Low rainfall (544 to 711 mm) and shorter growing periods (<150 days) are recorded in Anantapur and Nalgonda districts. Chittoor, Guntur and Krishna districts, on the other hand, are found to have intermediate (rainfall and LGP) climatic conditions. The overall temperature conditions prevailing across the districts are found favorable for all the crops. Areas with low rainfall and associated shorter growing periods observed in Anantapur and Nalgonda districts (Sweet orange), Nellore (Acid lime) and parts of Chittoor (Mango) district require supplemental irrigations as compared to other areas. For these drier tracts, drip-irrigation systems are to be recommended for high production and productivity of orchards.

Soils and their suitability for different crops

The distribution of dominant soils, their important characteristics, fertility status and suitability for growing mango, citrus, banana and cashew are presented in table 2. District-wise potentials and limitations of the soils are discussed below.

Anantapur: Very deep, alluvial (calcareous) clayey soils/very deep, red loamy soils occurring on very gently sloping lands are highly suitable for sweet orange production (Fig. 1). Shallow, well drained, red gravelly

Table 1. Climatic features of major fruit growing districts of Andhra Pradesh

	Max. Temp. (°C)	Min. Temp. (°C)	Mean Annual rainfall (mm)	RH (%)	LGP (days)
Anantapur	33.3	21.9	544	53.5	<90 and 90-150
Chittoor	30.0	19.8	828	59.5	120-180
East Godavari	31.7	23.8	1138	72.0	150-210
West Godavari	32.7	23.0	1082	71.0	150-210
Guntur	34.7	23.2	814	55.5	150-180
Khammam	34.2	22.9	1046	62.5	150-180
Krishna	31.2	24.0	962	73.5	150-180
Nalgonda	31.7	20.0	711	58.5	120-150
Nellore	34.0	24.4	1042	67.0	120-180
Vizianagaram	31.0	23.5	1075	77.5	180-210

Table 2. Dominant soils and their characteristics, fertility status and suitability classes

Dominant soil	Physical Characteristics											
	Depth (cm)	Drainage	Texture		Gravel (%)	$CaCO_3$ (%)	Slope (%)	**Suitability class**	**N**	**P**	**K**	**Z**
			Surface	Sub-soil								
Anantapur district												
Shallow Red gravelly loam soil	<50	Well drained	Sandy loam	Clay	15-40	Nil	1-3	N				
Med. Deep Red gravelly clay soil	95	Well drained	Sandy loam	Sandy clay loam	15-40	Nil	3-8	N				
Deep Red gravelly clay soil	109	Well drained	Sandy loam	Sandy clay	35-75	Nil	3-8	N	L	M	H	L-M
Very Deep (calcareous) Alluvial clay soil	>150	Well drained	Sandy clay loam	Clay	Nil	Cal	1-3	S1				
Very deep Red loamy soil	>150	Well drained	loamy sand	Sandy clay loam	Nil	Nil	1-3	S1				
Chittoor district												
Deep alluvio-colluvial clay soil	130	Mod. well drained	Sandy loam	Clay loam	Nil	Nil	1-3	S2				
Medium deep red clayey soils	58	Well drained	Loamy sand	Clay	Nil	Nil	3-8	N	L	M	L-M	M-A
Shallow red gravelly loam soil	32	Well drained	Sandy loam	Sandy loam	15-60	Nil	3-8	N				
Very deep red loamy soils	>150	Well drained	Loamy sand	Sandy clay loam	Nil	Nil	1-3	S1				
E&W Godavari												
Deep red clayey soil	150	Well drained	Loamy sand	Clay	Nil	Nil	1-3	S2				
Deep red gravelly clay soil	100	Well drained	Sandy loam	Clay	25-40	Nil	8-15	N				
Deep deltaic black soil	150	Imperfectly drained	Clay	Clay	Nil	Cal.	0-3	N				
Deep red clayey soil	100	Well drained	Sandy clay loam	Clay	Nil	Nil	1-3	S1	L-M	L-M	H	A-H
Brown forest gravelly loam soil	76	Well drained	Sandy loam	Sandy clay loam	15-70	Nil	15-30	N				
Deep (calcareous) black soil	110	Mod. well	Clay	Clay	Nil	Cal.	0-1	S2				
Very deep red loamy soils	>150	Well drained	Sandy loam	Sandy clay loam	Nil	Nil	1-3	S1				

contd.

Khamman district												
Deep alluvio-colluvial clayey soil	130	Well drained	Sandy loam	Clay	Nil	Nil	1-3	S2				
Very deep red loamy soil	>150	Well drained	Loamy sand	Sandy clay loam	Nil	Nil	1-3	S1				
Shallow red gravelly loam soil	<50	Well drained	Sandy loam	Sandy loam	40-60	Nil	3-8	N	L-M	L-M	M-H	A-H
Medium deep red clayey soil	66	Well drained	Loamy sand	Clay	Nil	Nil	3-8	N				
Deep red clayey soil	150	Well drained	Sandy loam	Clay	Nil	Nil	1-3	S2				
Deep (calcareous) black soil	150	Moderately Well	Clay	Clay	Nil	cal	1-3	S3				
Krishna district												
Deep red clayey soil	150	Well drained	Sandy loam	Clay	Nil	Nil	1-3	S2				
Deep calc. black soil	>150	Moderately well	Loam	Clay	Nil	Nil	0-1	S2				
Deep red gravelly clayey soil	100	Well drained	Sandy clay loam	Clay	25-75	calc.	1-3	N	L-M	M	M-H	M-A
Deep (calcareous) black soil (salt affected)	150	Moderately well	Clay	Clay	Nil	calc.	0-1	N				
Very deep red loamy soil	>150	Well drained	Loamy sand	Sandy clay loam	Nil	Nil	1-3	S1				
Nellore district												
Deep red gravelly clay soil	100	Well drained	Sandy clay laom	Sandy clay	25-40	Nil	1-3	S3				
Med. deep red loamy soil	52	Well drained	Sand	Sandy clay loam	Nil	Nil	3-8	S3				
Deep calcareous black soil	>150	Moderately well	Clayey	Clay	Nil	calc.	0-1	S2				
Deep red clayey soil	>150	Well drained	Sandy loam	Clay loam	Nil	Nil	1-3	S2				
Very Deep red loamy soil	>150	Well drained	Loamy sand	Sandy clay loam	Nil	Nil	1-3	S1				
Nalgonda district												
Med. Deep red gravelly loam	95	Well drained	Sandy loam	Sandy clay	50-75	Nil	3-8	N				
Deep red gravelly clay soil	110	Well drained	Sandy loam	Sandy loam	30-75	Nil	3-8	N	L	H	H	M- A
Deep calcareous black soil	>150	Moderately well	Clay	Clay	Nil	calc.	0-1	S2				
Deep alluvial loamy soil	130	Well drained	Sandy clay loam	Sandy clay	Nil	Nil	1-3	S2				
Guntur district												
Deep red gravelly clay soil	100	Well drained	Sandy loam	Sandy clay	25-40	Nil	8-15	N				
Shallow red gravelly clay soil	<50	Well drained	Clay loam	clay loam	45-60	Nil	3-8	N	L	L-M	M-H	L-H
Deep calcareous black soil (salt affected)	>150	Moderately well	Clay	Clay	Nil	calc.	0-1	N				
Very deep red loamy soil	>150	Well drained	Loamy sand	Sandy clay loam	Nil	Nil	1-3	S1				
Deep alluvial black soil	150	Mod. well	Clay loam	clay loam	Nil	calc.	1-3	S2				
Vizianagaram district												
Med. Deep red clay soil	66	Well drained	Loamy sand	Sandy clay	Nil	Nil	3-8	N				
Deep red gravelly clayey soil	>100	Well drained	Sandy clay loam	Clay	25-75	Nil	1-3	N	L-M	L-M	L-M	LL
Deep red clayey soil	150	well drained	Loamy sand	Sandy clay	Nil	Nil	1-3	S2				
Medium deep red loamy soil	52		Sand	Sandy clay loam	Nil	Nil	3-8	N				

Suitability Class : S1-highly suitable, S2-moderately suitable; S3-marginal suitable and N-not suitable; NPK status : L-low, M-medium, H-high; Zinc : L-low, M-marginal, A-adequate and H-high

loam and medium deep/ deep red gravelly clay soils are unsuitable for sweet orange production due to presence of more gravels (>25% gravel) or undulating topography (>5% slope). Nearly 2.02 lakh ha area has been identified as suitable and 17.2 lakh ha area as unsuitable for sweet orange production. Soils, in general, are low in available nitrogen, medium in phosphorus and high in potassium status. The available zinc status ranges from low to marginal. Zinc deficiency and lime induced iron chlorosis need nutrient corrective measures for enhancing sweet orange production.

Chittoor: Very deep, red loamy soils are grouped as highly suitable for mango cultivation and deep alluvio-colluvial clayey soils are categorized as moderately suitable. Medium deep, red clay, shallow red gravelly loam soils are categorised as unsuitable due to limitations of shallow depth and high gravelliness in sub-soil. Nearly 2.13 lakh ha area was highly suitable and 13.15 lakh ha area as unsuitable for mango production (Fig. 2). Soils in the district are dominantly low in available nitrogen, medium in phosphorus and low to medium in available potassium. Available zinc ranges from marginal to adequate. Low to medium K status and marginal zinc status in some pockets have been found as major fertility constraints.

East and West Godavari: Deep red clayey, very deep red loamy soils occurring on level lands (<3% slope) are categorised highly suitable for banana, cashew and mango crops whereas deep (calcareous) black soils are categorized as moderately suitable for banana. Deep deltaic black, brown forest gravelly loam and deep, red gravelly clay soils are grouped as unsuitable for mango, banana and cashew crops due to poor drainage, steep slopes or high gravel content in sub-soil. About 2.47 lakh ha area are found as suitable and 7.71 lakh ha area as unsuitable for mango (Fig. 2). In case of banana, 2.47 lakh ha are reported suitable and 7.71 lakh ha area are unsuitable (Fig. 3). In case of cashew, 2.51 lakh ha area are reported suitable and 7.78 lakh ha area as unsuitable (Fig. 4) in East Godavari district. In West Godavari district, about 3.36 lakh ha area are found to be suitable and 4.3 lakh ha area as unsuitable for mango (Fig. 2). For banana production, about 3.35 lakh ha area and 4.32 lakh ha area are found as suitable and unsuitable, respectively (Fig. 3). For cashew, about 3.72 lakh ha area are categorized as suitable and 3.95 lakh ha area as unsuitable (Fig 4). The available nutrients status with regard to N and P are low to medium whereas K and zinc status in soils of these districts was observed to be adequate.

Guntur: Deep, alluvial black and very deep, red loamy soils are assessed as moderately suitable and highly suitable, respectively for banana crop. Shallow red gravelly clay, deep red gravelly clay soils, deep black soils (salt affected) are rated as unsuitable for banana crop due to limitations of shallow depth, presence of high gravel in sub-soil, poor drainage and sodicity problems. About 6.29 lakh ha is suitable and 5.18 lakh ha area is unsuitable class for banana cultivation (Fig. 3). The soils are low in available nitrogen, low to medium in available P and medium to high in available K, available Zn ranges from low to high. In some pockets, medium K and low to marginal Zn are found to be the fertility limitations for banana production.

Khammam: Very deep, red loamy/deep red clayey/deep alluvial clayey soils are categorised as highly and moderately suitable, respectively for mango. On the other hand, shallow red gravelly loam, medium deep red clayey and deep calcareous black soils are grouped as unsuitable and marginally suitable for mango crop due to severe limitations of depth, high gravel content in sub-soil, heavy texture. Land suitability assessment shows 3.17 lakh ha area as suitable and 13.27 lakh ha area as unsuitable for mango cultivation (Fig. 2). The soils are dominantly low to medium in available N and P, medium to high in available K and adequate to high in available Zn. Areas that have medium K status need judicious fertilization to overcome K deficiency.

Krishna: Very deep, red loamy/ deep red clayey soils are rated as highly and moderately suitable for mango production. Deep deltaic black/black soils (salt affected), red gravelly clay soils are assessed as unsuitable for mango due to poor drainage, presence of salts, gravel and heavy texture. About 1.30 lakh ha area has been found as suitable and 7.52 lakh ha area as

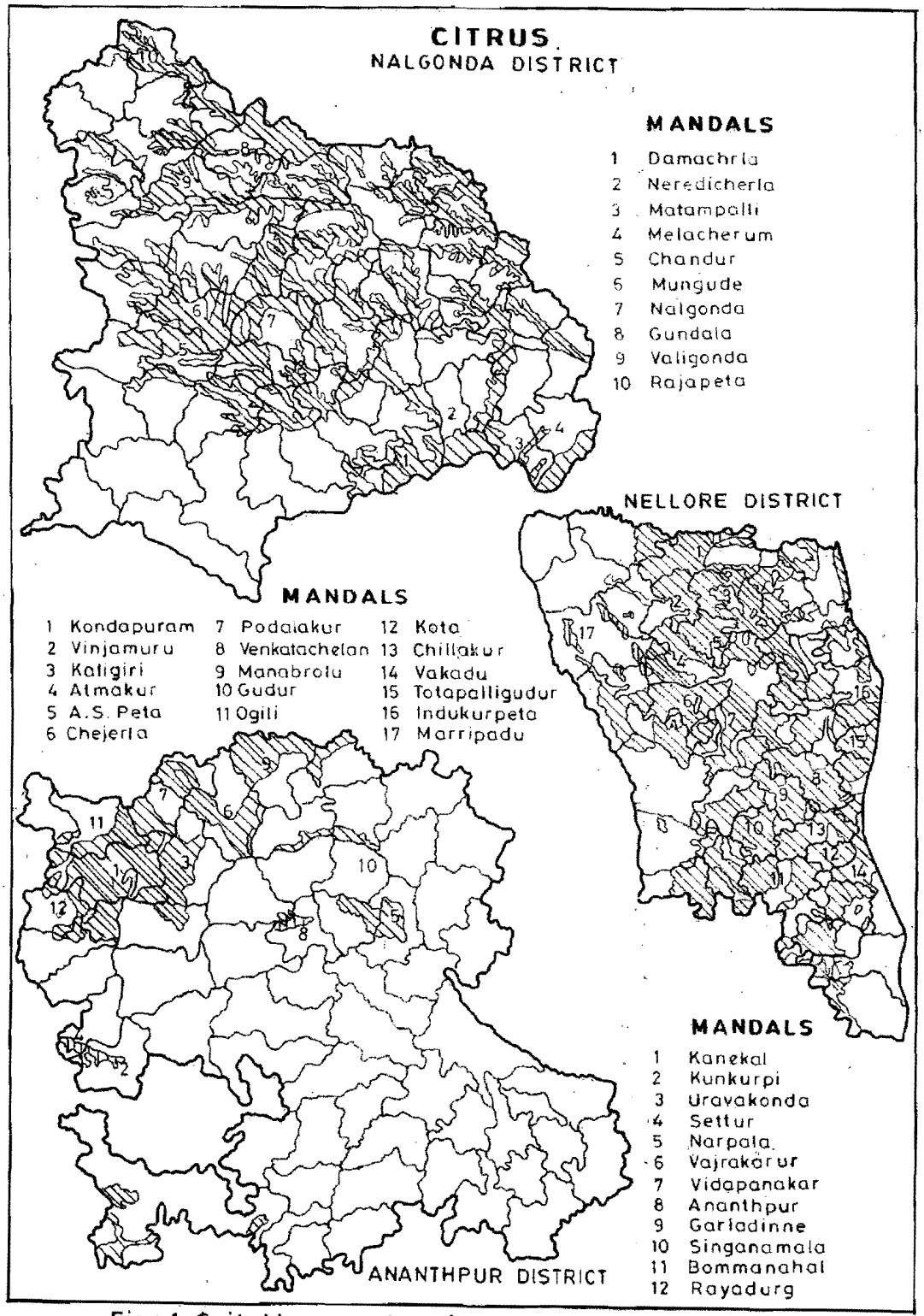

Fig : 1 Suitable areas for Citrus production

unsuitable for mango (Fig 2). The soils are low to medium in available N, medium in available P, medium to high in available K, marginal to adequate for available zinc. In some pockets, available Zn and K are deficient.

Nalgonda: Deep, alluvial loamy soils are categorised as moderately suitable for sweet orange production. Medium deep, red gravelly loam, deep red gravelly clay and deep calcareous black soils are respectively grouped as unsuitable and marginally suitable for sweet orange production due to severe limitations of depth, undulating topography, presence of high gravel content in the sub-soil and heavy texture (black soils). About 2.63 lakh ha has been found suitable and 11.70 lakh ha as unsuitable (Fig. 1). The soils, in general, are low in available N and P, high in available K, and marginal to adequate in Zn. The deficiency of Zn was observed in some pockets.

Nellore: Very deep, red coastal loamy soils are categorized as highly suitable because of their good soil physical conditions. Deep red clayey, deep alluvial clayey soils are categorized as moderately suitable. Deep red gravelly clay and deep calcareous black soils are rated as marginally suitable for acid lime due to presence of sub-soil gravelliness and lime and heavy texture, respectively. Nearly 6.07 lakh ha have been found as suitable and 5.90 lakh ha as unsuitable for acid lime (Fig. 1). The soils, in general, are low in available N and P, medium to high in available K, low to marginal in available zinc. On the whole, areas with medium available K and low to marginal Zn status need judicious fertilizer applications.

Vizianagaram: Deep red clayey soils occurring on very gently sloping lands are rated as moderately suitable for mango. Deep red gravelly clay, medium deep red clayey and medium deep red loamy are grouped as marginally suitable and unsuitable for mango production due to high gravel content in subsoil and shallow depth. Nearly 3.67 lakh ha area have been assessed as suitable and 7.77 lakh ha as unsuitable for mango production in the district (Fig. 2). The soils, in general, are low to medium in available N, P, and K and very low in available Zn. Low to very low available K and Zn contents are found as major fertility constraints for mango.

Delineation of potential area: Areas with nil/slight/moderate limitations of soil and climatic conditions are delineated as potential areas for expansion under major fruit crops in different districts. On the whole, potential areas for mango production are found highest in West Godavari (3.36 lakh ha) followed by Khammam (3.17 lakh ha), East Godavari (2.47 lakh ha), Chittoor (2.14 lakh ha), Krishna (1.30 lakh ha) and Vizianagaram (1.08 lakh ha) district (Fig. 2). For acid lime production, Nellore district has a potential area of 6.08 lakh ha. Anantapur and Nalgonda districts are found to have nearly equal extent of 2.02 lakh ha for sweet orange production (Fig. 1). Among banana growing districts (Fig..3), potential area was the highest in Guntur district (6.30 lakh ha) followed by that in West Godavari (3.36 lakh ha) and East Godavari district (2.47 lakh ha). In case of cashew crop, potential area was the highest in West Godavari district (3.72 lakh ha) followed by that in East Godavari (2.52 lakh ha) district (Fig. 4).

Conclusion

Identification and delineation of suitable areas for mango, citrus, banana and cashew crops in major fruit crop growing districts of Andhra Pradesh based on land suitability evaluation could serve as the basis of effectively implementing horticulture development programmes in the state.

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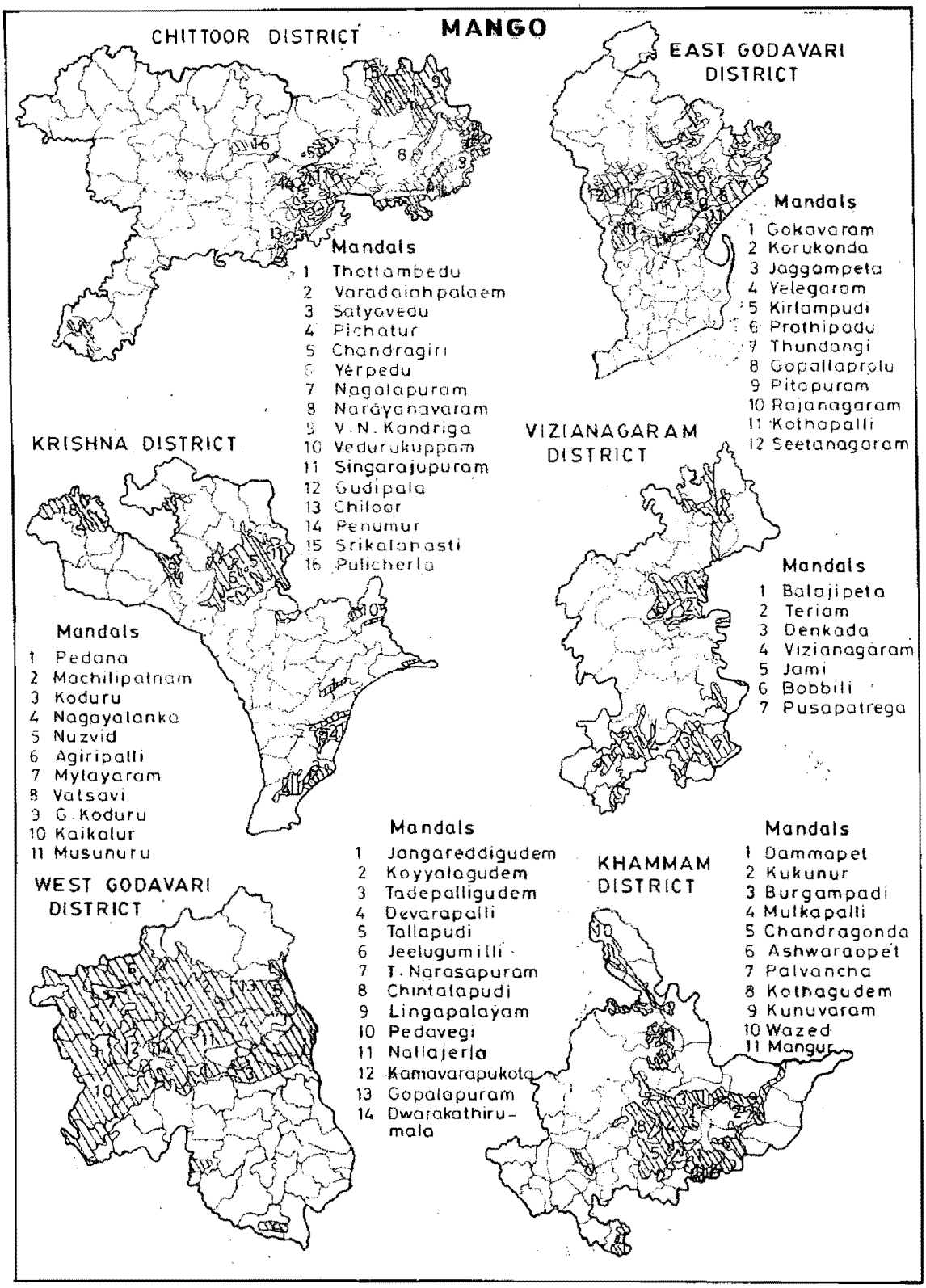

Fig : 2 Suitable areas for Mango production

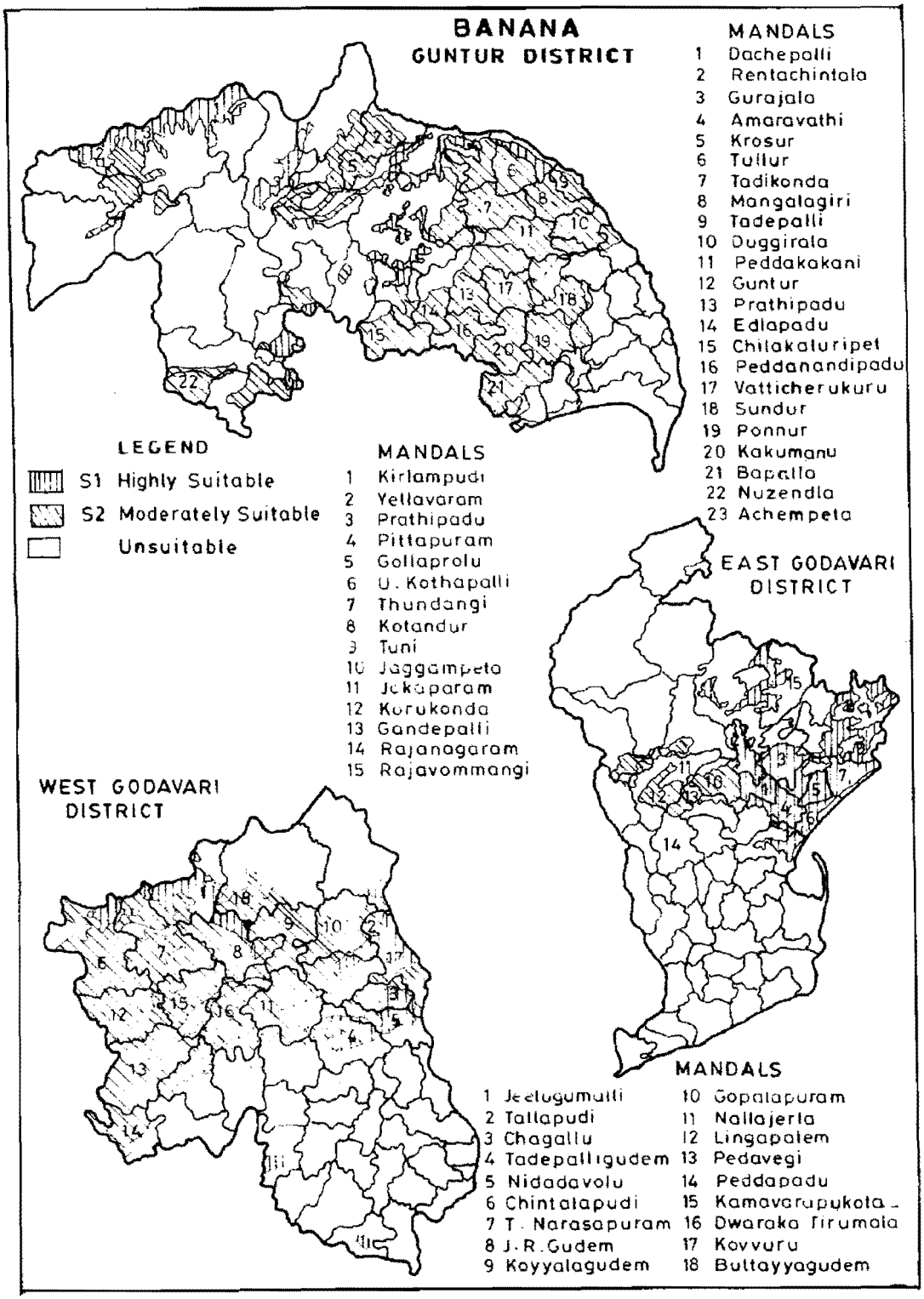

Fig: 3 Suitable areas for Banana production

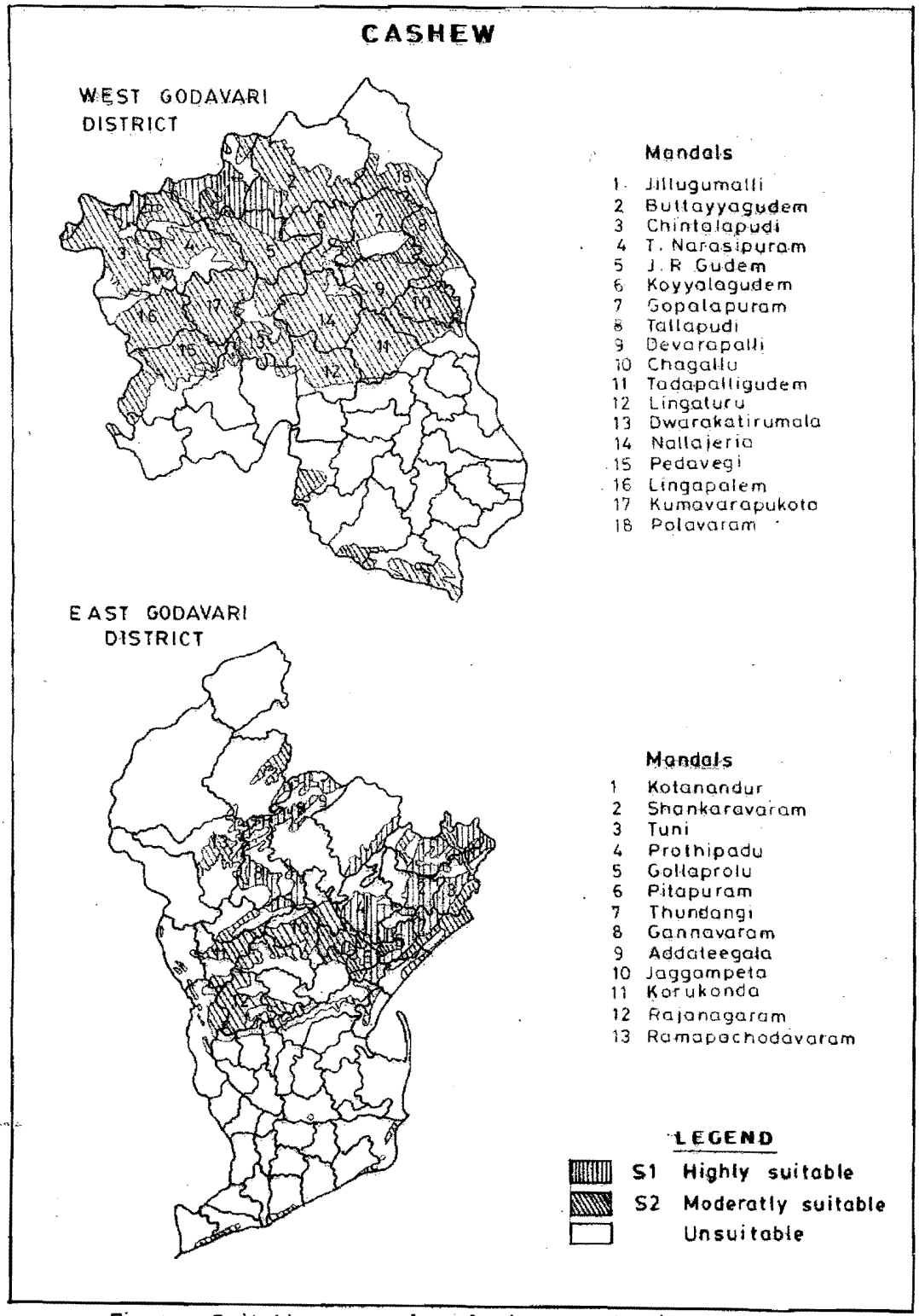

Fig : 4 Suitable areas for Cashew production

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