



GIS Utilization in Fisheries Sector: A Geographical Analysis of Kinnaur & Shimla Districts, Himachal Pradesh, India

KEYWORDS

Fisheries, Remote Sensing, GIS.

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ABSTRACT GIS is by far the best suitable technology to assemble spatial and non-spatial information in a systematic and easily understandable manner. In a study of inland fisheries in Kinnaur & Shimla districts of Himachal Pradesh (India), the distribution of locations of fish ponds/farms is spread over a huge area with diverse accounting factors associated with each spot as non-spatial data, thus, qualifying GIS and remote sensing as viable technologies for the purpose to map out such locations with satellite imagery and analyzing the trends incorporated with them. The analyzed trends encompass the drifts in fish production in government farms, the licenses being issued, the illegal cases getting caught, the subsidies being received & issued and the overall revenue generated over a period of past five years in order to visualize the deficiencies and needs for the better implementation of fisheries sector in the region.

INTRODUCTION:

Geographical Information Systems enable a scientific approach towards a number of spatial and informational problems. India is a huge country with a vast amount of data and the management of such staggering amount of data in a systematic way is necessary in order to prepare the development plans and track the growth rate in specific fields. We can divide the fishery industry of India into two parts. One which includes all the inland water resources (rivers, dams, lakes and canals) and the other includes the marine resources. There has been a dramatic change in fish production in India over the last decade. In 2010, India produced 3.9 million metric tons of fish and currently is one of the prominent fish suppliers in the world (FAO of UN, 2006). The states of India which has no marine boundary are promoting inland fishing as a source of state's new permanent income. Himachal Pradesh is one of such states. There are considerable amount of water resources in this mountainous state which led to the growth in the hydro-power in the state resulting in the construction of reservoirs and dams. Soon, potential of such water bodies towards the growth of fisheries has been realized and government started various fishery projects in major reservoirs like Govind-Sagar, Chamera and Pong.

Besides reservoirs, the number of trout farms and community ponds are also rising. The government is providing subsidies under various schemes to build ponds to encourage people to adopt fishing as a profession. The focus of this study will be on the development of community or personal subsidized ponds in the districts of Shimla and Kinnaur. Through the years, there has been tremendous increase in the people adopting fishing as a profession resulting in the increase in the overall output in the state. For an instance, if we compare the revenue generated by this industry in Himachal Pradesh in 2012-13 and the previous year, we'll observe a rise of INR 223966 over a year time period.

The proper and optimal management of these resources require a systematic database to observe the growth trends in the area, economic impact of fishery in the state and to make policies which will ultimately led to a better

future for this industry in the state. GIS is a tool which can be used for various purposes in the fishery industry. With the help of sufficient data, locations of fishermen villages and their ponds, level of involvement of fishermen in fishery as a profession, locations of co-operative societies, fish landing centers, water resources in the state, fish markets & fish hatcheries can be identified. In the present study, ArcGIS 10.2 software has been used for this purpose.

OBJECTIVES:

- To develop a Geo-spatial database for the department of fisheries for a given area which will include the following information:
 - Locations of community ponds.
 - Locations of Subsidized personal ponds, fish hatcheries and markets.
 - Water resources of the districts.
- To show economic impact of fisheries industry on the economy of the study area which includes:
 - Production of fish on various ponds (community/personal).
 - Overall revenue created by the fisheries in the study area.
 - Production of fish in the government farms in Sangla and Dhamwari.
 - Revenue generated in Kinnaur and Shimla in the past five years.
- To analyze the trends in licenses "issued", illegal fishing cases, production and revenue in these districts.

DATA & METHODOLOGY:

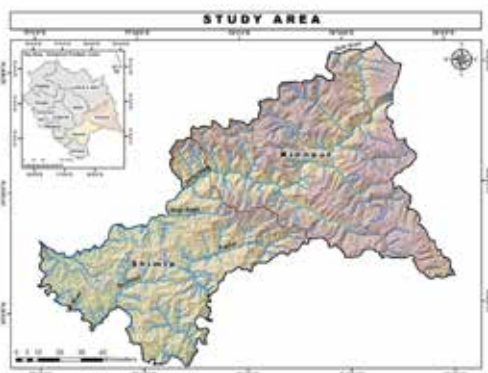
Methodology describes the overall progress of the project in a systematic manner. The methodology begins with the gathering of data and after passing through various analyses, final maps and results are prepared. ESRI's software ArcGIS 10.2 is appropriate for all of the image processing and map preparing operations. For analysis of tabular data, Microsoft Excel can be utilized along with ArcGIS for graphs making process in order to visualize the changes that are occurring over some past years. Generally, the data for past five years is taken.

A huge amount of data would be required to obtain the desired output. Data can be categorized into primary and secondary data. **Secondary data** will include the various types of fish species found in Himachal Pradesh along with the distribution of fish population in the natural as well as artificial habitat in the specified area. Generally, secondary data is in tabular form. Most of such data is collected from the fisheries department in Shimla. Erstwhile, **Primary Data** will also be required which will include toposheets and/or satellite imagery of the required parts of the state for the digitization purpose. The data about the number of major fish farms in the state along with the specification about the diversity, population, output, type, revenue, and location of each fish farm is available in the detailed reports provided by the fisheries department. Other than that, the locations of the man-made water reservoirs like dams where fishing is being done on a commercial level in the specified area can be easily identified on satellite imagery though currently, there are no reservoirs in Shimla and Kinnaur for the purpose of fishing.

Accurate information about the number of the people involved in aquaculture and fishery industry in the region along the locations & types of such minor fishing areas is required for depicting the rise in the number of fishermen in the region over past several years. Such data is recorded by the fisheries department. The detailed number of the licenses issued in the region is noted in an orderly fashion to keep track of legal fishing activities. Also, economic data is required showing the share of fishing in the state's or study region's economy. With its help and its further divisions, different graphical representations can be prepared. All the mentioned data has been provided by the fisheries department. The data about various locations is collected by either field study or remote sensing techniques. In the approachable locations, field study has been conducted to mark the locations of farms and ponds. Firstly, with the help of global positioning system (GPS), the latitude and longitude of two government farms in the two districts situated in Sangla in Kinnaur and Dhamwari in Shimla are noted along with the other nearby ponds.

STUDY AREA:

Figure 1



The project area is confined to the Shimla and Kinnaur districts of Himachal Pradesh state of India. The mountain ranges in *Kinnaur region* are divided into three categories- Himalayas, Zaskar and Dhauldhar. These ranges consist of three prominent rivers i.e. Satluj, Sipiti, Baspa and their multiple tributaries. The longitude of Kinnaur

ranges between 77° 45' and 79° 00' 35" East Longitude and its latitude ranges between 31° 05' 50" and 32° 05' 15" North Latitude. The longitude for Shimla varies from East (76°59'22"-78°18'40") and latitude varies from North (30°45'48"-30°43'0"). Figure 1 represents map of the topographical map of area prepared using drainage, elevation, slope and aspect patterns in ArcGIS 10.1.

The irregular and mountainous surface of both the districts results in a complex elevation and drainage pattern. Using DEM of the area, the features like drainage, slope, elevation and aspect can be found used various tools in the spatial analyst in the Arc Toolbox. The topography of the area directly affects the fisheries industry in the state. The types of fish available in the area, the shape, size and other constructional aspects of the artificial ponds/tanks and the types of natural fish habitats found – all depend on the topography along with many other factors.

Artificially, almost all the subsidized personal ponds contain Trout species which is compatible with the atmospheric conditions of the area as well as is in demand. The government farms of the two districts situated at Sangla and Dhamwari are the two lone biggest producers of fish in the districts. Mostly, the combined production of the other recorded production is lesser than total production of these farms. The markets are local i.e. fish is locally consumed and it can also be deduced from the data that consumption of Trout in the state of also on rise. Other than trout, common carp is also another species available in the region.

DATA ANALYSIS AND PRESENTATION:

All the data collected related to fisheries in the study area can be sub-divided into three categories:

1. Government Farms
2. Community Ponds
3. Personal Subsidized Ponds

Firstly we need to understand the concept of above three types of fisheries tanks/farms as the data related to the revenue, production and location data is presented in the mentioned categories for better understanding and more transparent approach. The descriptions of these ponds and farms are given as follow:

Figure 2

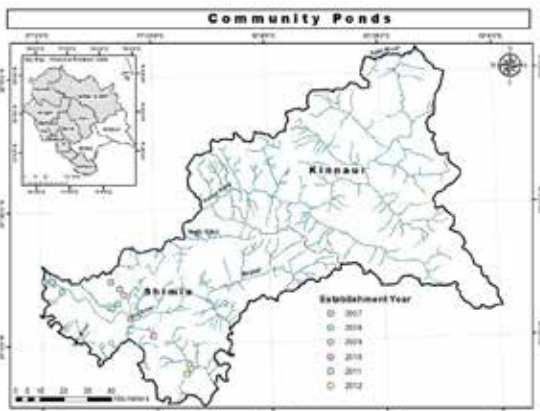


1. Government Farms:

Government farms are those categories of fish farms which

are completely managed by the state authorities. All the profits/losses, management of workers, maintenance of tanks are government's own responsibility. In Shimla and Kinnaur, there are two such farms situated in Dhamwari and Sangla. The production of these farms varies greatly every year as discussed in data analysis. The map here represents the locations of these two farms identified via remote sensing using satellite imagery of CARTOSAT 1&2. **Figure 2** above shows government farm locations in the study area.

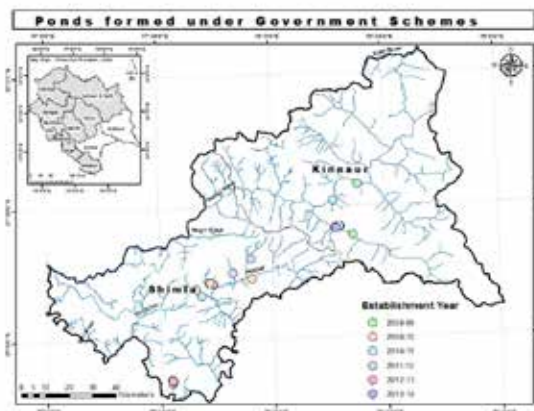
Figure 3



2. Community Ponds:

Community Ponds are those ponds which are partially financed by the government on the request letter of a village 'Panchayat'. Generally, Panchayat further give the pond on lease for maintenance and other activities. As shown in **Figure 3**, in the given study area, the community ponds are only situated in Shimla district. The optimal utilization of this opportunity provided by the state government is yet to find its rightful place in Kinnaur district.

Figure 4



3. Personal Subsidized Ponds:

Personal ponds, as the name suggests, particularly belong to a single individuals. When the certain criteria are met, then the state government issues subsidies as per pre-defined rules under various schemes such as RKVY and NFDB. Depending on the total area to be covered under the ponds, subsidies are given. For example, the total subsidy amount is around INR (Rs.) 1, 10,000 when the volume of the tank is 90 Cubic meters. The locations are shown in **Figure 4** above.

The Table-1 represents the data collected from the fisheries department about various factors associated with the above mentioned locations:

Years	Sangla Farm Revenue (INR)	Dhamwari Farm Revenue(INR)	Total Production in Shimla District	Non-Spatial Data		
				Total Licenses issued in Shimla	Total licenses issued in Kinnaur	Total Illegal cases in Study Area
2009-10	325025	42908	220.785	421	18	26
2010-11	366675	710387	123.039	383	27	36
2011-12	66975	89559	219.427	440	24	31
2012-13	176179	39000	228.30	387	28	12
2013-14	127320	154040	272.20	384	26	13

*Source: Fisheries Department, Shimla

The results and final conclusions derived from the data given are discussed in next section.

RESULTS & DISCUSSIONS:

In a single phrase, we can conclude that the fisheries sector is not yet a prominent source of income either for the citizens or the government of the state. Also, the unpredictable trend in the production and revenue of different farms and ponds make it highly improbable for future predictions. The efforts by government are definitely boosting this industry. Overall, the licenses that are being issued in the past five years have almost remained on a constant level with minor changes. The terrain of both the districts in study area is rough and weather is not always in the favor of formation of ponds and progress of fisheries sector. It has been observed that the conditions of the large number of ponds are not as per standards. Amongst them, many have been severely damaged by rough weather conditions while some others are suffering from the lack of water. Tanks need a permanent water source which, depending on the environment and the species under farming, has to be altered in a regular time interval.

We need better planning and management of the resources along with infrastructure and financial help of farmers in the form of subsidies. Geographical information systems have proven themselves as a reliable for of management of such resources in many other parts of the world. As we know, Himachal Pradesh just has inland water resources than marine and we already have mapped most of the drainage pattern of the state. So, the work can be further extended to find new suitable locations for fisheries. Nevertheless, the potential of this sector in Himachal Pradesh is undeniable.

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