Agropedology 2006, 16 (1), 42-49

Need for refinement of agro-technologies in NARP zones- a case study of Karnataka

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Abstract : NARP-agro-climatic zone is considered as a single management unit for the purpose of agrotechnology transfer. Examination of soils in each NARP zone indicated wide range of soils with different potentials, limitations and response to management. Similarly, two to four crop growing situations with different duration of moisture availability are observed in each zone. Single blanket fertilizer recommendation will result in excess application on some soils and less application on some other soils leading to nutrient mining and fertility degradation. Uniform varietal recommendation across the zone showed varied suitability indicating the need for site specific recommendation. Zonal recommendations currently advocated are very generalised and need refinement suiting to the soils and length of growing period of the zone.

Additional key words *: Agro-technologies, agro-climatic zone, revalidation, refinement.*

Introduction

Soil, water and agroclimates are the prime natural resources in the growth and development of agriculture. Indiscriminate and over exploitation of these resources due to competing and conflicting land uses resulted in emergence of various kinds of soil degradation problems. The low and declining soil fertility is one such degradation process. For maintaining the productivity of resource base, there is need to diagnose the nature, properties, potentials and limitations of each piece of land and to treat each soil as per its capability. Therefore, evaluation and monitoring of soil resources and developing site- specific management strategies to each agroclimatic region, subregion, zone, district, village and watershed level will ensure rational land use and its sustainability. The current recommendations are very generalized. Single blanket recommendation is adopted for entire zone with the assumption that the NARP zone is homogenous with respect to soils and prevailing climate. In this paper an attempt is made to examine the variability of soils and crop growing situations in 10 NARP zones of Karnataka and see whether the current agrotechnologies recommended are suitable to the resources existing in the zone and if not, suggest the need for refinement to protect the soil resources.

Materials and Methods

The soil resource inventory data (1:250,000 scale) prepared for Karnataka state (Shivaprasad *et al.* 1998) was used as base information. The NARP zones map prepared by University of Agricultural Sciences (UAS 1989) was superimposed on soil map and 17 crop growing situations were identified (Fig.1) in the state (Naidu and Srinivas 2003) to delineate major soils and variation in length of growing period in each NARP agro-climatic zone. The package of practices with regard to fertilizer dose and varieties recommended in each zone (Table 1) were evaluated to judge their suitability to the existing soils and length of growing period prevailing in the zone to suggest site specific recommendations (Table 2) suiting to the resources of the zone .

Results and Discussion

University of Agricultural Sciences, Bangalore and Dharwad had demarcated the Karnataka state into 10 NARP-Agroclimatic zones (Fig. 1) for the purposes of generation and transfer agrotechnologies to farmer's fields. Currently, extension agencies of State Agricultural Universities (SAU) and Department of Agriculture, Government of Karnataka are

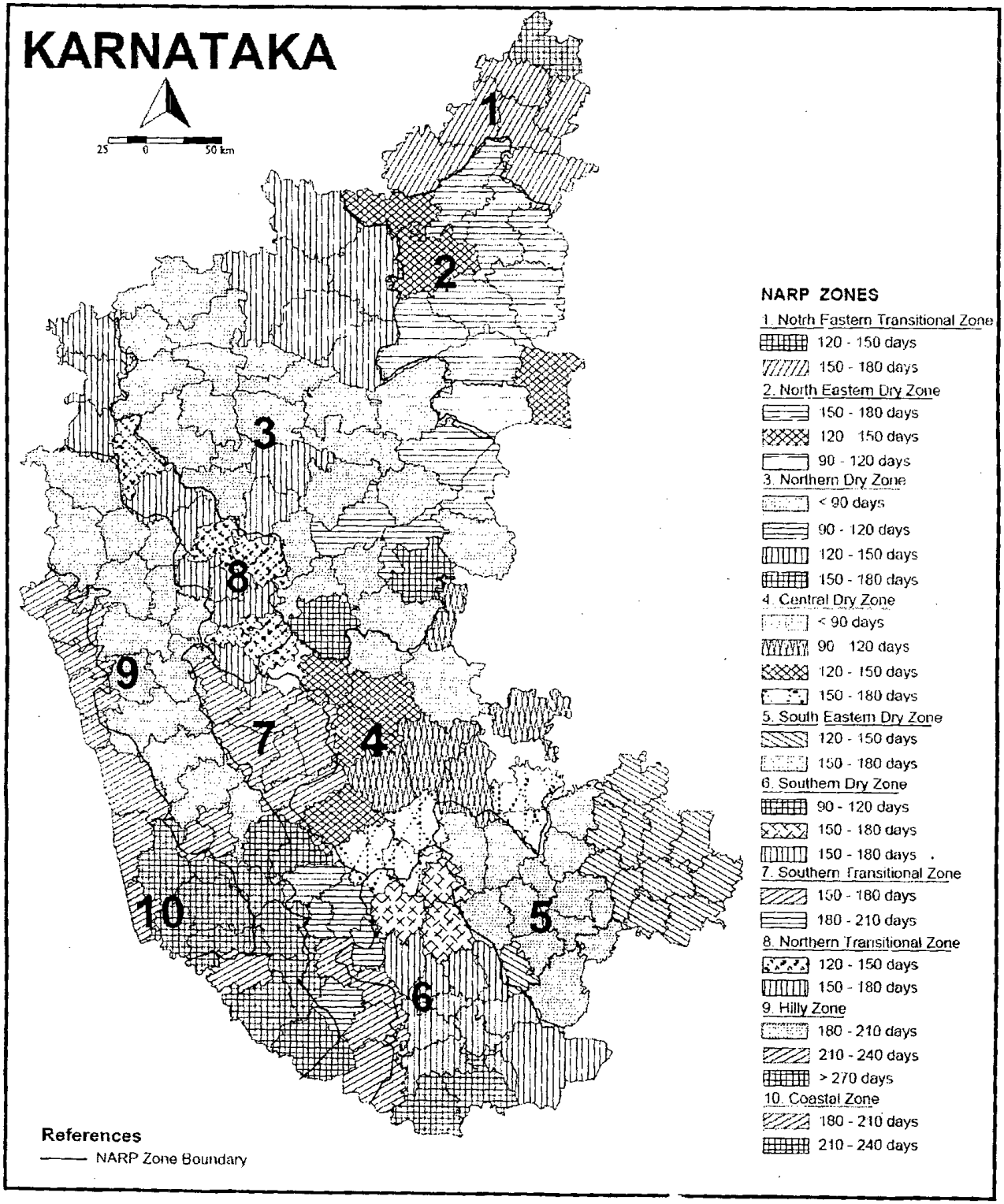

Fig. 1 : Crop growing situations in NARP zones

Table 1 : Soils and crop production technologies recommended in NARP Zones

NARP zone	Dominant soils (area in Lakh ha)	Major crops	Fertilizer dose ($N\text{-}P_2O_5\text{-}K_2O$)(Kg/ha)	Recommended Varieties	Crop duration (days)	Remarks
1.North eastern transition zone	Deep black soils (2.58)	Sorghum	100-75-35(Kh) 50-25(R) SSV-74	M-35-1, Mugathi,DSH-3 CSH-14, CSH-16, DSV-1	120-130 100-120	Fertilizer recommendations are very generalised
	Medium deep black soils (2.14)					All varieties (medium and long duration) of pigeon pea are not equally suitable across the zone due to variations in growing period
	Shallow black soils (2.10)	Pigeonpea	25-50-20	PT-221,JS-1	155-165	
	Lateritic gravelly clay (1.89)			TS-3, Maruthi	170 -190	
				Pragathi, Selection -31	110-130	
		Sorghum	60-40-0(Kh)	M-35-1, Mugathi	125-130	All varieties are equally suitable
2. North Eastern dry zone	Deep black soils (8.94)		100-75-40(R) SSV-74	CSH-14,CSH-16,DSV-1, 115-120	105-115	throughout the zone
	Shallow alluvial loamy (2.0)	Pigeonpea	25-50-20	Selection-31,JC-11-39	110-135	All varieties (medium and long duration)
				PT-221,WRP-1	155-165	are not equally suitable across the zone
				Maruthi, TS-5	170-190	due to variations in growing period
	Moderately shallow red gravelly clay (1.04)	Cotton	25-25-12(LRF) 30-15-15(MRF)	NHH-44,DHH-11 Abaditha, Ganesh	160 145-170	
	Shallow black soil (0.95)		80-40-40(HYRF)(IV)(SV)	Jaydhar,Renuka,DDHC-11	180-200	
	Medium deep black (0.70)		150-75-75(Inter sps) 120-60-60(Intra sps) 120-60-60(Imp.var)	DHB-105	180	Fertilizer recommendations are very generalised
3. Northern dry zone	Deep black (24.0)	Sorghum	100-75-37.5(Kh) 100-62-37(R)	M-35-1,Mugathi CSH-5&CSH-18, CSH-5	125-130 110-115	
	Shallow black (8.94)			DSH-4, DSV-2	115-120	
	Mod. deep red gravelly clay (6.11)					All recommended varieties (medium and long duration) are not equally suitable across the zone due to variations in growing period
	Deep alluvial clay (2.0)	Cotton	25-25-12(LR) 30-15-15(MR) 80-40-40(H)	Jayadhar, Varalakshmi Renuka, DDHC-11, DCH-32 DHB-105	190-200 180-190 180	
	Shallow red gravelly clay(1.5)		Abaditha, Ganesh	145-170		
	Deep red clayey (1.0)			NHH-44,DHH-11	160	
		Pearlmillet	50-25-0(R)	ICTP-8203	70-80	More successful in drier areas
				ICMV-221	75-85	-
		Sugarcane	250-75-190 (I) 315-75-190 (Ratoon)	CO-86032,CO-740, Co-7314	Irrigated crop	Fertilizer recommendations are very generalised
	Moderately deep red gravelly clay (6.47)	Sorghum	100-75-40(I) 65-40-40(RF)	CSH-5,CSH-9,CSV-4, DSV-2	110-120	

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4. Central dry zone	Deep red gravelly clay (2.03) Deep red clayey (1.11)	Ground Nut	25-75-38 + 500 kg Gypsum (I) 25-50-25 (RF)	TMV-2,JL-24	90-120	All recommended varieties(sorghum / groundnut / fingermillet) are not equally suitable across the zone due to variations in crop growing period
	Shallow red loam (1.0) Deep cal. Black (0.82) Deep black soils (0.82)	Finger-millet	100-50-50(I) 50-40-25 (RF)	Indaf-8,Indaf-5,MR-1,GPU-28	110-125	Fertilizer recommendations are very generalised
		Rice	100-50-50 (Kh) 125-62-62 (S)	Jaya,IR-20,KRH-2,BR-2655	Irrigated crop	
5. Eastern dry zone	Deep alluvial clayey (4.0) (salinity in patches) Moderately deep red gravelly clay (3.55)	Finger-millet	100-50-50 (I) 50-40-25 (RF)	Indaf-8,MR-1, MR-2 Indaf-5,GPU-28	120-130 105-115	All recommended varieties are equally suitableacross the zone due to longer. crop growing period
	Deep red clay (3.4) Deep lateritic clay (1.95) Deep red gravelly clay (1.34) Deep red loams (1.24)	Groundnut	25-75-38 (I) 25-50-25 (RF)	K-134,VRI-2	95-110	Fertilizer recommendations are very generalised
		Rice	100-50-50 (Kh) 125-62-62 (S)	IR-30864,IR-20,KRH-1, KRH-2,Jaya,Rasi	Irrigated crop	
6. Southern dry zone	Deep red clay soils (3.53) Very deep alluvial clayey(2.92)	Rice	100-50-50 (I) 50-40-25 (RF)	IR-30864, IR-20, KRH-1, KRH-2, Jaya, Rasi	Irrigated crop	Fertilizer recommendations are very generalised
	Moderately deep red gravelly clay (2.9) Deep red gravelly clay (0.92)	Sugarcane	250-100-125	CO-419, B-37172, CO-62175,CO-7804	Irrigated crop	All recommended varieties (medium and long duration) are not equally suitable across the zone due to variations in growing period
		Finger-millet	100-50-50 (I)	Indaf-8, Indaf-5, Indaf-7,	105-125	
7. Southern Transitional zone	Deep black soils (0.62) Moderately deep, red gravelly clay (3-10) Deep alluvial clay (2.76) Moderately deep red clay(2.47)	Finger-millet	50-40-25 (RF) 100-50-50 (I) 50-40-25 (RF)	MR-1, GPU-28 Indaf-8 MR-1 Indaf-5, Indaf-7, GPU-28, L-5	120-125 105-120	All recommended varieties are equally suitable across the zone due to longer crop growing period
	Deep red gravelly clay (1.52)	Rice	100-50-50 (Kh) 125-62-62 (S)	KRH-2, IR-20, Jaya, Jyothi, KRH-1	Irrigated crop	
	Very deep red clay (1.0) Deep black (0.66)	Sugarcane	250-75-75 (Bhadra Command area) 250-100-125 (Mandya	CO-419,B-37172 CO-62175,CO-7804	Irrigated crop	Fertilizer recommendations are very generalised

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			Vanivalasa Sagar : Command)			
8. Northern Transitional zone	Deep black soils (5.30) Moderately deep red gravelly clay (2.0)	Maize	100-50-25-10 $ZnSO_4$ 150-75-37.5-10 $ZnSO_4$	DMH-2, Prabha Deccan-103	115-120 110-115	
	Shallow loamy soils (1.5) Moderately deep red clay(1.20)	Sorghum	62.5-75-25(Kh) 100-60-40(R) 100-75-40(S)	CSH-16, CSH-18, DSV-2, DSV-15, DSV-74 M-35-1, Mughuthi, A-1, DSV-4, DSH-3	100-120 120-130	All recommended varieties are equally suitable across the zone due to longer crop growing period
		Cotton	25-25-12(LRF) 30-15-15(MRF) 80-40-40(HYRF)(IV)(SV) 150-75-75(IHYB) 120-60-60(IScross) 120-60-60(SHYB)	DHB-105,Varalakshmi, Jayadhar Sahana, Abaditha, Suvidha DHC-11,NHH-44	180-200 140-160 160-180	All recommended varieties (medium and long duration) are not equally suitable across the zone due to variations in growing period -
		Rice	100-50-50(Kh) 125-62-62(S)	Jaya,Rasi,Jyothi,Amruth, IET-7564,Madhu	Irrigated crop	Fertilizer recommendations are very generalised
9. Hilly zone	Deep lateritic clay (2.58) Moderately deep red clay(1.58)	Finger-millet	100-50-50(I) 50-40-25(RF)	Indaf-8,Indaf-5, Indaf-7	120-125	All recommended varieties are equally suitable across the zone due to longer crop growing period
	Moderately deep red gravelly clay (0.83) Shallow red clay (0.72) Deep black (0.70) soils Very deep alluvial loam (0.50)	Rice	75-75-90(Kh)	Jaya, Mangala, Abilash, KHP-2, IET-719, IR-20, Madhu	Irrigated crop	Fertilizer recommendations are very generalised
10 Coastal plain	Deep lateritic gravelly clay(2.08) Moderately deep lateritic gravelly clay (1.80)	Rice	60-30-45	Mahaveer, Shakthi, KKP-6, Palguna, Jaya,IR-20, Mukthi	Irrigated crop	Fertilizer recommendations are very generalised
	Deep alluvial sandy soils (1.10)	Groundnut	75-38-0 (I)	TMV-2 JL-24	100-120 90-120	All recommended varieties are equally suitable across the zone due to longer crop growing period

Note: Kh – Kharif, R – Rabi, S – Summer season, I – Irrigated crop, RF – Rainfed crop
LRF – Low rainfall conditions, MRF – Medium rainfall conditions, HRF – High rainfall conditions
HY – I Hybrid (Irrigated), Inter Sps – Varieties of inter species cross, Intra Sps – Varieties of intra species cross

Table 2. Site specific varietal recommendation in NARP zones of Karnataka

NARP zone	Crop growing situations and their geographic distribution		Remarks
	LGP (Days)	Crop Growing Situations (taluk/district)	
1. North eastern transition zone	120-150	Aurad(Bidar)	Selection 31 and Pragathi varieties of pigeon pea are highly successful than long duration varieties
	150-180	Bhalki, Bidar, Besavakalyan, Humnabad(Bidar),	Present recommendations have no limitation
		Chincholi and Aland (Gulbarga)	Fertilizer recommendations are to be revalidated based on the soil types
	90-120	Manvi(Raichur)	Cotton is not successful
2. North Eastern dry zone	120-150	Jevargi and Afzalpur (Gulbarga), Raichur(Raichur)	Selection 31 and Pragathi varieties of pigeon pea are highly successful than long duration varieties
	150-180	Gulbraga, Chittapur, Sadam, Yadgir, Shahpur, Shorapur, Deodurg (Gulbarga)	Present recommendations have no limitation
			Fertilizer recommendations are to be revalidated based on the soil types
	< 90,	Athni, Raibag, Gokak, Soundatti (Belguam), Jamkhandi Mudhol, Bilgi, Bagalkote, Badami, Hungund(Bagalkote district), Navalgund (Hubli district), Nargund (Gadag district), Kustogi,Yelbarga and Gangavathi (Koppal district)	Only pearlmillet to be recommended
3. Northern dry zone	90-120	Sindhnur, Siriguppa, Hospet(Bellary district) , Koppal (Koppal district)	Sorghum will be more successful
	120-150	Ron and Gadag (Gadag district)	Abaditha and Ganesh varieties of cotton are more successful than long duration varieties
	150-180	Sandur(Bellary district)	Present recommendations have no limitation
		Harapanahalli (Devanagare district)	Fertilizer recommendations are to be revalidated based on the soil types
	<90	Jagalur(Davangere), Challakere (Chitradurga)	Pearlmillet only to be recommended
	90-120	Molakalmaru, Pavagada & Sira, Hiriyur & Hosdurga (Chitradurga district)	Sorghum and groundnut are to be recommended. Cotton not successful
4. Central dry zone	120-150	Harihar and Davangere (Davangere), Chitradurga & Holalkare (Chitradurga), Kadur (Chikmagalur)	Finger millet and sorghum crops are more successful
	150-180	Arsikere, Tiptur, Chiknayakanahalli, Madhugiri and Kortagere (Tumkur)	Present recommendations have no limitation
			Fertilizer recommendations are to be revalidated based on the soil types
	120-150	Bagepalli, Gudibanda, Chikaballapur, Sidlaghatta, Chintamani,Mulbagal, Kolar, Malur and Bangarpet (Kolar) Devanahalli and Hoskote (Bangalore).	

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5. Eastern dry zone	150-180	Gauribidnur(Kolar), Doddaballapur, Nelamangala, Magadi,Ramnagaram, Anekal and Kanakapura (Bangalore) Kunigal, Gubbi and Tumkur (Tumkur)	Present recommendations are more appropriate across the zone Fertilizer recommendations are to be revalidated based on the soil types
	90-120	Gundlupet and Chamarajnagar (Chamarajnagar)	Indalf-5 and Indalf-9 varieties are more successful than other varieties
	120-150	Yellandur, Kollegal(Chamarajnagar), K.R.Pet, Maddur, Mandya, Srirangapatna, Malavalli (Mandya), Nanjangud, Mysore, K.R. Nagara and T. Narsipur (Mysore)	
6. Southern dry zone			Present recommendations have no limitation
	150-180	Channarayapatna(Hassan), Nagamangala (Mandya), Turuvkere (Tumkur)	Fertilizer recommendations are to be revalidated based on the soil types
	150-180	H.D. Kote and Hunsur(Mysore), Channageri and Honnali (Davangere) Shikarpur, Shimoga and Bhadravathi (Shimoga), Tarikere (Chikamagalur)	Present recommendations have no limitation
7..Southern Transitional zone	180-210	Belur, Hassan, Alur and Holenarsipur (Hassan)	Fertilizer recommendations are to be revalidated based on the soil types
	120-150	Byadgi, Ranibennur (Haveri), Shirhatti (Gadag), Kundgol (Dharwad), Bailhongal(Belgaum)	All varieties of maize and sorghum are equally suitable across the zone. Sahana, Abaditha varieties of cotton are more successful than long duration varieties
8. Northern Transitional Zone	150-180	Chikodi, Hukkeri, Belgaum (Belgaum), Dharwad and Hubli (Dharwad), Shiggaon, Savanur, Haveri and Hirekerur (Haveri)	Present recommendations have no limitation
	180-210	Khanapur(Belgaum), Kalghati (Dharwad), Hangal (Haveri), Supa, Haliyal, Yellapur, Mundargi, Sirsi and Siddapur(U. Kannada), Sorab, Sagar, Hosanagar, Tirthahalli(Shimoga), N.R.Pura(Chikmagalur)	Fertilizer recommendations are to be revalidated based on the soil types
9. Hilly zone	210-240	Koppa and Sringeri (Chikmagalur)	Present recommendations have no limitation
	>270,	Mudigere, Chikmagalur(Chikmagalur), Sakaleshpur (Hassan), Virajpet, Madikeri and Somvarpet (Kodagu)	Fertilizer recommendations are to be revalidated based on the soil types
	180-210,	Karwar, Ankola, Kumta, Honnawar and Bhatkal (U. Kannada)Kundapur and Udupi(Udupi), Mangalore	Present recommendations have no limitation
10. Coastal plain	210-240	Karkala, Belthangady, Bantwal, Puttur (D. Kannada)	Fertilizer recommendations are to be revalidated based on the soil types

advocating single blanket package of practices uniformly to all farmers within the zone. In reality wide range of soils with different potentials, limitations and response to management are found to occur in each zone (Shivaprasad *et al.* 2001). Similarly, number of crop growing situations with different duration of moisture availability are found to occur in each NARP zone (Naidu and Srinivas 2003). Zonewise crop production technologies recommended (UAS 2004 and UAS 2003) in each zone and their suitability to the prevailing soils and crop growing situations are discussed below.

Scrutiny of crop recommendations (Table 1) in each zone showed single package is advocated across the NARP zones with no due consideration on type of soils occurring and length of growing period prevailing in the area. Perusal on distribution of soils in each zone indicated that more than one-soil type occur in each zone in all NARP zones and they differ greatly with regard to depth, texture, moisture retention and response to management. The soil heterogeneity is high in all NARP zones *i.e.* northeastern transitional zone (black/ lateritic) , northeastern dry, northern dry and northern transitional zone (black / red /alluvial), central dry and southern dry zone (red / alluvial / black), eastern dry zone (alluvial / red / lateritic), hilly zone (lateritic / red) and coastal zone (lateritic / alluvial). Each crop is grown on wide range of soils with different potentials and limitations. Adoption of single fertilizer recommendation on widely differing soils will result in excess application of nutrients and less application on some soils leading to fertility decline.

Similarly, length of growing period (LGP) is also highly varying with in and among the NARP zones. The assessment of LGP in the state showed wide variation in each zone i.e. 120 to 180 days (north-eastern transitional, northeastern dry , eastern dry zone and northern transitional zone), < 90 to 180 days (northern dry and central dry zone), 90 to 150 days (southern dry zone and north eastern dry zone), 150 to 210 days (southern transitional zones), 180 to 240 days (coastal zone) and 150 to 270 days (hilly zone). On the whole, 2 to 4 crop-growing situations occur in each zone. The present blanket recommendation of varieties (short / medium / long duration) will have critical moisture limitation in some pockets of NARP zones where crop growing period is shorter than the duration of the varieties as seen in many of the zones. This prevailing variations in LGP across the zone necessitates site-specific varietal recommendations (Table 2) for successful crop production.

The present study indicates that the zonal fertilizer and varietal recommendations, currently advocated, are very generalised. More than one soil types with different kinds of soil limitations, response behaviour to management occur in each zone. Single blanket fertilizer recommendation will result in wastage of fertilizers. Two to four crop growing situations exist in each NARP zone which needs site-specific varietal recommendation to ensure better performance. Occurrence of widely differing soils with different durations of crop growing periods were common in NARP zones of other states also. Hence there is a need to identify homogenous land management units within each NARP zone and refine agrotechnologies in tune with the prevailing natural resources for better management to minimize degradation of soil resources.

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Received July 2004; Accepted February 2006