Indigenous People and Geographic Information Systems for micro level Forest Management

A case study in Parambikulam Wildlife Sanctuary

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Key Words
Indigenous Knowledge, Indigenous People, Natives, GIS, Forest Management, Streams, Seasonality and Tiger Distribution

Abstract
Parambikulam wildlife Sanctuary, located in the oblivions of Anamalai hills, in Palakkad district of Kerala is highly traversed by streams of the upper reaches of Chalakkudy River. Major part of the sanctuary becomes dry for a period from December to May. An inventory of the seasonal character of individual stream segments across a year can act as a knowledge source for forest administrators in effective habitat management planning. It is also equally important to know the distribution of critical species in the sanctuary. The paper describes three separate attempts, all part of the 10 year management plan preparation process carried out from the year 2001 to 2002 where in inputs from and efforts of indigenous people were used in preparing a forest management planning database; first, it describes how indigenous people and their knowledge on the seasonality of the streams were collected and compiled into a GIS, second, how these communities helped in collecting information and mapping tiger distribution in the sanctuary and third how the assistance from indigenous people were utilized in collecting soil samples for a scientific analysis. Such attempts incorporating indigenous communities in scientific forest management planning will bridge the gap between bureaucracy and local communities, thereby resulting in a harmonious forest management scenario. Further, these datasets can act as inputs in scientific models that require input parameters related to the seasonality of streams, for example, mapping zones of varying soil moisture and erosion, as it was the case with the present study. Present study was the humble attempt of a geographer and a forest administrator in utilizing indigenous people and their local knowledge as data sources in GIS for effective forest management. The attempt resulted in a detailed GIS database containing the seasonality of the streams and also in deriving a generalized map of the distribution of tigers in the sanctuary.

Introduction

Modern-day forest management paradigm considers Indigenous People (hereafter IP) and Indigenous Knowledge (hereafter IK) they possess, to be important and valuable inputs for forest management planning, database generation and even decision making process, drastically diverting from erstwhile concept of natives. The term Indigenous Knowledge was coined and first used by Brokensha, Warren and Werner, in their 1980, edited volume Indigenous Knowledge Systems and Development. Their goal was to find a term that "represented the dynamic contributions of any community to problem solving, based on their own perceptions and conceptions, and the ways that they identified, categorized and classified phenomena important to them" (Warren 1996). Indigenous Knowledge, more recently has also come to be recognized as "local knowledge that is unique to a given culture" (Flavier et al. 1995). Sui and Waldron state "…IK should be treated as any other set of data to be factored in to the scientific decision-making process". Lawas and Luning (1998), states, "There is a general agreement that the concepts 'indigenous knowledge' (IK), 'traditional knowledge', 'local knowledge', 'community knowledge' and

'rural people knowledge' are all terms for knowledge belonging to grassroots people. Thus in a more unconstrained manner, indigenous knowledge can be defined as the local knowledge processed by indigenous communities about their milieu. Therefore, terms indigenous knowledge, local knowledge and traditional knowledge are used throughout the article to refer to the knowledge possessed by the traditional inhabitants of the sanctuary about their surroundings. The Indigenous People (tribal) of Parambikulam are referred though out the article as natives.

Geographic Information System (hereafter GIS), the most modern tool available for a forest administrator enables a better quantification, storage and retrieval of collected IK. More over, it enables to create, analyze and process scenarios, using the stored data. GIS is simply defined as 'a powerful set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world' (Burrough, 1986). It is a system that acts as a platform for integrating information and ideas developed in many disciplines including the field of geography, IK, forestry, surveying and zoology, to name a few.

The utility of GIS and its inseparable relationship with IP and IK is well explained by Pathak (1997); he states 'Geographical Information System (GIS) helps foresters meet the challenges of integrating bio-physical and socio-economic information and drawing inferences regarding the complex interaction between people and their environment… It (GIS) enables foresters to incorporate the knowledge and participation of community members in planning, managing and evaluating local forestry projects. This process helps link community needs with project benefits'.

The article elaborates on three different instances in Parambikulam Wildlife Sanctuary wherein local and useful information was collected from and through IP and integrated into a forest management context through a GIS database. The paper is an extract from the two year management plan preparation process, spanning from 2001 to 2002, that included the preparation of the ten (10) year management plan (Fourth Management Plan; 2002 – 2012), a customized geographic information system, a website and a CD-Rom generaleria of the sanctuary. These projects were funded under Kerala Forestry Project (KFP).

Relevance

Parambikulam valley, which forms a major catchment of the Chalakkudy River, is to a great extent, bestrewed by a large number of stream segments (Map 2.a, Table 1). Even though a considerable number of stream segments are present, many of them are not perennial. The seasonality status of each stream segment is of great relevance to forest administrators. Decisions are to be made from time to time regarding the civil works to be undertaken in areas requiring soil erosion control, soil moisture conservation activities and also from time to time, meet the fresh water requirements of wildlife by digging waterholes. Construction of check dams and gully plugging, etc. requires a comprehensive database regarding the seasonality characteristics of the streams. Further, such a database can also serve as base data for many problems requiring spatial analysis. Maps pertaining to such data sets and cross-tabulated results of such a database are of great importance for a ten (10) year comprehensive management plan of any wildlife sanctuary.

Tiger monitoring, utilizing the pugmarks collected from impression pads is an ongoing project for the last 5 years (Pugazhendi, 2002) under the tiger-monitoring cell functioning in the sanctuary. The impression pads for pugmark collection were laid at locations suggested by local communities. Sizable amount of data regarding the number,
gender, size, age etc of the tigers that freely rove the sanctuary are available. Tigers are highly territorial animals; individual tiger claims a particular piece of land as his/her territory. There were only vague ideas about the exact area that could be claimed as the territory of an individual tiger in the sanctuary. The pattern of distribution of tigers within the sanctuary was also a question that required an answer, as it can aid in further deciding upon the locations of new impression pads. Further, such a database can also aid in conducting tiger vise behavior studies, their food habits and their response to different habitats.

Even though there existed a general idea on the soil and soil characteristics of the sanctuary, the ten-year comprehensive management plan demanded a much elaborate database. Planning on restoration of natural habitat, particularly when the requirement of artificial assistance is high, requires a comprehensive knowledge about the Physico-Chemical characteristics of the

soil. Habitat wise information of the soil characteristics will enable forest administrators in deciding the best species of saplings to be planted at a given area.

All these efforts and even more were required to prepare a 10 year Management Plan for the sanctuary. However, the available time and money for such a comprehensive project was considerably limited compared to the efforts required. A practical solution to accumulate and analyze as much data as possible in a short period of 2 years with a given financial constrain had to be worked out. The following efforts are a result of such a search for quick, pragmatic and relevant information within the constrained situation of forest management in the developing countries, especially in India.

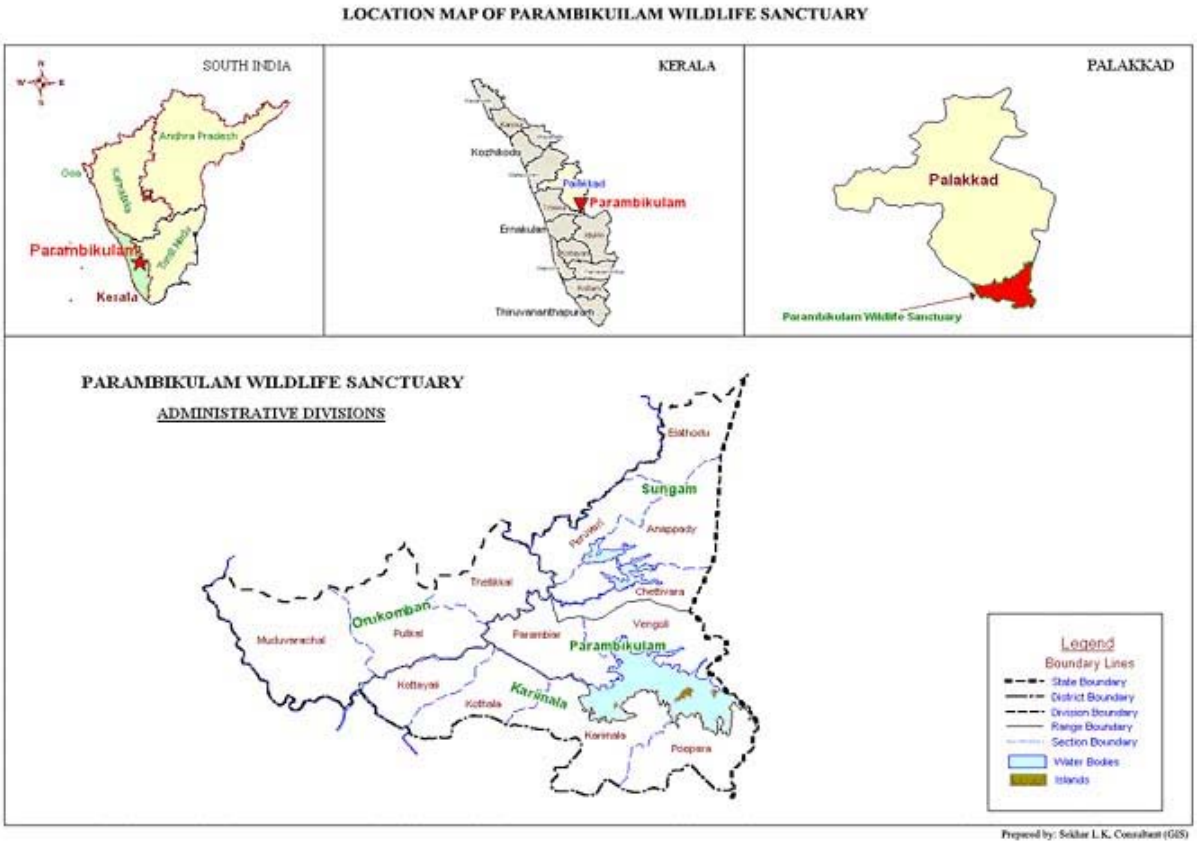
Study Area

Parambikulam Wildlife Sanctuary lies between the longitudes 76° 35' and 76° 50' East and latitudes 10° 20' and 10° 26' North (Map 1). The sanctuary lies in the Chittur taluk of Palakkad revenue district in the state of Kerala. Surrounding the sanctuary are Pollachi and Valparai taluks of Coimbatore district in the state of Tamil Nadu and Thrissur and Mukundapuram taluks of Thrissur district of Kerala, India.

Lying in the southern part of Western Ghats, immediately south of Palghat gap, Parambikulam Wildlife Sanctuary, exhibits a mountainous terrain. The sanctuary lies between the Anamalai hills and Nelliampathy hills. Altitude ranges between 300m and 1438m above MSL. There are 7 major valleys and 3 major river systems. Geologically, the sanctuary has hornblende biotite gnesis and charnockites. Major peaks in the sanctuary are Karimala (1438m), Pandaravarai (1290m), Kuchimudi, Vengoli (1120m) and Puliyarapadam (1010m). Apart from the natural rivers and streams, the sanctuary possesses 3 man-made reserviors namely Parambikulam, Thunacadavu and Peruvaripallam whose cumulative water spread is 20.66 sq. km.

Parambikulam Wildlife Sanctuary is the most protected ecological piece of Anamalai sub unit of Western Ghats. Surrounded on all sides by protected areas and sanctuaries of Kerala and Tamil Nadu, The sanctuary is endowed with a variety of peninsular flora and fauna, which are excellently conserved due to total protection and minimal human interferences. The sanctuary is part of a major ecological continuum from Peechi to Eravikulam through Anamalai, which aids the survival of large viable populations of wildlife possible.

The sanctuary exhibits wet tropical climate. Temperature varies from 15° C to 32° C. March is the hottest month and January, the coolest month. Total rainfall varies between 1400mm and 2300mm. July is the wettest month and January, the driest. Sanctuary is blessed with rain during both South West and North East monsoons.



Native People

Parambikulam Wildlife Sanctuary is the home of 4 different indigenous communities viz., Kadar, Malasar, Muduvar and Malamalasar who are appreciably different in their cultural, socio-economic and spatial organization. These four ethnic groups are settled in six colonies. Another non-native human settlement is also there known as P.A.P. colony, which came into existence in the 1950's and 1960's during the construction of the three dams for Parambikulam-Aliyar Project, which is an inter-state multipurpose project. The settlements are widely distributed in the sanctuary, that each community in the sanctuary knows one or the other part of the area in detail. The teams actively involved in the entire set of projects were hand picked natives from every community and colony having a good knowledge of some or the other part of the forest. It is relevant to mention the anthropogenic groups that the natives of Parambikulam belong to.

- Kadar otherwise known as "Kadir" (Thurston, 1906) is the primitive inhabitant of Anamalai hills. They are short statured, dark skinned and platyrhine (flat nosed). Their original language is a mixture of Tamil and Malayalam. According to Thurston, they are nomadic.
- Malasar used to live in small hamlets abutting the forest on the hills of Anamalai, Palakkad and Darapuram. They speak a mixture of Tamil and Malayalam. Malasars are sturdier in build but do not have the characteristic features of Hill men (Thurston, 1906). Malasars traditionally were Non Wood Forest Products collectors and also used to work as labours.
- Muduva also known as "Mudugar" are traditional cultivators living in the hills of Anamalais and Idukki areas. They practiced slash and burn cultivation. They speak a dialect closely related to Tamil with few Malayalam words. Thurston found a mixture of West Coast and East Coast cultures in them.
- Malamalasar are also known as "Mahamalasar" and "Malaimalasar" as noted in the Encyclopaedia of Indian Tribes (1989) and "Malamanushyar" (Susmita and Sekhar, 2001). They are taller than Malasar, well built, dark brown and have prominent nose and thin lips. They are generally nomadic who shift their settlements frequently. They speak a dialect, officially named as ‘Malasir’.

Methodology

The authors have tried preserving an innovative attitude towards the work right from choosing the software to the way of executing the project. The software that was used for the tasks was Spring 3.5 from Brazil's National Institute for Space Research (INPE). Existing maps were scanned in A0 with the help of Department of Geography, University of Madras. Raster images were then registered using the registering module of the software and vector layers were prepared. These layers were later exported to the '.tab' file format of MapInfo and were finalized. The files were further exported to '.shp' format and customized using Map Objects from ESRI.

Drainage maps were prepared in section level (smallest administrative unit of a sanctuary) accompanied by a table (Appendix 1) to be filled by the staff (foresters and guards) as they were entrusted to visit individual stream segments in the respective section, strictly along with natives. The department staff had no liberty in inking the tables other than with those observations made by the natives on the seasonality of the streams. Natives, mostly the local tribes are very much aware of the water flow status of the streams (even to the scale of First Order Streams) in the sanctuary. The table carried unique identification codes for each stream and thirteen cells corresponding to each stream pertaining to twelve (12) months and one extra, for collecting the water flow status of each stream through out the year. The options to be filled in the cells were, 'yes and no'; if 'yes' water flows during that month, if 'no' water does not flow during that month. Based on the collected data, stream segments of the sanctuary were classified into three, Perennial, Partially Perennial and Non-Perennial. Streams that have water flow for more than 10 months were classified as perennial; those with water flow for a period of 6 to 10 months were classified as partially perennial and those with water flow for less than 6 months, as non-perennial. The status thus derived was verified for accuracy in some randomly chosen stream segments. Training was imparted to the staff in the field identification of individual, mapped, stream segment. However, staff had the discretion of choosing the most suitable native(s) for a particular area. The whole exercise was to be carried out in a period of one month; given the area to be covered and the terrain, it appeared to be an insurmountable task but without inputs from indigenous people.

In light of the compiled database from the tiger-monitoring cell, a team of tiger monitoring staff, mostly natives, under the guidance of the Wildlife Assistant (a department official) was sent for collecting the Lat/Long information of impression pads using Global Positioning System (GPS) handsets. Measures were taken to reduce the Estimated Position Error. Depending on the frequency of visit to each impression pad by a particular tiger, pad location was assigned to the animal that visited the site most. This enabled the researchers to identify the territory of individual tigers and position each tiger by determining the mean center of the impression pad locations that it visited the most. This point was considered as a static location to refer to the particular tiger for all practical purposes and especially for mapping the distribution. The task had to be completed with a period of two weeks.

Teams of natives were sent to previously chosen locations in every habitat type of the sanctuary to collect soil samples. Locations were selected randomly but care was taken so that every unique habitat type in the sanctuary is represented. Training was imparted to them on the systematic collection of soil samples using V-ditches. Collected samples where sent to Tamil Nadu Soil Survery Laboratory, Coimbatore. The samples were analyzed for its physico-chemical characteristics such as, pH, Electrical Conductivity, Organic Carbon and Cation Exchange Capacity; physical characters like texture, maximum water holding capacity, porosity, etc; and status of macro-nutrient (N, P and K) and micro-nutrients (Zn, Cu, Mg and Fe). The effort has to be completed within a period of one month.

Results and Discussion

The necessity of using Spring 3.5 was to remain independent of commercially supplied software. Governmental departments in developing countries lack the necessary amount of money to be continually depended on commercially supplied software. The experience in developing countries as understood is that enough and more financial assistance will be available during a project period, as and when the project is completed, all the facilities put in place using expensive and commercially supplied products will run redundant. The present effort was just an attempt to draw attention towards which independent initiatives such as this can move. However, there were

crucial issues that could not be addressed using Spring due to lack of work proficiency in it, which necessitated the use of commercially supplied software in a later stage.

The survey resulted in enormous quantity of data, which were coded into the vector drainage layer of the sanctuary. The vector layer for drainage data was prepared based on Strahler's method of Stream Ordering (Map 2.a). This enabled in issuing queries that resulted in cross-tabulating and summarizing the number of streams in each order, number of streams in each order with a given seasonality and so on (Table 1). Seasonality Map (Map 2.b) of the sanctuary was prepared. The database served as one of the major parameters in analyzing and preparing maps of the soil moisture conservation category areas and soil erosion vulnerability classes (Map 3.a & b). The database served as the primary parameter in identifying and delineating the wet and dry regions of the sanctuary. These maps are pivotal for the further management and work planning in the sanctuary and has been incorporated and widely used in the Fourth (4th) Management Plan. The task would have been next to impossible to complete in the short period of one month without local knowledge inputs on the seasonal character of streams. Communities living in the respective sections had clear knowledge of the seasonal characters of individual streams. The effort is quick and pragmatic in the sense that in a strictly objective method of collecting and compiling such a database it would have clearly required as much as a year and efforts from a larger group of individuals to monitor the water flow conditions in every minute stream segment of the sanctuary. Without the assistance of the indigenous people it would not have been possible for the department staff to reach exact locations of each stream depicted in the maps. It must be noted that the if the indigenous people who assisted in the task had sufficient writing and reading skills the task including filling up of the forms could have entirely been assigned to them, unfortunate that they are not. Thus this is a clear example of effective utilization of local knowledge inherent in indigenous communities for deriving quality data for forest management.

It was identified that there is only one tiger that has its entire territory (Map 4.b) with in the sanctuary boundaries. The distribution of tigers (Map 4.a) is more or less even. It was also understood from the exercise that there is only one tiger, with the reference code T17, which has its entire territory within the sanctuary boundaries. With these maps, it is possible for the effective furthering of the activities of Tiger Monitoring Cell. Action planning for the tiger-monitoring cell during the 4th Management Plan period is heavily depended on these maps and database. Similar to the seasonality database generation exercise, the task was also to be finished in a short period of 2 weeks. It should also be noted that since the inception of tiger monitoring cell in the sanctuary, it were the indigenous people who worked as staff members and were paid a remuneration for their contributions. This approach of incorporating indigenous communities in the main stream

Stream Morphology

Stream Order		
Order	No of Segments	Length (Km)
1st Order	580	397.40
2nd Order	146	106.60
3rd Order	31	50.97
4th Order	3	12.75
Unordered	7	30.10
Canal	1	2.97
Seasonality Status		
Stream Type		Total Flow Length (Km)
Perennial		253.91
Partially Perennial		228.10
Non-Perennial		234.1

Table 1

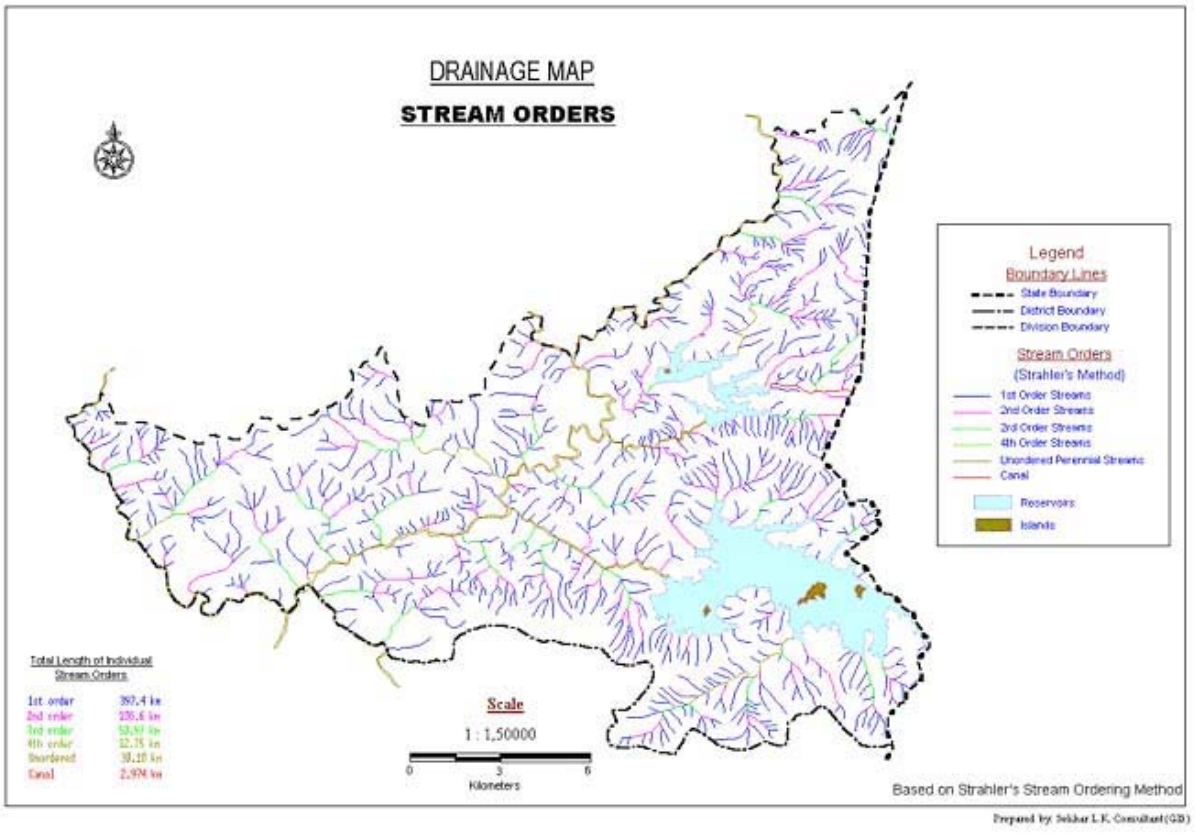
management aspects of the sanctuary increase the confidence of the communities and forest managers and thus bridging the gap between bureaucracy and natives. Parambikulam Wildlife

Sanctuary is one of the very first to formalize such an initiative and the described task in a further logical continuance of the same.

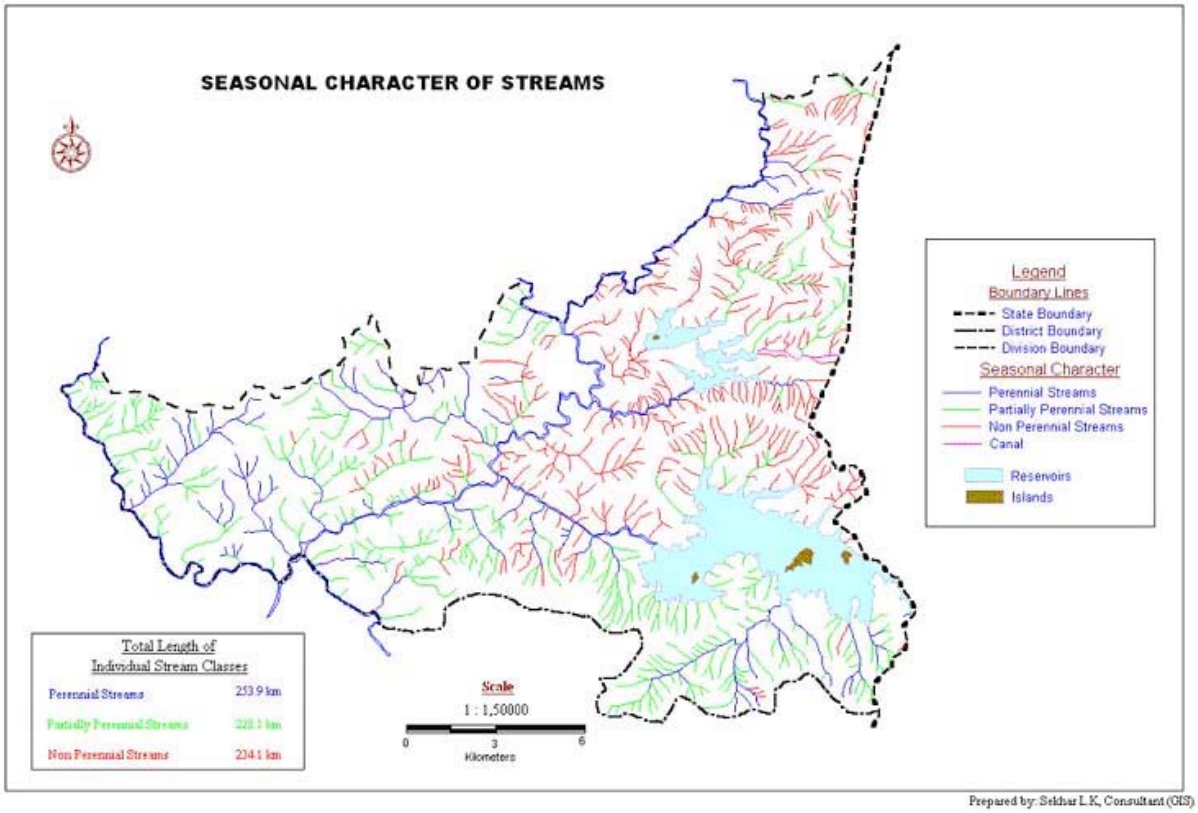
The soil is found neutral in reaction in the dry deciduous forest and very strongly acidic in montane grasslands, whereas, it is moderate to strongly acidic in other forest types. EC is normal and organic carbon is high in all forest types except for teak plantations where it is medium. The texture is clay to sandy loam. Soils in all the forest types have moderate water holding capacity [see 4th Management Plan, PWS, Annexure V (a and b)]. This database was heavily relied on in preparing the Fourth (4th) Management Plan period habitat and soil conservation strategies of the sanctuary. Hiring a team of experts from outside the sanctuary would have incurred a heavy cost on the plan preparation budget. So also, if it were not the natives who were assigned to collect the samples they would not have found their way to the sites deep inside the thickly vegetated forests without any modern navigation aid. Similar to the other two tasks, the fieldwork component of the task also was to be completed within a months' time.

The projects that were executed in Parambikulam Wildlife Sanctuary had great contributions from Indigenous Communities, all through these years. Their contributions are not limited to data collection alone; their local knowledge had been utilized through out the preparation of the Fourth (4th) Management Plan. The instances discussed above are those were in the information collected through them and their local knowledge is integrated into a GIS environment. To name a few other initiatives towards this end during the planning phase were, design and preparation of micro plans for community development plans for each native population, eco-tourism planning, eco-trek route selection and activity selection, etc.

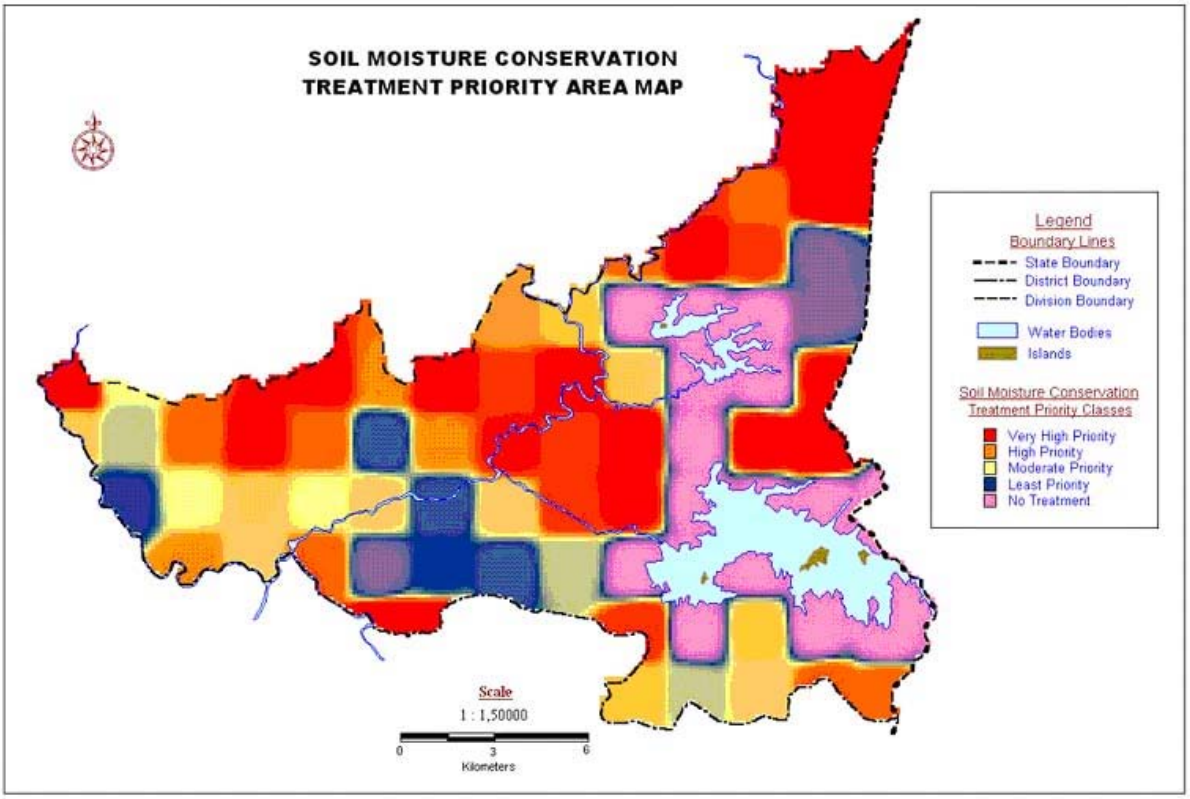
Indigenous People are no more considered by the elite world as some idealized embodiment of spiritual values or as some impediments in the process of modernization. They are considered as people who cherish their own distinct culture, are victims of the past and present day colonization and are determined to survive. Sui and Waldron states, "Researchers, by overlooking the role of indigenous knowledge (IK) have failed in sustaining the human-environment relationship…" Many other authors have stressed the value of indigenous people and the knowledge that they posses. However, indigenous knowledge has its own limitations and is not a means to the end by itself.



Coupled with scientifically organized knowledge, indigenous knowledge can be useful in almost all stages of forest management. IUCN and the WCDE also stress that



the sustainable management of natural resources can only be achieved by developing a science based on the priorities of local people and creating a technological base that includes both traditional and modern approaches to problem solving. Combining indigenous knowledge and scientific knowledge means, integrating information collected from indigenous people with scientific information and technology. This necessarily means that there are to be means devised to collect, store and process indigenous knowledge in a similar manner as that of the scientific knowledge. GIS with its capability to integrate information that originate from varied sources, is the most suitable means achieve the same.



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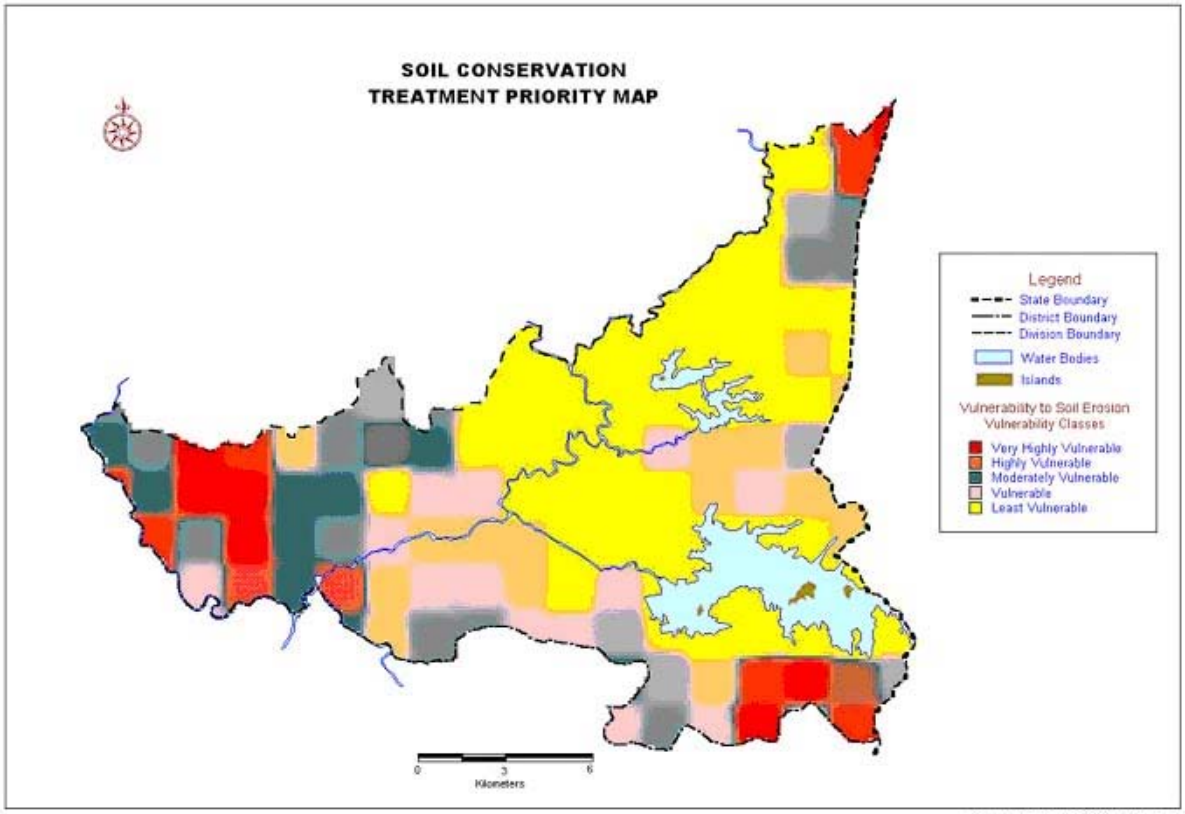

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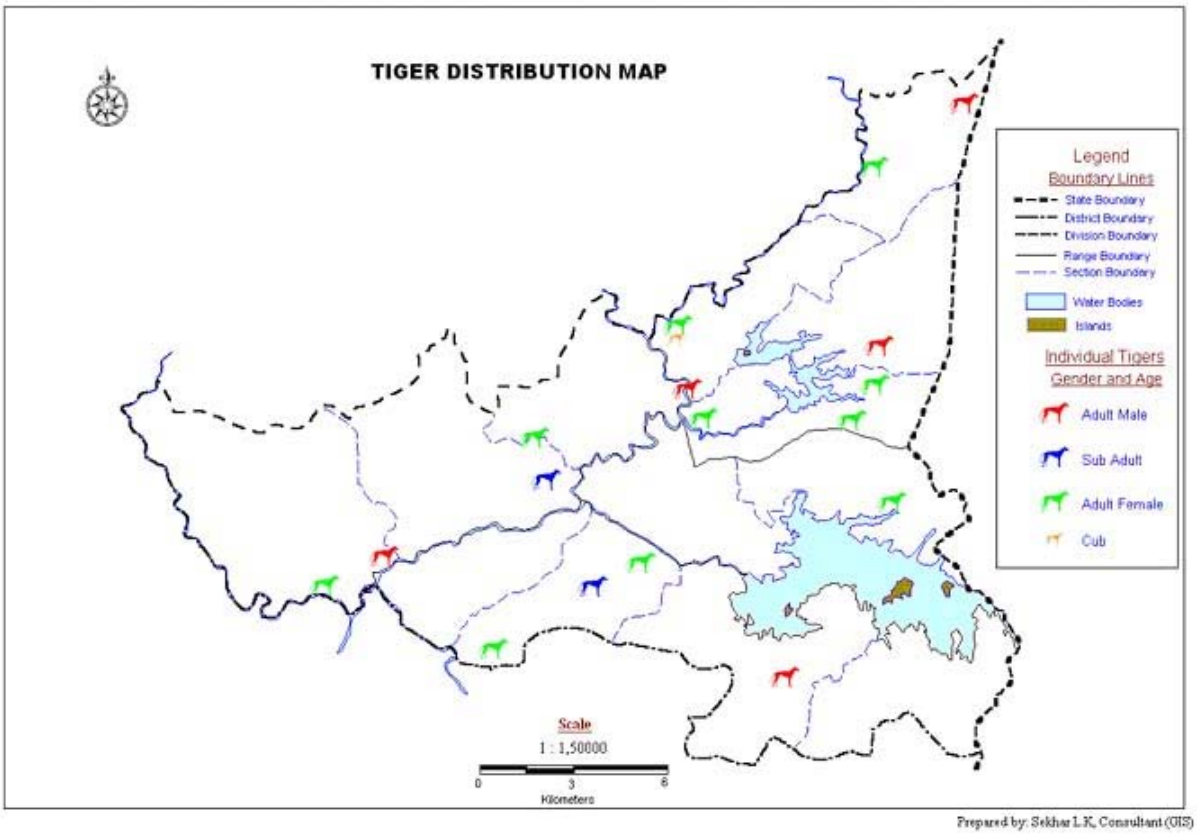
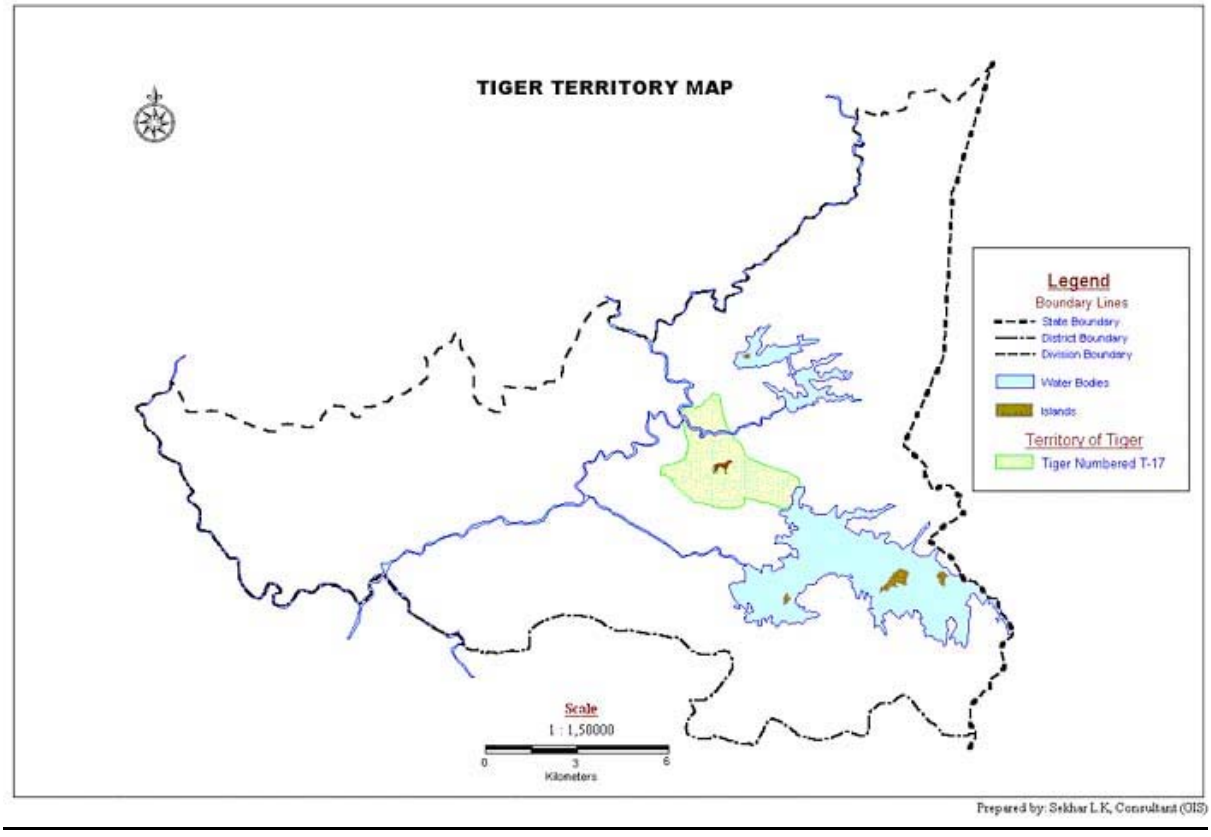

TIGER DISTRIBUTION MAP
Legend
Boundary Lines
State Boundary
District Boundary
Division Boundary
Range Boundary
Section Boundary
Water Bodies
Islands
Individual Tigers
Gender and Age
Adult Male
Sub Adult
Adult Female
Cub
Scale
1 : 1,50000
0 3 6
Kilometers
Prepared by: Sekhar L K, Consultant (OIS)


TIGER TERRITORY MAP
Legend
Boundary Lines
State Boundary
District Boundary
Division Boundary
Water Bodies
Islands
Territory of Tiger
Tiger Numbered T-17
Scale
1 : 1,50000
0 3 6
Kilometers
Prepared by: Sekhar L K, Consultant (OIS)

Conclusion

The study undoubtedly shows that indigenous communities and the knowledge they posses are of great relevance to forest management. GIS can be a single platform on which, scientific knowledge and indigenous knowledge can be integrated. The projects that were carried out in Parambikulam Wildlife Sanctuary over the past two (2) years had indigenous community participation to a great extent. In the present situation of ongoing unrests between indigenous communities and administrators, across the world, and especially in Kerala, these projects and particularly the exercises discussed are brilliant examples of exceptional harmony between both. The authors appeal to follow this path, as it ensures community participation and will add value to the opinions of indigenous, local communities as a whole in a management, decision-making context.

Such attempts to involve local communities in all possible aspects of forest management have to increase. By ensuring indigenous community participation in forest management, the administrators can ensure transparency, which is mandatory to modern day administration. Indigenous Knowledge incorporated in management planning ensures concord as it is to the interests of the local community. Further, GIS acting as an integration platform will ensure that assess to stored information is quick and effortless, retrieval and analysis is easier and thereby, planning, decision making and management is fast and highly accurate.

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Appendix 1

Data Sheet Circulated to the Foresters for mapping the perenniality of streams

Sl. No.	Code Number	Local Name	Present Condition			Months (Fill with Y or N)											
			Full	Partial	Dry	1	2	3	4	5	6	7	8	9	10	11	12
1	D.1		These columns are to be filled by the researcher														
2	A.109																
3	C.9																

* Code strictly with the help of local people