Having no community land in resource poor region creates a sustainable system: Case study of Kangayam grassland

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Abstract
Examples of sustainable management of tropical grassland on very large area are difficult to locate. The management of Kangayam grassland spread over 4000 sq km in south India, in a sustainable way for hundreds of years; hardly make a news inspite of the frequent drought because of the collective action of the people and use of innovative technologies. The most important factor has been the absence of communal grazing lands, negating the play of 'tragedy of Commons'. The cultivators in the Kangayam grassland had occupancy rights for more than 100 years, which encouraged them to invest in the unproductive land over generations, building wells for drinking water to animals, identifying and using *Balsmodendron berryi* as live fence (Voelcker 1893) around the grazing areas, taking a collective decision to discourage goats in the region which damage the live fence etc. Thus, the paddock system of livestock rearing evolved, following the principles of rotational grazing and required minimal labour input because of the live fence around the grazing areas. The sustainable system was also reflected in stable human population during last century (growth rate: 0.45% p.a. between 1891-1991) and a healthy gender ratio (1046 female/1000 male). The Kangayam grassland offers an insight into the collective action in a resource poor region creating a sustainable system over hundreds of years which could be replicated elsewhere.

Keywords: Kangayam grassland, Property rights, Tropical grassland

Introduction

The common property resources (CPR) in India are an important source of livelihood of people especially the small and landless livestock keepers. Wherever the CPRs have been managed effectively, the benefits derived from it has been many fold- not only in terms of higher biomasss production resulting better livestock nutrition but also forging the social cohesion among the people dependant on it. Examples of rejuvenating the CPRs have been achieved by mobilizing the community and securing the tenure over the CPRs (FES 2009). Very often the conflicting interests of the various groups of people come in way of mobilizing the community for devising mechanisms for development and benefits sharing from CPRs. From many case studies of successful management of CPRs, the most important factor comes out to be the security of land tenure. Security of land tenure- be it vested in community or the people have resulted in making the land more productive especially in the drought affected regions. The Kangayam region in Tamil Nadu state in peninsular India has in practice a range of technological and social interventions for over a century, which has made the grassland a sustainable production system. The collective actions of people in a 4000 sq km area in the rain-shadow area have ensured a secure livelihood for people where grass is the main crop. Ironically, such

a well-managed grassland production system has remained unheard of beyond its immediate vicinity, obscured from policy makers and field workers who remain on the lookout for a successful model of sustainable management of grazing lands. FES (2009) has also observed that the restoration of the degraded Commons is akin to land distribution for the poor and helps in reducing the vulnerability of poor livestock-keepers to environmental and economic uncertainties, and to stabilise the livestock sector. Improved Commons also provide a strong ecological foundation that can spur poor livestock-keepers to becoming drivers of livestock sector.

The Kangayam region located in the rain shadow region of south India is a drought prone area where pasture grass is the main crop and livestock rearing a major occupation of the farmers. Almost every field in the Kangayam region has a live hedge of *Balsmodendron berryi* which helps secure the animals grazing inside the field. This frees the farmers from having to tend the animals throughout the day and the farmers utilize their time productively in other vocations. The innovation lies in recognizing the use of the *B. berryi* plants as live fences. Maintenance of the live fences entails a collective responsibility in keeping away the goats, which has been achieved by taking a decision by the panchayats (democratically elected body at village level) in the past in restricting the population of goats and imposing heavy penalty on those who infringed the rule. Over a couple of hundred years the grassland has evolved into an excellent productive system, which has sustained the livelihood of farmers and has helped overcome the frequent droughts that the area faces. Due to this harmony of living with the inherent limitation of the system there has been little degradation of the land and out migration of people. The social issues also resolved in a way that the long term sustainability of the system was strengthened. A grazing area should be large for the livestock to graze and roam around so that the re-germination capacity of the grasses is not adversely affected. Therefore, the people have consciously limited their family sizes to either one or two offspring. This has been in vogue for at least the last 3 - 4 generations and hence the human population is almost stable over a hundred year period. Moreover, the equality of gender and their empowerment has been a hallmark in this region and unlike most other parts of India; there are more number of females than males here.

Methods of study

The extent of the Kangayam grasslands were generally taken to spread in five districts namely, Coimbatore, Erode, Karur, Nammakal and Dindigul of Tamil Nadu state. We made an extensive survey of the five districts and concluded that only the first three districts have significant area under grassland, spread over 9 blocks in three districts (Coimbatore, Erode and Karur) in 3841 sq km area. The lowest administrative unit at village level is panchayat, which is a democratively elected body. A few panchayats make a block and a few blocks make a taluk. Several taluks constitute a district and several districts make a state/ province. We started by talking to people about history and evolution of the paddock system of grassland, based on which we developed an questionnaire to gather data regarding the landholding, cropping pattern, livestock rearing practices etc. The basic statistics about the human population were collected from government departments, the other block level data were obtained from the respective blocks. In 1800 AD, the whole area was in Coimbatore district from which Erode and

Karur district were later carved out. In the present study, the population figures and area occupied were constructed for Dharapuram taluk (area 2165 sq km, in Coimbatore district of 1800 AD), although at present it is in Erode district and divided into Dharapuram and Kangayam taluks. The livestock population was taken from the 17th Livestock Census (GOI 2003). The livestock population was converted into standard Adult Cattle Unit (ACU) (Patel and Kumbhara 1983).

Location

The grasslands of the Kangayam region are spread over three districts of Tamil Nadu state in south India, covering an area of approximately 3,841 sq km. The grassland is located between 77º 17" E and 77º 55" E longitude and 10º 44" N and 11º 03" N latitude. The east-west spread of the grassland is 70 km and the north-south spread is 45 km. The region lies west of the Western Ghats in the rain-shadow area. The three districts which include the grassland are Erode (2217 sq km, 5 blocks), Karur (976 sq km, 2 blocks) and Coimbatore (648 sq km, 2 blocks).

Historical development of the grassland

The Kangayam grasslands is located in the historical Kongu region which corresponds to the present day districts of Coimbatore, Erode and Karur of Tamil Nadu state in south India. When the British East India Company took over the administration of the region in 1799 after the fall of its ruler Tipu Sultan, all the three districts mentioned above formed the part of Coimbatore district. The Kangayam grassland formed part of the historical Kongu country and was one of the earliest territorial divisions of the ancient home of the Tamils (Nicholson 1887). The original inhabitants of the Kongu region were *Eyinar*, *Kurumbar* and the *Vedar* tribes. In the Sangam age which is generally placed in the first three centuries of the Christian era, a new set of tribes of whom the *Malavar*, the *Kosar* and the *Kongars* appeared in the region and subdued the original inhabitants. *Malavar* were great warriors and they possessed horses, elephants and chariots. The *Kosars* were the martial race and all Tamil Kings of the period tried to secure their support in their wars. The *Kongars* were pastoral people who had to put up severe fights to get a foothold in the region. In the poems of Sangam literature, the advent of the *Kongars* is described in short as the march of a pastoral people in search of water and pasture. *Kongars* suffered from scarcity of water in their native home and they had to dig deep by cutting hard-bound rocks for a small quantity of water to ooze (Ramamurthy 1986). Another poem gives a graphic description of how the Kongar sank their wells as they marched along for giving their cows the much needed water to drink (Ramamurthy 1986). There are many other references about the *Kongars* – the people of the Kongu country- from the Sangam literature from which we learn that the *Kongars* were pastoral people and they had possessed numerous herds of cattle.

From the earliest times till the acquisition of the region in 1799 by the British, the human population remained low because of incessant wars, famines and occurrence of frequent drought in the region. Quoting surveys conducted by the British officers during that period, Nicholson (1887) described the country as covered with thorns and stones. During the sixteenth, seventeenth, and first half of the eighteenth centuries, the government,

especially in the south and east, was largely conducted by Poligars, who were feudal lords, paying an annual tribute to Madura rulers, and bound to keep up a certain number of soldiers for the aid of the lord paramount.

In the initial days of British administration in the early nineteenth century, farmers were encouraged to keep their land under pasture by providing them two kinds of incentive. The first, *ayen pillu* remission in tax was reduction of three-fourths of the assessment on lands held for grazing, such reduction being limited to one-fifth of the farmers' holding. The other was *paravu pillu*, which was a grazing rent, but it was rather a mode of assessment than a remission; public waste land could be held for grazing at one-fourth the assessment so long as no one wished for the land for cultivation at the full rate (Nicholson 1887).

The population at the beginning of eighteenth century was low. In the Dharapuram taluk (of 1800 AD), occupying over 2000 sq km, the population density was only 32 persons per sq km and the total occupied area was only 26.7 percent (Table 1). Nicholson (1887) has quoted the reports of Buchanan who surveyed the area in 1800 and Campbell in 1832 and concluded that the best lands in the district were under cultivation early in the century, and only the poorer sorts were left untilled. The farmers were compelled to rent more land than they were able to cultivate (Buchanan 1807). This, so called grasslands, part of which were held on puttah (leased land), part formed the large area of poor lands that were classed as government waste and were taken into puttah only after 1855. The population and prices increased rapidly after 1855, and the land of a farmer's regular farm (patkat) were all broken up for tillage than for pasture, because it became more profitable. Additionally, farmers took more government wastelands on puttah for grazing their animals. Nicholson (1887) noted that by that time government wastelands had also almost disappeared. Thus, between 1855 and 1887, almost all of the poor government wastelands were leased by the farmers and consolidated as grazing paddocks.

The process of new settlement of land (for fixing revenue) was initiated by Mr. Clogstoun in 1860 taking into account the type of soil and productivity among other factors and the preliminary settlement scheme was elaborated from 1873 to 1875. The *ayen pillu* remission entailed that a farmer might so long as he chose, held indefeasibly up to one-fifth of his patkat land as pasture at one-fourth of its true assessment, and it was only charged full rates when cultivated. This remission had practically died out by 1875 by spread of cultivation brought about by increase in prices which had stated since 1855 and doubled by 1875 (Nicholson 1887). This remission practically died out by 1880 and hence abolished at the new settlement (1880).

By the year 1881, 87.4% of the land was occupied by the people, of which 85.2 % was dry lands and 1.5% wet lands, after which there was little scope for expansion as in the year 1991 the total area occupied excluding forest, barren & uncultivable area and non agricultural use was 89.7% (Table 1). While talking to the people of the region, it was always emphasized that the paddock system of grassland management has been in vogue since time immemorial, but in fact it had developed in a short span of time between 1855 and 1881. That is, 4 to 6 generation before from now. People can hardly recall the

process of expansion of area under occupation, although at few places old persons about 80 years of age did tell that English rulers had given puttah (land given on lease) to their forefathers. The technology of using live fence around garden lands by *Ephorbium tirucalli* and *Euphorbium antiquorum*, and *Balsmodendron berryi* was known to people even in 1800 AD (Buchnan 1807). It is interesting to know how the Kangayam grassland has sustained itself over one hundred years with an increasing human population which doubled from 90 persons per sq km in 1881 to 183 in 1991 in Dharapuram taluk (of 1800 AD with an area of 2000 sq km).

Table 1. Change in human population and area occupied in Dharapuram taluk from 1800 AD to 1991

Year	Human population	Human density (no/sq km)	Occupied area (ha)		
			Dry area	Wet	Total
1991	395940	183			195786* (89.7)
1881	195232	90	185799 (85.8)	3304 (1.5)	189103 (87.3)
1871	207667	96	176951 (81.7)	3239 (1.5)	180190 (83.2)
1861	155142	72	127704 (59)	3155 (1.5)	130859 (60.4)
1856	150154	69	123577 (57.1)	3048 (1.4)	126580 (58.5)
1851	147224	68	121165 (56)	2989 (1.4)	124110 (57.3)
1836	99955	46	82263 (38)	2029 (0.9)	84262 (38.9)
1821	81429	38	67016 (31)	1653 (0.8)	68645 (31.7)
1800	70176	32	57755 (26.7)	1425 (0.7)	59158 (27.3)

**=Total area - (forest + barren & uncultivable area+ non agricultural use)*

Note: The human population of Dharapuram taluk in 1881 was 11.8% of the Coimbatore district. Based on this figure, the population before 1881 was derived from the population of Coimbatore district. Statistics for area occupied in 1861 was used to estimate the area occupied per person. Area occupied prior to 1861 was estimated by multiplying the area occupied per person (1861) and the human population of the respective years. Figures in parentheses indicate the percent of above.

The first and the foremost factor in making a wasteland / degraded land / common property resources (CPR) into a sustainable production system are to instill a sense of ownership among the farmers. Having assigned the ownership rights encourages the farmers to invest in land and it takes a few generations to improve the production capacity of a wasteland/ degraded land. Therefore, security of tenure is of paramount importance. The ownership, be it vested in an individual farmer or in a community in a real sense has done wonders in improving the productivity of the land and devising the benefit-sharing mechanisms among the stakeholders. The '*tragedy of the commons*' (Hardin, 1968) is that in most of the cases the community does not have effective control of the CPRs which have been usurped by the unscrupulous elements in the society. There is evidence (Archana and Sharma 2009) that wherever the society has risen up to take up

the common cause by evicting the illegal encroachers, the CPRs have been rejuvenated and an acceptable benefit sharing mechanisms arrived at.

Area and population

The total human population in the grassland in three districts covering an area of 3841 sq km is 764,913 with a population density of 199 persons per sq km (2001) (Table 2). In the year 1800 AD, the population of Dharapuram taluk in Coimbatore district (area 2165 sq km) was only 70176 with a population density of 32 persons per sq km and only 26.7 percent of the area was occupied (Table 1). During this period, farmers were forced to rent more land than they could till (Buchanan 1807), so that the British colonizers would get more revenue. Between 1800 and 1881, was the period of expansion. The increase in human population resulted in 85.8 percent of the area occupied by the people with a peak population density of 96 persons per sq km (1871), although it declined to 90 persons per sq km in 1881 because of severe famine that occurred in 1877-78. Beyond 1881, there was little land left for expansion. Thereafter, it was period of consolidation and improving the land by digging wells and erecting live fence which will be discussed later in the text. The human population growth rate in Dharapuram taluk in the erstwhile Coimbatore district between 1800 and 1891 was 1.42 percent p.a. which slowed down in the next one hundred years between 1891 – 1991 at 0.45 % p.a., as against 1.45 for the whole of India during the same period (GOI 2009). This indicates a stable human population in this region, which only the advanced western countries can currently boast of. The wisdom of the people and their conscious decision to keep families small needs to be appreciated in context of fear of fragmentation of grazing lands making them unviable. In the grassland of Karur district, the growth rate in human population between 1931 - 1991 was 0.52 percent p.a. and between 1991 and 2001, the human population actually declined at the rate of 0.09 p.a. In the present study we found that 45 percent of the family had only one child and 40 percent had 2 children. The people in the region pointed out that further fragmentation of grazing lands would make them unviable because of high cost of management of fence and limited duration of grazing permitted for the animals. Therefore, couples mostly restrict their family by having only one or two child(ren) by undergoing sterilization (mostly the females) irrespective of the sex of the child. This is in contrast with the scenario seen in most parts of India, or the male dominated society elsewhere in the world, where there is a marked preference for a male child. Historically also, the region has not shown any negative bias towards girl child as can be seen from the population data where there were 1051 females per 1000 male in 1931, 1006 in 1991 and 1010 in 2001 in the grasslands of Karur district (Table 3).

Table. 2 Area and population in the Kangayam grassland-blockwise

District	Erode					Karur		CBE		Total
Blocks	Kangayam	Kundadam	Mulanur	Dharapuram	Vellakovil	K.Parmathi	Aravakurichi	Palladam	Pongalur	
Area (sq Km)	348	575	462	474	358	539	437	298	350	3841
Human population	74801	79528	65109	90665	85837	85920	81056	136353	65644	764913
Population density	215	138	141	191	240	159	186	458	187	199

(no./sq km)				

CBE = Coimbatore

Table 3. Human population in grasslands (Aravakurichi and K. Parmathi blocks) of Karur district

		2001	1991	1931
Human population		146536	147811	108420
Male		72894	73886	52820
Female		73642	74313	55520
No of female/1000 male		1010	1006	1051
Growth rate (% p.a.)				
1931-1991	0.52			
1991-2001	-0.09			
1931-2001	0.43			

Rainfall and its distribution

The grassland is located in the rain shadow area of the Western Ghats which means rainfall is reduced. The shadowing effect of the chain of mountains towards the east of the grassland can be appreciated from the fact that in less than 50 km distance the total annual rainfall of over 3,000 mm (along Western Ghats) is reduced to less than 700 mm in Kangayam grassland (Table 4). The south west monsoon (June-September) brings the bulk of rain in the Indian sub continent, but it fails to drench the Kangayam grassland because the rain-laden clouds coming from the Arabian sea are emptied along the Western Ghats, bringing only 191 mm of rainfall (29% of the total) and cool breezes in the grassland. Even this meager rainfall brings life to the grassland and the dormant, grazed tussocks begin sprouting, giving the first flush of the grass crop. The bulk of the rain in the grassland is received during the retreating north-east monsoon (Oct-Jan). During this period 330 mm rain (50% of the total) is received which gives the second flush of grass crop, besides initiating other farm activities. The remaining hot summer months (Feb-May) get only 145 mm of rainfall (22 % of the total). Thus, a total of 666 mm annual rainfall is received in the Kangayam grassland. The quantity of rain and its distribution is hardly sufficient for raising the traditional grain crops. But the rainfall distribution and the soil condition encourages healthy growth of grasses. Even the crop that is raised during the north-east monsoon is primarily meant for the livestock, as discussed later.

Table 4. Seasonal pattern of rainfall distribution in different districts

Season\ districts	Erode	Karur	Coimbatore	Average
Hot summer (Feb-May)	149	144	142	145 (21.7%)
S-W monsoon (Jun-Sept)	128	340	106	191 (28.7%)
N-E Monsoon (Oct-Jan)	340	223	428	330 (49.6%)
Total (mm)	617	707	675	666

(100%)

Land use and landholding pattern

The land holding pattern of the Kangayam grassland has been studied by taking the case of Dharapuram taluk (of 1800 AD) which covers over 50 percent of the area under grassland. The Dharapuram taluk comprising five blocks is predominantly agrarian in character. 84.2 percent of the total workforce is engaged in agricultural activities, of which 37.4 percent are cultivators and 46.8 percent are agricultural labourers. The remaining 15.8 percent of the workforce is engaged in other pursuits like handloom weaving, poultry production etc. This region also provides a backward linkage to export oriented hosiery and cotton industry of Tripur located in Coimbatore district. Yarns from Tripur are brought here and woven into clothes and sent back for final stitching. Thus, farmers get gainful employment during their spare times.

Table 5. District wise land use pattern (in ha) in the grassland

Sl no	Landuse category	Districts			
		Erode	Karur	CBE	Total
1	Forest	1156	294	0	1450 (0.38)
2	Barren & Uncultivable	626	528	32	1186 (0.31)
3	Non-Ag. Use	20776	8433	6513	35722 (9.38)
4	Cultivable waste	55	34124	269	34448 (9.05)
5	Pasture & Grazing land	80	6975	20	7075 (1.86)
6	Misc. tree crops	268	115	87	470 (0.12)
7	Current fallow	46969	6264	16610	69843 (18.34)
	Other fallow	82886	22167	15961	121014 (31.78)
9	Net area sown	65583	18716	25290	109589 (28.78)
10	Geographical area*	218399	97616	64782	380797 (100)
11	Area sown more than once	461	5	139	605 (0.16)
12	Grazing area (2+4+5+7+8)	130616	70058	32892	233566 (61.3)

** As per revenue record; Figures in parentheses indicate percent of the total*

The Kangayam grassland has only 0.38 percent of land under forest and 1.86 percent under pasture and grazing land (Table 5). But they both do not represent the correct picture of the grassland as discussed in the following paragraphs. The land use pattern of whole of the grassland (Table 6) indicate that the 61.3 percent of the area is under grazing. The percent area under cultivation has remained almost constant over last 200 years, as Buchanan (1807) reported that only a quarter of the dry fields were under

cultivation and in 2002-03 it is still 28.8 percent of the total. The area cropped more than once is meager (0.16 percent). This means that the area sown could also be potentially used as grazing area after the crop is harvested. Thus, considering land use pattern and land holding together, we can assume that between 60 to 70 percent of the area in the grassland is exclusively devoted for grazing by the livestock.

Table 6 District wise landholding (in ha) pattern in the Grassland

Size of land holding (ha)	Erode	Karur	CBE	Total
<0.5	3736	568	1807	6111 (1.9)
0.5-1.0	10657	3291	5224	19173 (5.8)
1.0-2.0	28107	8743	13000	49850 (15.2)
2.0-3.0	27393	9219	9026	45639 (13.9)
3.0-4.0	23784	7952	6424	38160 (11.6)
4.0-5.0	19362	7706	4269	31338 (9.5)
5.0-7.5	34685	12559	5825	53070 (16.2)
7.5-10.0	18493	9106	2791	30391 (9.2)
>10	29601	21161	4071	54832 (16.7)
Total	195819	80306	52438	328562 (100)

Role of wells in the grassland

Presence of wells in the Kangayam grassland has an important role to play. In the garden lands near homestead they help grow crops for human consumption and in the far off grazing paddocks, they are used to draw water for drinking of animals. After getting the government wastelands on lease between 1855 and 1881, the farmers started the process of consolidation by growing live fence and digging new wells. In 1881, there were 9835 number of wells which irrigated 18799 ha of land (Table 7) at an average of 1.9 ha per well (Nicholson 1887). By 2002, the number of wells increased by 386 percent to 47826. But the area irrigated by well increased by only 23.2 percent. Assuming the per unit area irrigated by well to be similar in 2002 as in 1881, total area irrigated by wells in 2002 required 12117 wells only. Therefore, the remaining 35709 wells were dug up by the farmers in the wastelands held on puttah in the last one hundred year. Construction of new wells was also encouraged by the generous loans provided by the British rulers in the form of *taccavi* advances (Voelcker 1893). The new wells dug up were primarily meant to water the animals that remained day in and out for months together between July and February. Voelcker (1893) observed that anything which induces the people to

invest money on the land gives them a permanent interest in the continuance of the English rule.

Table 7. Increase in number of wells in the Kangayam grassland between 1881 and 2002

Year	No of wells	Area irrigated, ha	Per unit area irrigated by well (ha/ well)
1881	9835	18799	1.91
2002	47826	23161	0.48
% increase between 1881 and 2002	386.3	23.2	

Livestock

The ownership pattern of livestock (Table 8) in the Kangayam grassland indicate that the 70 percent of the farmers own 1 to 4 cattle or buffalo, 65 percent own 15 or more sheep and 85 percent of the farmers do not own any goat. The grassland is well known for the Kangayam breed of draft cattle which were earlier used for drawing water from the wells and ploughing dry lands. Now a days, because of mechanization of agriculture, most of the agricultural operations are carried out by tractors hence, the Kangayam cattle has gradually been replaced by crossbred cattle and buffaloes. However, the Kangayam cattle could still be seen in cities transporting water in tankers. Vivekanandan (2007) reported that the crossbred population in the Kangayam grassland was 43% of the total cattle. Although crossbred cattle have made their presence in the grassland over last decade, at many places, the farmers pointed out that these cattle require much attention and they would prefer to try indigenous dual purpose breed like Tharparker which give moderate milk up to 5- 7 litres and are very tolerant to extreme climatic conditions. Buffalo are also predominant in the Kangayam grassland and they are mostly of Murrah breed. Murrah breed of buffalo is the best milch breed of the world and they are kept mostly for milk production. There are two breeds of sheep found in the grassland- *Curumbar* and *Shyambliar*. The *Curumbar* is a wooly breed with white body and black head while the *Shyambliar* is hairy breed of sheep, hornless and generally brown in colour and is also known as Mecheri breed. The farmers informed us that over the years the hairy breed of sheep have almost completely replaced the wooly breed because the mutton of Mecheri sheep is more preferred and are in great demand. Moreover, the skin of this breed makes good export quality leather. The goats are not a preferred animal in the Kangayam grassland because they demand constant attention of their keepers and damage the fence of *B. berryi*. Some farmers in Aravakurichi block in Karur district reported that several village panchayats of the area had resolved in the past to banish goats from the region and impose heavy fine on the keepers whose goats were found straying into the grazing paddocks. We noticed very few herds of goats in the region being grazed along the roadsides and they mostly belonged to the landless people. The livestock population in the grassland is presented in table 13. There are 1019 number of livestock per 1000 people, which indicates that high dependence of people on the livestock for their livelihood. Nicholson (1887) has also observed that pasture growing is often a better speculation than crop growing in this region. The livestock pressure in the grassland is also moderate as there are 0.82 ACU per ha.

Table 8. Livestock population and other attributes in the grassland

	Erode	Karur	CBE	Total
	Population			
Cattle	87312	25049	29453	141814
Buffalo	68534	27240	8234	104008
Sheep	224383	162264	15693	402340
Goat	89018	23792	18362	131172
Total	469247	238345	71742	779334
Livestock no/ 1000 human beings	1185	1427	355	1019
Total ACU	195771	78764	41742	316276
ACU/ha	0.88	0.81	0.64	0.82

The good practices in the grassland

The management of grazing lands today is the culmination of a series of good practices adopted by the farmers over one hundred and fifty years. The paddock system of grassland management has evolved from the wasteland into an organized system of management. The region does not have any community land and all land including grazing lands is under private ownership. Littlewood (1936) observed that in Dharapuram taluk, there is no culturable waste, no communal grazing land, and no forest grazing, yet it is one of the best known cattle breeding centres of the Presidency, and its cattle have a higher market value than any other, besides which, it contains some of the best garden cultivation to be seen anywhere in India, as well as an excellent mixed farming. Munro (1931) reported that systematic planting and grazing of grass was practiced in some parts of Coimbatore district e.g., in the taluks of Dharapuram, Erode, Gobichettipalaiyam, Coimbatore and Palladam and the system at its best could be seen in the Kangayam tract of Dharapuram.

The task force on grasslands and deserts (Planning Commission 2007) constituted by the Government of India observed that the importance of rotational or seasonal grazing, some control on free ranging animals, total protection of selected grassland plots to serve as nucleus for seed bank, secure tenure for pastoralists (both resident and nomadic) over pastures, and genetic improvement of livestock (using indigenous breeds, not exotics ones) have not been taken in to consideration in animal husbandry programmes of the country. The Kangayam grassland fulfills most of the wishes of the Grassland Task Force as explained in this paper.

Among other factors that have contributed to the success of the Kangayam grassland, absence of communal grazing land could have been one of the most important factors. It is difficult to find a direct evidence for it but the deplorable conditions of community grazing lands all over the country is so obvious, we are ready to accept that absence of the communal grazing land may have a positive effect on its sustainability. Almost all the unoccupied and wastelands in the Kangayam grassland were given on lease (*Pillu Patta*) to the farmers between 1855 and 1891 (Table 1). A century ago Nicholson (1887) had

also observed that as far as communal grazing land is concerned, there is everything against it. Where there is communal grazing, every ryot in the village naturally claims as large a share of it as possible, with the result that grazing lands are always overstocked, are never given rest and are usually little more than exercise grounds for cattle. He also reported that when the grazing were regulated, pastures not overstocked, and manure not removed from ground, excellent pasturage should in time be formed.

Use of B. berryi as live hedges

The importance of *Balsmodendron berryi* (also called *Mulu-kilivey*) was known to the people of the region even in 1800 AD. Buchanan had made an extensive survey of the area in 1800 on the directions of the East India Company and the type of fence being used in the fields by the people was a point covered. This enquiry may have been prompted by the "Inclosure acts" which were passed in England starting 1750 which enclosed the open fields in the country (The Isles Project 2010). Between 1750 and 1860, over 5000 individual 'Inclosure acts' were passed and 21% of land in England was enclosed, amounting to nearly 28,000 km². The enclosures made it easier for farmers to try out new farming techniques. Farmers could now invest in new machinery for use on their land, work in one area and not waste time walking between strips of land. The enclosed land was also useful for farmers wanting to experiment with selective breeding and new crops from abroad.

Buchnan (1807) had reported that many of the hedges in Coimbatore district were of *Mulu-kilivey*, which made good fence. Its cuttings were put in the ground between 12th March and the 10th April and it quickly took roots. It formed a good fence against cattle but seemed to require a better soil than either *Ephorbium tirucalli* or the *Euphorbium antiquorum*, which were the most common hedges in the district. Although Buchanan (1807) has reported that *Ephorbium tirucalli* and *Euphorbium antiquorum* were more commonly used as fence in the early nineteenth century, we found almost all the paddocks used *B. berryi* as live fence. This could be because in the early nineteenth century most of the uncultivated lands were over grown with cactus and as they were brought into puttah and organized for systematic livestock production, fence of *B. berryi* were used. Voelcker (1893) had reported that hedges of *B. berryi* were found over the greater part of Coimbatore and cattle trespass was rare, cattle and crops were protected, large quantities of fuel supplied, and protection was given to growing trees. Under the paddock system of management, the grazing land is conveniently divided into paddocks of 2 - 4.5 ha, although very large paddocks also exist (Table 6). The paddocks are separated by straight rows of live fence of *B. berryi*. The live fence of *B. berryi* has width of 0.6 – 0.75 m and height 1.5 m. There are 16 stalks every meter of length of the fence arranged in two rows of 8 each. The hedge is pruned every two years and gap filling is done by planting the stem during June-July. In Edaiyakottai village, *Moringa* trees and *Agave americana* are also grown along live hedge. The fruits of Moringa are widely used in the traditional dishes of the region and provide additional income to the farmers. If the live hedge were to be replaced by barbed wire fence to secure the paddocks in the Kangayam region, it would cost approximately Rs. 1500 crore.

Management of grasses and reseeding of pasture

The dominant species in the grassland is *Cenchrus* which has a tussock density of 18-25 per sq. m. Reseeding with seeds of *Cenchrus* is done by broadcasting to boost the forage yield in subsequent years. Cenchrus is a hardy grass species. Continuous grazing by the livestock inside the paddock leaves only the tussock from which new shoots come up upon the onset of rain. 80 percent of the farmers reported that the pasture regenerates itself and do not require reseeding. However, 20 percent of the farmers reported that reseeding is done once in 4 to 6 years for better growth of grasses and to obtain higher biomass for livestock feeding.

Rotation of animals between paddocks to prevent overgrazing

A paddock usually has 1 or 2 cattle/ buffalo and 25-30 sheep. The animals are kept in the paddock day in and out for months together and they are rotated between the paddocks as per the fodder availability. This practice has been in vogue since the paddock system started. Nicholson (1887) also reported that grazing in these paddocks were regulated, pastures not overstocked and manures not removed from the ground, which resulted in excellent pasturage.

Withholding animals from paddocks after rains to let the grass come up

The rainfall in the grassland is not sufficient for cultivating cereal crops but encourages healthy growth of grasses. The grassland usually witness two flushes of grass growth. The minor one occurs after the rain in May and the major one in September-October. The animals are withheld from the pasture for one month after rain in May and September each, to let the pasture come up well. From mid June to mid September and from mid October to January, the animals remain on pasture alone and are not provided with any supplementary feed.

Enrichment of forage with incorporation of legumes and the feeding practices

The spread of dairy co-operatives in India has provided opportunities to millions of livestock keepers in the villages with one or two milch animals to obtain gainful employment and supplementary income by selling to the milk collection centres run by the co-operatives. The success of dairy co-operatives ushered in 'White Revolution' in India which resulted in farmers taking more care of their animals. In many areas of the Kangayam grassland, progressive farmers plough the cenchrus dominated field in alternate years and sow them with seeds of *Phaseolus trilobus* @12.5 kg per ha in October and a good crop of legume and grass comes up. Cattle and buffaloes are tethered in such fields who graze close to the ground. The animals are advanced a few meters every day to get the required intake. This practice continues from mid December till mid January, where after the mixed crop is harvested when still green, dried and stored for lean season feeding.

The trend of pushing crops not suitable for an area without the back up of irrigation may result in "Green Famine " as witnessed in many parts of Africa. For example, crops such as maize, not suitable for unreliable and erratic rainfall were introduced in some parts of Africa and year after year "poor" weather has been blamed for its failure to produce grain (Rinaudo 2002). The Planning Commission of India (2001) also holds the opinion that

livestock in the rainfed areas of the country contribute more than 70 percent of the family income and hence recommends that sustainable animal production should be promoted in such areas, rather than extending the crops, by improving the production of traditional pastures through improved technologies.

The usual feeding practices of animals reared in the Kangayam grassland is to let them graze inside the paddocks from July to February. During this period animals are hardly given any supplementary feeding. However, from March to June, there remains almost nothing to graze inside the paddock which necessitates supplementary feeding for animals while still being inside the paddocks. The animals are fed with stored sorghum, pearl millet stalks, tapioca leaves and the grass-legume hay. Sorghum is mostly obtained from the fields cultivated once in 4-5 years which is harvested at 50 percent flowering and stored for lean period feeding. Pearl millet and tapioca leaves are obtained from the fields under well irrigation. The lactating animals are given 1.5 to 2.0 kg rice bran mixed with wheat bran soaked in water overnight. Sheep are provided with 150-200 g of rice bran per head. Besides, the Acacia pods collected are also fed to animals. In periods of severe drought, palmyra leaves are lopped and fed to animals.

Judicious selection of livestock breeds

In the past, the Kangayam grassland was known for its prized 'Kangayam' breed of cattle which was used for heavy work like ploughing and carting water in tankers. However, with the mechanization of agriculture, the cattle have gone out of business and hence they are slowly being replaced by crossbred cattle. Vivekanandan (2007) reported that the crossbred population in the Kangayam grassland was 43% of the total cattle. Sheep are the choice of animal reared in paddocks which are far off and where daily milk collection is not possible. Alternatively, the farmers buy growing heifers/ dry cows and rear them until calving and then sell off to peri-urban dairies. A report by ILRI (2000) has also noted that raising livestock in the drier areas and finishing them in more intensive system closer to the final markets may offer the best option to increase productivity and the best opportunity to improve pastoralists' incomes. The sheep have flourished in the grassland because they are hardy, less demanding, and take very little of the farmers' time. Once inside the paddock they remain there for months at a time. However every evening they are herded into a small enclosure inside the paddock (5x 4.5 sq m for 30 sheep) and a dog keeps guard from the predating wolves. Between mid November- mid January, the enclosure is covered with a polythene sheet to protect the sheep from dew in the night.

Conclusions

The sustainable management of the Kangayam grassland is the culmination of several factors which started by giving the wastelands on lease to the farmers. The Kangayam grassland in its present state of expanse has been in vogue for the last one hundred and fifty years. The grazing lands in the Kangayam region are all in private ownership and there are no communal grazing lands. The unoccupied wastelands were taken on puttah (lease) by a growing human population between 1855 and 1881 and live fence of *B. berryi* was raised along the field boundary. A system of rotational grazing of livestock in

the paddocks was introduced which required minimal labor input. Careful management of the grazing paddocks was adhered to, among which was the withholding of animals for a month after initiation of rain to let the grass crop come up well and maintaining the optimum number of Acacia trees. Supplementary feeding is also practiced during lean period between March and June when the grass is almost completely grazed by the animals. The sustainable management of the grassland over a century also had some positive social spinoffs such as moderate growth in human population and a healthy female to male ratio. Conversely, the necessity to check human population growth may also have arisen to prevent the fragmentation of land making them unsustainable. The grassland provides some important lessons to emulate and replicate elsewhere in the areas of policy measures, technological interventions, and collective action for sustainable management of grassland in rain deficit region.

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