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Mapping of Fisheries Resources at *Panchayat* Level using GIS

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Abstract

The availability of information on resources is of primary importance in the planning and development process and for taking appropriate policy decisions. This is more apt in ecologically fragile areas like the coastal zones. The vulnerability of the coastal zone was evident through the devastating impact of the Tsunami in 2004. To make the process of retrieval and analysis of the data more perceivable, interactive, and easy to visualize, it is ideal to put it on a Geographic Information System (GIS) platform. This article highlights the development of GIS-based fisheries resource maps of Chellanam *panchayat* in the Ernakulam district, Kerala, India. The information incorporated in this map was generated using GPS and field level surveys and analyzed and interpreted using suitable geoprocessing tools of ArcGIS, an *ESRI* software of GIS, used for the development of the GIS models. In all, three resource specific maps were developed besides other figures and tables, generated out of survey data and of GIS analysis.

Introduction

An Information System is the systematic and organized way of providing information that can aid the decision making process. The system utilizes computer hardware, software, manual procedures, models etc. for analysis using databases. In short, Information System is the organized collection of computerized data stored in such a way that dissemination of information from the system will be rapid, accurate, and timely (Burrough 1986). This enable the users in decision making, which is based on comprehensive scientifically collected and analyzed data. In short, Information System is the culmination of development of databases of the information generated for a system using hardware, software, procedures, and data pertaining to the system.

Geographic Information System (GIS) is one such information system built on spatial and nonspatial data. Spatial data require geographical references and projections to make the data meaningful. GIS provides information in a geographic platform so that the information of an earth surface will be more precise and meaningful and easy to visualize (Goodchild et al. 2007). GIS is the totality of all process of the development of the information right from data collection. Although the concept of GIS is not new, the computerization of geographic information is of recent origin.

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Thus, GIS is the combination of spatial and nonspatial data, analytical methods, computer hardware, software, and personnel; these are all organized to automate, manage, analyze, update, and deliver information in a meaningful geographic platform.

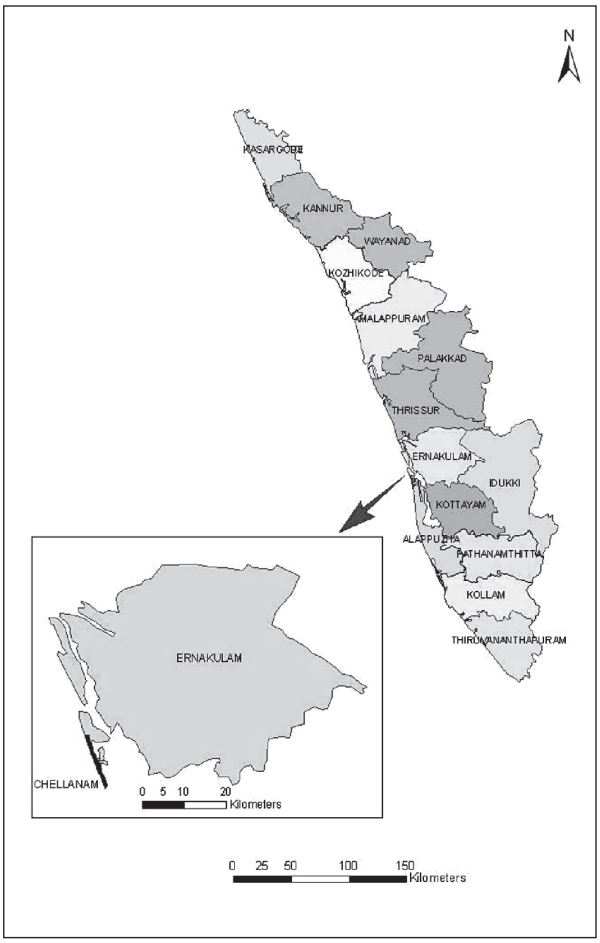

Figure 1. Chellanam grama Panchayat : Location Map

Decentralization of power and micro level planning with people's initiative and participation in the development process has been in focus since the eighth five-year plan in India. The 72nd and 73rd Amendments of 1991 in the Constitution of India ensure the establishment of *Panchayat* Raj system of administration at the district, block, and *village* levels (Chattopadhyay et al. 1999). A *panchayat* is a village level governance unit. The *panchayat* is supposed to be empowered with respect to preparation of plan for social and economic justice and implementation of plans to achieve these goals. This task of plan preparation and execution requires detailed technical and socio-organizational and economic input at various levels. Information with regard to resource availability, resource use, information gaps, constraints and potentials need to be generated at different levels for various plans (Dalal-Clayton and Dent 2001). An initiative in the direction of resource mapping at village level was taken up in 1990s in the state of Kerala, India in collaboration with various organizations. A pilot project was financially supported by the Department of Science and Technology, Government of India to cover 25 *panchayats* across the state of Kerala to shape the methodology. The program emphasizes the importance of warehousing of information at *panchayat* level for all planning at grass root level. A project on resource mapping of locations, which has bearing on national heritage in the Ernakulam district of Kerala, India, was also carried out in a GIS platform by Centre for Studies in Culture and Heritage, Cochin (Pisharody et al. 2005).

It is estimated that 60% of the rural poor in India are inhabited in the coastal areas. This emphasizes the fact that development of resource database at *panchayat* level, especially in the vulnerable coastal areas deserves high degree of priority in any national level developmental planning in general and fisheries development programs in particular. The devastating impact of Tsunami in 2004, along the coastal belt of South India has focused on the need for generating a resource database of coastal villages.

The present study is an attempt to generate an information base of natural resources and man-made infrastructure facilities pertinent to fisheries development of Chellanam *panchayat*, a coastal *panchayat* situated in the south–west part of Ernakulam district of Kerala, India (Fig.1) using GIS technology.

Materials and Methods

The study was conducted in 2006–2007. Secondary data regarding the population of the *panchayat* and boundary details were collected from secondary sources like the Chellanam *Panchayat* Office. The area was identified and the boundaries of Chellanam *Panchayat* as in 1988 were demarcated from the topographic map (toposheet) of 1993 (No.58/C/5/SW and 58/C/5/NW of Survey of India on scale 1:25000). Boundary points of the *panchayat* were located after discussion with the village officials. Based on the toposheet and the details of the border points collected through field survey, the boundary map and other resource maps of the Chellanam *panchayat* were digitized and created in GIS platform as given below.

Map creation and Vectorization

The toposheets of 1993, which include Chellanam *panchayat*, were scanned and the boundary map of Chellanam *panchayat* were digitized with the help of Identified control points and boundary points. The map was georeferenced with the help of toposheet and some landmark points of the *panchaya*t whose latitude and longitude values were collected using Global Positioning System (GPS), so as to assign each point of the area the corresponding latitude and longitude using the georeferencing tools in ArcGIS 9.0. Thus, base map was prepared by vectorizing different thematic layers like landing centers, infrastructural facilities (fish processing centers, markets, etc.) roads, canals, land-water resources (land use) etc.

Development of Database

A personal geodatabase was created using the *Arc Catalog* application of ArcGIS software to warehouse all spatial and attribute data pertaining to the *panchayat*. Feature dataset is created in the geodatabase. Different feature classes with polygon, line and

point geometries were also created in the feature data set as per the requirements of each theme. The study area boundary, land-water resources (landuse of the *panchayat area)*, were vectorized as polygon feature classes, the roads and canals as line feature classes and resource points like landing center, processing units, hatchery units, markets, etc. as point feature classes. These feature classes were vectorized using the *ArcMap* tools of ArcGIS. With the help of GPS handset, the fisheries resource points (fish landing centers) and fisheries infrastructure points (man-made infrastructure facilities pertinent to fisheries development) of Chellanam *panchayat* were located by measuring the latitude and longitude values of the geographic position of the respective resource. The corresponding attribute data for each feature class were collected through field level survey and were compiled and fed into the geodatabase of the GIS model. The topological rules were applied to the datasets and validated and the errors were eliminated by editing the erred feature classes. These feature classes of the feature data set incorporated in the

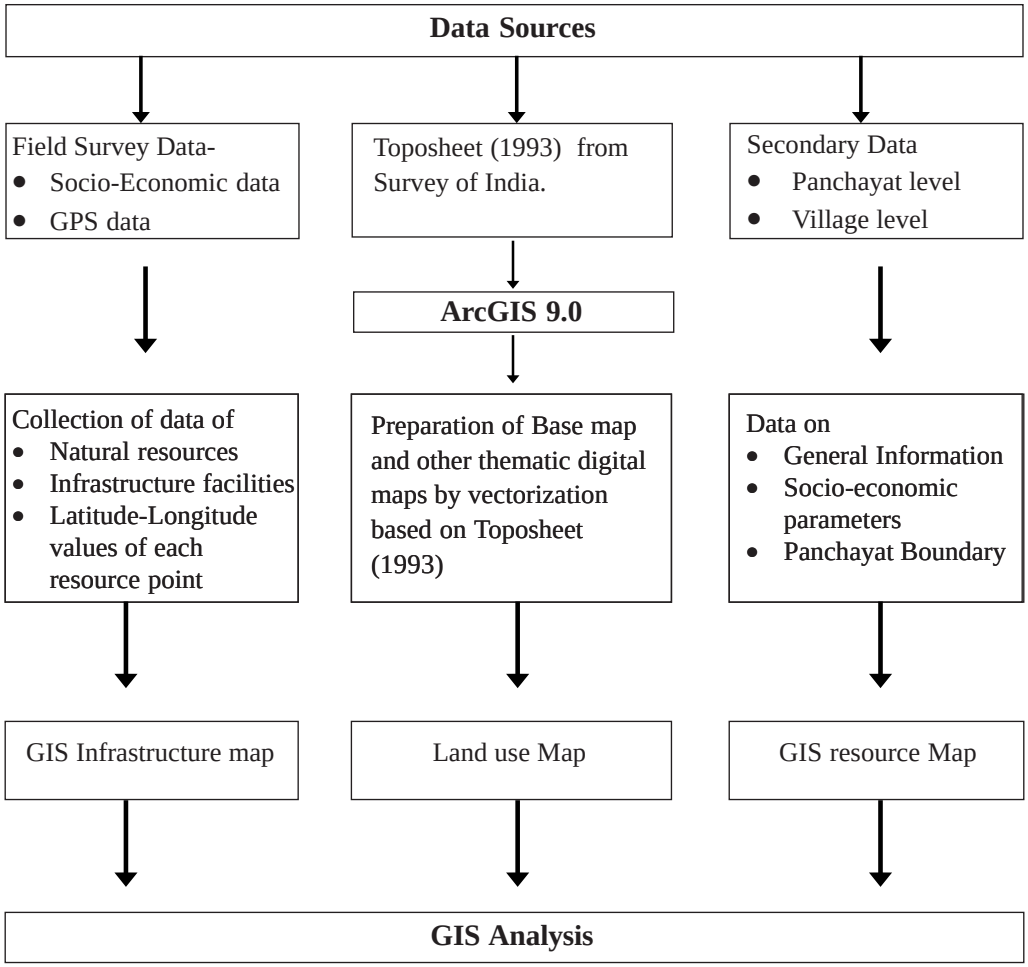

Figure 2. Flow Chart showing development of GIS model

personal geodatabase is used to develop the GIS resource models *viz.*, land-water resource maps, fish landing center map and infrastructure map of Chellanam *panchayat*.

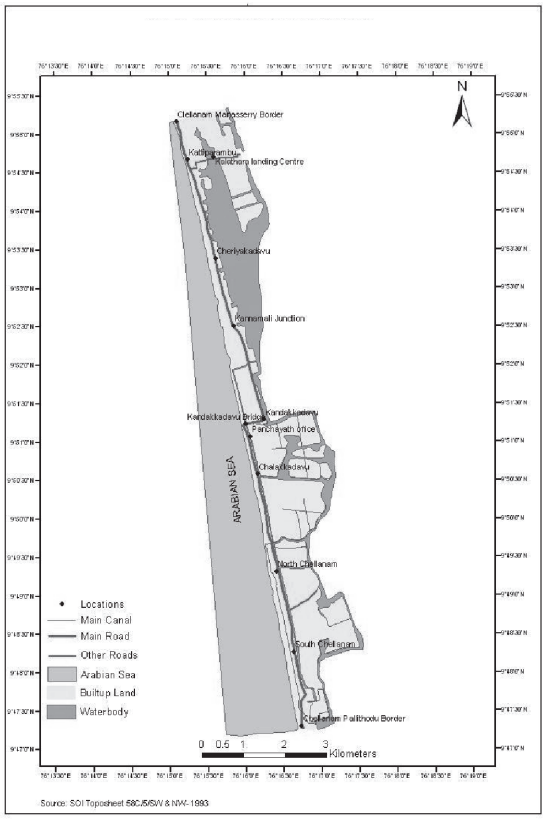

Figure 3. Chellanam Grama Panchayat : Study Area.

GIS Analysis

Based on the landuse map generated, the total area of the Chellanam *panchayat*, the land and water resources of the *panchayat* etc. were estimated quantitatively using GIS analysis tools of ArcGIS. ArcGIS software developed by Environmental Systems Research Institute, Inc. ESRI (Inc.), USA is versatile GIS software, which has different software tools to develop various GIS models and to carry out suitable GIS analysis to generate complete information about the geographical area under study. The procedure adopted for this study has been diagrammatically represented in the flow chart (Fig. 2).

Results and Discussion

Chellanam *panchayat* (Fig.1) is a coastal strip with an area of 19.37 sq.km situated in the south west coast of Ernakulam district of Kerala, India (Anon 2006-07), with latitude 9^{o} 47'- 9^{o} 56'N and longitude 76^{o} 15' -76^{o} 17'E. It has a coastal length of 16.5 km and the breadth about 1.5 km. (Anon 2006-07). It is flanked by the Arabian Sea in the West and Kumbalangi and Ezhupunna *Panchayat*s in the East and shares boundaries with the Cochin Corporation in the North and Alappuzha district of Kerala in the South (Anon 2006-07). It is a typical coastal *panchayat* endowed with natural resources like water bodies, canals, and low lying paddy fields used for fish farming. The *panchayat* area map created after vectorization and overlaying necessary thematic layers developed in the GIS platform is presented in Fig. 3.

Similarly, a fisheries resource map showing the 9 fish landing centers of Chellanam

panchayat was developed.

Infrastructure map showing the major man-made fisheries infrastructure facilities available in the *panchayat* was also mapped. In all 19 establishments that included fish processing units, markets, hatcheries, drying units, and fishing implements and accessory stores were mapped. The map is presented in figure 4.

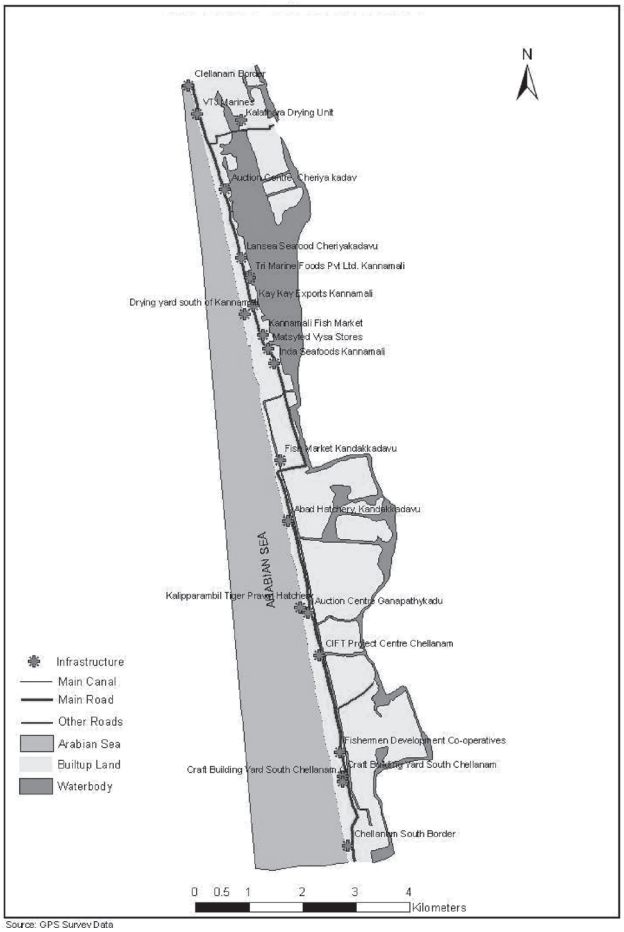

Figure 4. Chellanam Grama Fisheries infrastru-ctural facilities

A land-use map showing the major land and water resources of the *panchayat* were also generated based on the data pertains to the year 1988. The total area of the Chellanam *panchayat* during 1988 was estimated using GIS analysis. The land and water resources, which had been classified in the categories *viz.*, Built-up area/ Mixed crops, Paddy field/ aquaculture area, and water body, as per the top sheet, were also estimated. The analysis estimated that the Chellanam *panchayat* has a total area of 19.32 sq.km of which the built-up/mixed crop area is 5.85 sq.km, water body is 5.53 sq.km, and paddy field/aquaculture area is 7.95 sq.km (Table 1).

The land-water resources *viz.*, Built-up area/Mixed crop, Water body, and Paddy field/aquaculture area are, respectively, 30%, 29% and 41% of the total area of the *panchayat*. This figure shows that besides marine capture fishery, Chellanam *panchayat* has immense potential of aquaculture fisheries also, as majority of the land use is paddy field/aquaculture.

Table 1. Distribution of Land and Water Resources of Chellanam *Panchayat*

Land and Water Resources	Area (km^2)
Built up Area/Mixed crop	5.85
Water body	5.53
Paddy field/aquaculture area	7.95
Total Area	19.32

Conclusion

Through this study, a digital map of Chellanam *panchayat* in the Ernakulam district of Kerala state in India was developed. The major advantage of such a map over conventional paper maps is immense. The different resource points of the *panchayat* can be visualized and it is also useful in estimating different natural resources. The models developed can also be used to do further spatial and geographic analysis. The changes in resource use, especially land and water, can be studied by comparing the existing pattern with the toposheet estimated one. A number of need-based maps can be generated that can be used for appropriate modelling studies to catalyze viable fisheries developmental programs of the *panchayat* area. Constant updating of the data into the geodatabase can help in updating maps as well, that can be tailored to meet location specific needs, including development needs. Several value added information systems like Decision Support System (DSS), Management Information System (MIS), and Expert System (ES) to facilitate micro level planning of development programs of the geographical area under study can also be generated.

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