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Early Historic Agriculture in Southern Tamil Nadu: Archaeobotanical Research at Mangudi, Kodumanal and Perur

Introduction and research questions

Although Tamil Nadu witnessed the first historically attested complex, literate societies in Southern India, an understanding of the agricultural basis of these early polities is lacking. Complex, state-level, societies are necessarily supported by an economic base that is capable of producing sufficient surplus to support elites and specialists, craft production and trade. Furthermore the development of states and specialists is expected, based on the experience of other world regions to be a protracted evolutionary process by which small-scale agricultural village communities coalesced or were forcibly united into larger socio-economic units based on a productive surplus. The present research project aims to address the agricultural base of Early Tamil Nadu through addressing the following questions:

- What is the basis of early agricultural Production in inland Tamil Nadu? How much has it changed in more recent periods?
- Where do the crops that contribute to this come from? Any local origins? Or from which regions introduced?
- How is early agriculture in the region connected to the demands of emergent cities and polities in coastal Tamil Nadu or Kerala (Pandyas and Chola)?

Geographic and historic context

The study region of Coimbatore and Madurai lies within a semi arid area of rainfall similar to that of the ashmound tradition zone, where early agro-pastoralism, based on small millets and native pulses began around the 3rd millennium BC (Fuller 2003a). On the East coast which experiences higher rainfall due to the NE monsoon, rice cultivation was adopted at the end of the 2nd millennium filtering down from the Northern Ganges region (Fuller 2003a).

Rice agriculture probably played an important role in the economic foundations of the first polities of coastal Tamil Nadu, by allowing high surplus production in the wetter coastal zone. Although hard evidence is lacking rice may also have been important in supporting the Chera polity, implying that it spread around the tip of India.

Two of our sampled sites Kodumanal and Perur are in Coimbatore district, while one Mangudi, is in Madurai district. In general vegetation differs between the hilly regions, of higher rainfall with denser forests and perennial streams, and the lower flatter plains with predominantly red sandy soils resulting from the disintegration of the underlying gneiss rock which are generally poor in water retention with patches of richer, water retentive loams and clay rich soils. The richer soils could have provided locales for cash crop production such as the irrigated produce of the present day, cotton, tobacco, and sugar cane and oil seeds.

The vegetation seen today in the plains is dry evergreen scrub savannah, the extent to which this is a product of climatic aridity and poor soils or anthropogenic deforestation requires empirical research. As in other regions with this type of scrub vegetation dry cropping is largely restricted to millets and savannah pulses. Rice, cash crops (such as cotton and sugar cane) and winter crops generally require irrigation.

Agricultural constraints: seasonality, rainfall and irrigation

Much of this region is located within the rain shadow of the South West monsoon and beyond the zone of heavy North East monsoons. The less reliable rainfall combined with predominantly poor subsoil, and high evaporation rates, requires the modern agricultural communities to rely heavily upon artificial irrigation, and may in the past have favoured diversification of crops and more drought resistant varieties. While wells are by far the most important source of irrigation today, (Internet sources 1, 2, 3, 2003; Robinson 1976), well irrigation would have been of limited use in the megalithic/early historic period, relying as they did on human power via the Atram system (equivalent to the Arabic Shadof) prior to the introduction of the animal powered Karalai systems of late historic periods (e. g. the Persian wheel).

Rivers and seasonal streams utilised through embankments and canals are therefore likely to have been the most important source of irrigation, such as the river Noyil. Tanks fed by monsoon rains are few within the region, in contrast with Eastern Tamil Nadu where the influence of the NE monsoon has seen an emphasis on tank type irrigation (Robinson 1976) at least since early historic times.

Historical sources: Sangam literature

Early Tamil Sangam literature would probably include this area in the *Mullai-tinai* category (forested pastoral tracts), where shifting agriculture and animal husbandry were found (Zvelebil 1975). The inhabitants were considered pastoralists cultivating millets called varagu and samai *(Paspalum and Panicum)*, the pulse horsegram, beans (lablab), and other non-specified pulses.

A chronological framework for food production

The early historic period saw the emergence into historical sources of coastal polities, which developed shared linguistic, literary and cultural traditions, predominantly non-Vedic origin (Thapar 1966).

There is at present little evidence for great antiquity of agriculture in the area of these polities or in Southern Inland Tamil Nadu. The Southern Neolithic spread of agriculture on present evidence appears to have included northwestern Tamil Nadu (North Arcot and Dharmapuri dists.) where Neolithic sites have been reported based on ceramic finds (Narasimhaiah 1980) and Southern lowland Karnataka, while pastoralism and cultivation may have spread into (or were adopted) in eastern and southern Tamil Nadu during the Megalithic/Iron Age.

While the megalithic period was probably important for a shift towards food production, within the study regions we have sampled the first evidence for sedentary village communities appears in the early historic period c. 300 BC.

SITES AND SAMPLING.

Fieldwork in September 2002 included the first systematic archaeobotanical sampling from three sites in the state of Tamil Nadu. Sites sampled included two, Perur and Mangudi, which were under excavation by the Tamil State Government Department of Archaeology and the third Kodumanal, which has been excavated by Dr. Rajan. All three sites are primarily early Historic in date (300 BC – 200 AD), indicated by the presence of russet-coated painted ware (in small quantities) and some sherds with Tamil-Brahmi script graffiti.

Mangudi environmental context.

Mangudi lies within the Madurai district, south west of Rajapalayam, on the banks of a seasonal watercourse of the Vaippar river system, this region is still being explored and is rich in Megalithic sites. Most trenches had one or two layers yielding early historic pottery to a maximum of 2 m.

In two trenches on the South side of the site, underlying deposits yielded microliths without ceramics. It is not yet clear whether this represents much earlier mesolithic/microlithic occupation of the site that was reoccupied or whether aceramic (hunter-gatherer) societies persisted in this region up to c. 300 BC. Late Mesolithic sites excavated in the area have produced black and red ware, black and coarse red ware and iron slag and terracotta pipe fragments and domestic animal bones in association with microlithic assemblages (Selvakumar 1996). This might suggest interactions, and perhaps transition, between agro-pastoralists (iron age) and hunter-gatherers. 19 flotation samples were collected here although charcoal densities were generally low.

Kodumanal test excavations

Kodumanal, a habitation and burial site, located on the north bank of the Noyil River is a substantial occupation site. The agricultural base of this settlement has not been systematically investigated previously although earlier excavations did yield some chance finds of charred seeds, including a cache of charred cotton seeds. A small trench was excavated through the site for flotation.

The site has yielded evidence of stone bead production, cotton textile production, and iron production in previous excavations by K. Rajan, in addition to c. 150 megalithic burials, some of considerable wealth, in surrounding cemeteries.

It is situated upon the ancient route connecting Karur, the ancient capital of Chera polity of the west coast, via the Palghat gap and it is suggested that Kodumanal is the Kodumanan mentioned in the Sangam literature (Rajan 1997).

Evidence for imports include: finds of etched carnelian beads (closest sources in Maharashtra) and some lapis lazuli (closest sources in Afghanistan) in graves. And Rouletted ware, arretine ware and a roman coin from surface of site (no context info).

Gemstones have been unearthed in various stages of manufacture (Rajan 1997). The best attested close to the site is quartz working, as there is a quarry about 5 km north.

Perur Excavations

Perur, located northeast of the city of Coimbatore is the site of a historical 8/9th c. temple as well as an ancient settlement on the south bank of the Noyil River. Trenches were excavated by the Coimbatore office of the State archaeology department. The habitation layers samples run from the early historic to the 7th/8th century. 12 samples were collected and floated. Yields of carbonised material were substantial.

RESULTS (figs. 1–3)

Charcoal densities at all sites are fairly low (by comparison with early historic Paithan and some sites of the southern Neolithic), which may result from the high bioturbation in tropical soils. Nevertheless systematic flotation yielded important evidence.

At Mangudi, seeds are not prolific, cotton appears in the highest frequency (with similar numbers to that of Kodumanal), rice is also present with single grains of *Echinochloa, Brachiaria and Panicum.* There are no complete pulses present although a minute amount of indeterminate pulse fragments were recovered. Samples include many parenchyma tissue fragments, much higher numbers in relation to other crops than at the other two sites, which could indicate fruit gathering and tuber use, raising the question of wild tuber use traditions. The cultivation of fruit crops and fodder crops for cattle was undertaken by the inhabitants of the Mullaitinai areas and might also represent a system more focused on pastoral production than cultivation; the addition of faunal data would give us a better idea.

At Kodumanal, seeds are more common and are dominated by pulses *(Vigna radiata, Vigna mungo, Lablab and Macrotyloma)* but especially *Vigna radiata*. Small millets are also present, mainly *Brachiaria ramosa,* or browntop millet. Previous excavations found some Pearl Millet grains that were studied by Kajale. We also found some evidence for rice, and probable rice weeds. Cotton seeds and seed fragments are also present.

Perur displays a diverse assemblage with a wide range of millets, much rice, substantial quantities of rice weeds and small numbers of diverse pulses including *Vigna radiata, V. mungo, V. unguiculata, Lablab, Macrotyloma* and one cotyledon of *Vigna tribolata*. The later medieval western mound at the site shows higher numbers of *Brachiaria* and *Setaria* signifying continuity and possible increase in these types although the increase is minimal. Rice continues to be important and Vigna continues to be cultivated although the other smaller millets decrease in number. Panicum milliaceum appears at the site in this period. High quantities of Parenchyma fragments are present but it is relative to large quantities of crop seeds and is not unusually high as at Mangudi.

Southern Neolithic, African crops, and the coastal rice traditions: Agricultural traditions and presence in Tamil Nadu

The southern Neolithic agricultural tradition was based on the kharif (summer) cultivation of pulses and millets, with rabi (winter) cultivation adopted at certain sites of later dates around the 2nd millennium BC (Fuller/Korisettar/Venkatasubbaiah 2001). The staple crops, *(Brachiaria ramosa, Setaria verticillata, Vigna radiata, Macrotyloma uniflorum)* that were basis of this tradition (such as the Ashmound Tradition) of northern Karnataka since the 3rd millennium BC are present amongst the Tamil Nadu material studied here, although some difference are notable.

Browntop millet *(Brachiaria ramosa)* has strong presence at both KDM and Perur. And is present in a single seed at Mangudi. *Setaria verticillata* is, however, rare.

Macrotyloma uniflorum (horsegram) is relatively rare but present at both Perur and Kodumanal. It was more frequent relative to Mung bean in the southern Neolithic. Here, however, it is mung bean that appears to have been more significant.

Other Indian milletsthat are not considered part of the Southern Neolithic crop package (Fuller/Korisettar/Venkatasubbaiah 2001) are present. The three species of *Echinochloa colona, Paspalum scrobiculatum and Panicum sumatrense* are wild throughout much of India. They are cultivated but also known as weeds of rice. *Paspalum scrobiculatum* (kodo millet; varagu) is very widespread on early historic and iron age sites across peninsular India, in all cases co-occurring with rice suggesting that it may have spread with rice. *Panicum sumatrense* (little millet, samai) is dominant at Harappan period sites in Saurashtra where it may have first been cultivated. Their occurrence in the samples from Mangudi and Perur is possibly as cultivars. The presence of lopsided echinochloa grains in the present material suggests a domesticated form, although further comparative work is needed on this species.

African species were becoming available in India by the first half of the 2nd millennium BC, and possibly in some areas already in the second half of the 3rd millennium BC (Fuller 2003b). The available evidence suggests that these crops were not adopted on a large scale on individual sites nor is there consistent evidence over particular regions. This suggests that the adoption of particular crops depended on the specific and varied social and economic choices, that the African crops were locally important and adopted to supplement long standing agricultural practices of other indigenous crops. This pattern is reinforced by the data reported here.

Mangudi has no African crops present in the samples, while Kodumanal has *Lablab* and *V. unguiculata*, and some *Pennisetum glaucum*, identified by Prof. Kajale. Perur has *Lablab* and

TAXA	MGD3	MGD5	MGD8	MGD6	MGD7	MGD9	MGD11	MGD13	MGD14	PRR47	PRR57	PRR54	PRR51	PRR52	PRR58
Parenchyma/ endosperm	46	63	48	48	31	6		18	15	20	7		14	62	
seed frag	6		8	6	10	5			33	7	48	19		112	1
pulse frag					2	1				4	8	1	10	39	
Wood/nut endosperm		5			9	2									
millet frag										3				12	
CEREALS															
Brachiaria ramosa				1										3	
Brachiaria/Setaria															
Setaria verticulata															
Setaria sp															
Echinocloa								1				3		17	
Eleusine corocona												2		6	
Panicum sp										1					
Panicum Sumatrese														9	
Panicum milliaceum															
Paspulum													5		
Indet millets												2			
oryza						1		1	2.5	1.5	1	7.5	7	44	0.5
oryza glume base									1						
Oryza chaff						x				x					
PULSES															
Vigna radiata														2	
V.mungo										0.5				1	
V. unguiculata													0.5	0.5	
Vigna.sp										0.5				1	
Lablab													1	2	
Macrotyloma										1.5		0.5			
V. tribolata															
OTHER CROPS															
Gossypium frag						5				9				2	
Gossypium										1					
Gossypium caps						1		1	7	1					
FRUIT															
Cucumis melo															1
Curcurbitaceae cf.luffa													1		

a

TAXA	MGD3	MGD5	MGD8	MGD6	MGD7	MGD9	MGD11	MGD13	MGD14	PRR47	PRR57	PRR54	PRR51	PRR52	PRR58
SMALL SEEDS/PULSES															
cf.Cyperaceae			1								1		1	1	
cf. Cyperaceae- Scirpus															
cf.Aizooaceae		1	1	1	4	1	2	2	1	4	2	2		2	
cf.Aizooaceae/Caryophyllaceae				1										2	
cf. molluga					1										
cf.stellaria															
Cyperaceae/Polygonaceae														5	
Boroginaceae															
Dactyloctenum aegyptium			1												
cf.Cruciferae											2				
cf. Medicargo/Meliolotis															
Commelinaceae													1		
Malvaceae														1	
chenopodiaceae														1	
Rubiaceae															
Eleusine indica														1	
Ischmaeum									1					1	
Verbascum scrophulariaceae															
Euphorbiaceae															
cf. crotolaria															
Asteraceae															
INDET SEEDS/PULSES						1									
SEEDS	1				5						5		2	20	
PULSES				1						1					2
grass seed type/rachis/rachilla												1		5	
Woody bit											1				
rice chaff in small fractions						yes				yes					
MOD SEEDS/PULSES	2		1	10							11				
TOTALS															
total cereals	0	0	0	1	0	1	0	2	3.5	2.5	1	14.5	12	79	0.5
total pulses	0	0	0	0	0	0	0	0	0	2.5	0	0.5	1.5	6.5	0
total crops	0	0	0	1	0	2	0	3	10.5	7	1	15	14.5	85.5	1.5
total rice	0	0	0	0	0	1	0	1	3.5	1.5	1	7.5	7	44	0.5
total cotton	0	0	0	0	0	1	0	1	7	2	0	0	0	0	0
total millets	0	0	0	1	0	0	0	1	0	1	0	7	5	35	0
total parenchyma/endosperm	46	68	48	48	40	8	0	18	15	20	7	0	14	62	0
total seeds	1	1	3	4	10	9	2	5	12.5	21	11	18	18.5	126.5	3.5
bulk sample	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000
flot vol	55	42	80	50	60	60	80	100	50	202	55	110	246	130	6
charcoal density	0.003	0.002	0.004	0.003	0.003	0.003	0.004	0.005	0.003	0.010	0.003	0.006	0.012	0.007	0.000
flot weight g	23.5	22.0	56.7	31.0	32.0	20.5	33.3	79.8	23.0	67.0	38.0	79.0	84.0	47.0	2.0
seeds/charcoal	0.018	0.024	0.038	0.080	0.167	0.150	0.025	0.050	0.250	0.104	0.200	0.164	0.075	0.973	0.583
wood approx percentage	0-25%	0-25%	0-25%	0-25%	0-25%	0-25%	0-25%	0-25%	0-25%	75-100%	0-25%	0-25%	?	50-75%	0-25%

b

TAXA	PRR53	PRR-1 59	PRR-1 62	PRR-1 63	KDL30	KDL36	KDL37	KDL44	KDL45	KDL 43	KDL 40	KDL 42	KDL 38	KDL39
Parenchyma/endosper	156	4	5	33		3	15		3	4	10	9	7	?
seed frag	130	3	8	37	7	6	4	6	10	7	2	7	9	15
pulse frag	55		2				13	9	61	70	51	15	21	56
Wood/nut endosperm			1											
millet frag				1										
CEREALS														
Brachiaria ramosa	10			7			2		1	3		3	2	1
				1										
Setaria verticulata	1													
Setaria				1										
Echinocloa	6													
Eleusine corocona	2													
Panicum Sumatrese	5									1				
			1											
Paspulum	14													
Indet millets	5								1					
oryza	51		5	30				0.5		1.5	0.5	0.5	1	3
Oryza chaff	X		x	x										
PULSES														
Vigna radiata							0.5	2		1	2.5			8
V.mungo	2						0.5	0.5			2			
V. unguiculata														0.5
Vigna.sp	1			1		1	3	3	3.5	1	12.5	2.5	1	10.5
Lablab	1												1	1.5
Macrotyloma	1							1						0.5
V. tribolata	1													
OTHER CROPS														
Gossypium frag										1				1
Gossypium														1
								1						
FRUIT														
Cucumis melo														
Curcurbitaceae cf.luffa														

c

TAXA	PRR53	PRR-1 59	PRR-1 62	PRR-1 63	KDL30	KDL36	KDL37	KDL44	KDL45	KDL 43	KDL 40	KDL 42	KDL 38	KDL39
SMALL SEEDS/PULSES														
cf.Cyperaceae	11		1			2				2				1
				3										
cf.Aizooaceae	6			3						2				
cf.Aizooaceae/Caryopl	1													
cf. molluga										1		1		
cf.stellaria												1		
Cyperaceae/Polygonaceae														
Boroginaceae											2			
Dactyloctenum aegyptium														
cf.Cruciferae														
cf. Medicargo/Meliolotis														
Commelinaceae														
Malvaceae				1							2			
chenopodiaceae	1													
Rubiaceae										1				
Eleusine indica														
Ischmaeum	4		1	1										
Verbascum scrophular	7													
Euphorbiaceae	3													
cf. crotolaria	2													
Asteraceae									1					
INDET SEEDS/PULSES														
SEEDS	9			9			1	1		1	2	3		
PULSES	5									2	2			
grass seed type/rachis	2													
Woody bit														
Rice chaff in small fractions			yes	yes										
MOD SEEDS/PULSES		25								1	3			
Total cereals	94	0	6	39	0	0	2	0.5	2	5.5	0.5	3.5	3	4
Total pulses	6	0	0	1	0	1	4	6.5	3.5	2	17	2.5	2	21
total crops	100	0	6	40	0	1	6	8	5.5	7.5	17.5	6	5	26
total rice	51	0	5	30	0	0	0	0.5	0	1.5	0.5	0.5	1	3
total cotton	0	0	0	0	0	0	0	1	0	0	0	0	0	1
total millets	43	0	1	9	0	0	2	0	2	4	0	3	2	1
total parenchyma	156	4	6	33	0	3	15	0	3	4	10	9	7	0
total seeds	151	0	8	57	0	3	7	9	6.5	17.5	25.5	11	5	28
bulk sample	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000
flot vol	120	240	85	80	38	37	110	180	145	167	205	185	?	120
charcoal density	0.006	0.012	0.004	0.004	0.002	0.002	0.006	0.009	0.007	0.008	0.010	0.009	?	0.006
flot weight g	32.0	61.5	17.1	17.2	18.4	24.7	93.7	108.4	72.0	109.0	105.0	94.5	34.4	48.0
seeds/charcoal	1.258	0.000	0.094	0.713	0.000	0.081	0.064	0.050	0.045	0.105	0.124	0.059	?	0.233
wood approx percentage	?	0-25%	0-25%	0-25%	0-25%	0-25%	0-25%	0-24%	50-75%	0-25%	50-75%	0-25%	25-50%	?

d

Fig. 1. Data Table.

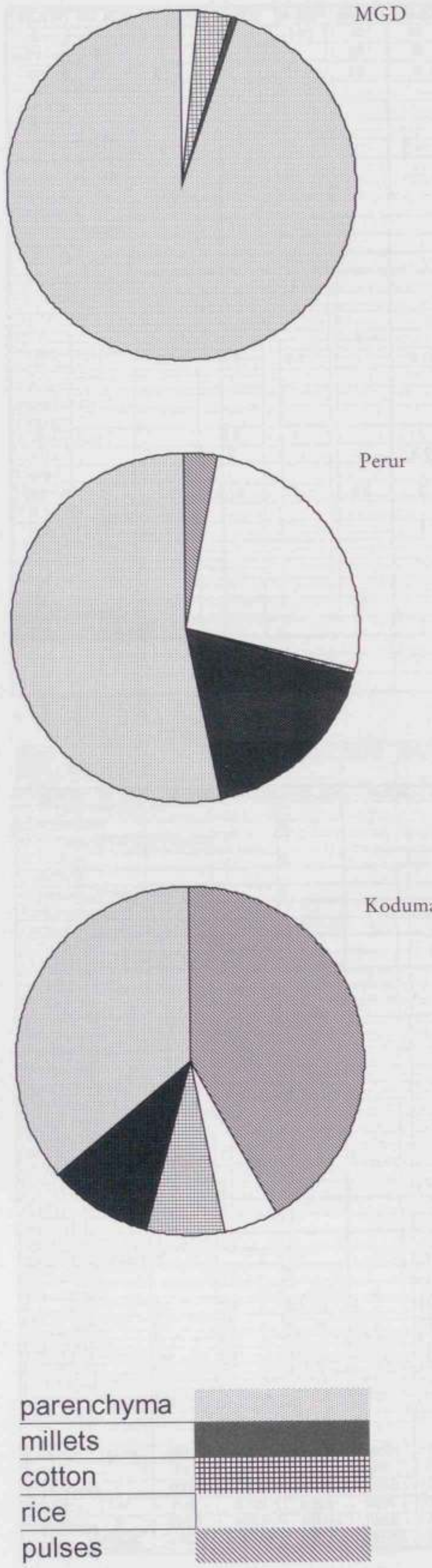


Fig. 2. Relative frequency of crops at sites.

V. unguiculata but also *Eleusine corocana*. All these species are much less frequent than millets or pulses.

Eleusine corocana: finger millet (ragi). There have been problematic identifications of finger millet cited in past literature and it is now clear that many represent mis-identifications. Evidence from Iron Age (and possibly late 2nd millennium BC) and Early Historic period is, however, clear, including that from Perur, which has well-preserved morphology and a warty surface anatomy. In more recent times this species has come to dominate much of the small millet cultivation at the expense of indigenous crops that are more frequent in prehistory and early history.

African millets have the same cropping regimes and same natural seasonality as the native millets. Their adoption may have been based on their ease of insertion into a cultivation system that relied on crops with monsoon seasonality.

Coastal rice traditions and adaption of rice

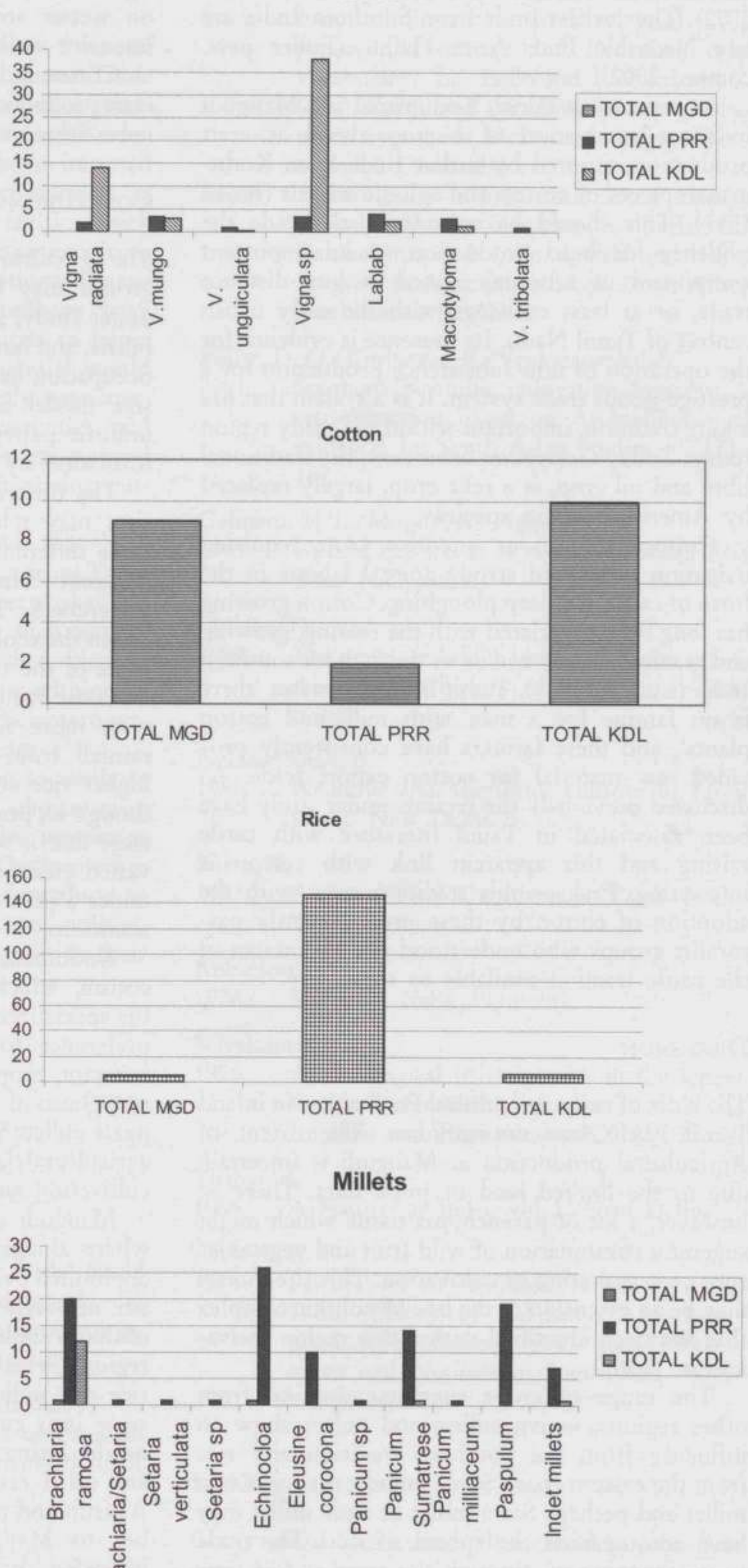
Rice origins in North India are possible but not South India where there is no extensive distribution of the wild progenitor and wild populations are likely to represent the spread of the crop weeds. The sub continental evidence for rice suggests diffusion from the Ganges valley, starting in the late 3rd millennium (Fuller 2002).

Rice agriculture may have spread southwards in Eastern coastal regions and is found in quantities on sites of the Iron Age in South India, such as in the Vidarbha and Kurnool regions. It may then have been adopted in coastal Tamil Nadu. The spread of rice in South India during the Iron Age may have constituted part of a major culinary shift as well as agricultural change. This area would have been particularly suited for rice cultivation with higher rainfall and wetter conditions and the implementation of tank irrigation.

Rice is found in much higher quantities at Perur but is also present at Kodumanal and Mangudi. It is further suggested by the presence of weed seeds such as wetland grasses, sedges and *schrophulariaceae*. Furthermore three millet species *Echinochloa, Paspalum and Panicum sumatrense* may have been weed seeds and not cultivars. It has been suggested that these species may have been domesticated in association with rice in humid East India (Galinato/Moody/Piggin 1999). Rice cultivation in the study region would likely require irrigation, and the adoption of rice therefore has implications for new watering regimes.

Further information about changing culinary traditions including rice might be gained from a study of ceramic types and changes through time at the sites. Allchin (1959) has studied the evolution of the Thali dish which first appears in the Ganges, the rice zone. A shallow dish traditionally used for rice accompanied by a smaller bowl for

Fig. 3. Crop counts at sites.



liquid, this shape and form filters down to the southern region and by the 1st millennium AD there is a rouletted form developed in South India.

Cotton

Gossypium arboreum is considered to be of South Asian origin, and is likely to be the species found at Neolithic Mehrgarh (Costantini 1984; Fuller 2002). The earliest finds from Southern India are late Neolithic finds from Hallur (Fuller pers. comm., 2002).

Its presence at Perur, Kodumanal and Mangudi indicates production of a crop aimed at craft production, attested by earlier finds from Kodumanal: pieces of cotton and spindle whorls (Rajan 1997). This should be considered alongside the evidence for bead production, as an important component of economy aimed at long-distance trade, or at least exchange with the early urban centres of Tamil Nadu. Its presence is evidence for the operation of non-subsistence production for a prestige-goods trade system. It is a system that has a long tradition, important within the study region today. Today *Gossypium arboreum*, the traditional fibre and oil crop, is a relic crop, largely replaced by American cotton species.

Cotton is a labour intensive crop, requiring irrigation input and strong animal labour in the form of cattle, for deep ploughing. Cotton growing has long been associated with the rearing, growing and grazing of bulls and cows throughout southern India (Ludden 1999). Tamil literature states 'there is no famine for a man with milk and cotton plants', and these farmers have consistently provided raw material for cotton export trade. As discussed previously the regions under study have been associated in Tamil literature with cattle raising and this apparent link with cotton is interesting. Perhaps this tradition grew with the adoption of cotton by these predominantly pastoralist groups who understood the advantages of the cattle traction available to them.

Discussion

The basis of early agricultural Production in inland Tamil Nadu was not uniform. The extent of Agricultural production at Mangudi is uncertain due to the limited seed or pulse data. There is, however, a lot of parenchyma tissue which might suggest a continuation of wild fruit and vegetable/ root crop gathering or cultivation. This site indeed may be an extension of the late Mesolithic complex that has been identified within this region (Selvakumar 1996).

The range of crops suggests adoption from other regions; native millets and pulses show an influence from the Southern tradition and rice from the eastern coast. Some millets, such as Kodo millet and perhaps Sawa millet or little millet may have accompanied the spread of rice. The trade routes opening up through the areas at this time would have encouraged the diffusion of crop types and new agricultural practices.

There is not the presence of winter crops, which suggests that dry cropping was the predominant form of cultivation. However, rice and cotton cultivation implies that some form of irrigation may have been necessary, perhaps focused on wetter soils near rivers, or through labour intensive well irrigation.

Cotton indicates an agricultural contribution to craft production for trade. And could have justified more intensive forms of cultivation.

Conclusions and further questions

The agricultural evidence so far is complex. Several groups may have been occupying these regions under study, settled agriculturalists, mobile pastoralists, and hunter-gatherers with camps of varying occupation lengths. There is no unilinear progressive model and consequently there can be no uniform pattern of acculturation or cultural transformation by Eastern coast polities.

The differences in crop types at the different sites may relate to practical choices relating to these different lifestyles and environments, or to different cultural traditions with different food preferences. There are certainly differences between the ecological fertility and agricultural prospects of the three sites, although closely situated.

Perur would be more advantageously situated with more fertile soils and experiencing more rainfall from run off which might explain the higher rice counts, and wider crop diversity, although its position near the Palghat gap raises the issue that it was a cultural crossroads drawing on varied culinary traditions, it may also have been under a greater influence form eastern coast crop traditions.

Kodumanal on the other hand was producing cotton, which complements artefactual evidence for specialized craft production. And may show a preference for reliable, tried and true, drought resistant crops, like the brown top millet and mungbean of the Southern Neolithic tradition and pearl millet. Such crops would have required less agricultural labour, freeing up labour for cotton cultivation and craft activities.

Mangudi again, produces a different pattern where alongside high quantities of *Parenchyma*, are limited evidence of cotton, rice and millet. This site may represent an extension of the late Mesolithic complex that has been identified within the region (Selvakumar 1996). Here perhaps cotton, rice and millets cultivation was introduced small scale into cultivation through the influences of neighbouring cultivators, while traditional fruit and tuber crop trade continued to be important. As fruit and tuber crops seasons are from November to May, there may have been a greater influence on this season of gathering and cultivation than with the other crops.

Agriculture is, on the whole, most likely dry farming with additional irrigation for cotton and rice, particularly at Perur. Mixed cropping is undertaken, suggesting a spread of labour and different harvesting and sowing regimes, with the added benefit of increased nitrogen for soil fertility.

Trade is potentially an important force of change within the region at this time. Trade networks are increasing and the sites under study are advantageously positioned, Perur and Kodumanal particularly, which would have imposed new ideas and influences upon communities as well as a growing volume of human traffic, which would have included agricultural practitioners from different regions with different traditions. Potential for increased wealth would perhaps have spurred mobile pastoralist communities to begin cultivation. Richness of local raw material would in a growing market environment only have augmented already established trade activities and craft production and would also have encouraged movement to these areas, doubly increasing cultivation.

Raw material interests from outside may have encouraged colonization of population from Tamil polities, creating internal market networks and shepherding in new crop influences, such as rice. However, the possibility of established kin exchange networks and social ties existing within and between communities might be sufficient to account for diffusion without migration.

Agriculture represented a decision to dedicate labour time to the cultivation of choice crop species and less time for foraging. This important transition requires further research. This project is only a the first step in the effort to contribute to our understanding of these early Tamil polities, their relationship with more complex polities, their hinterlands and economic networks.

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