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Use of Geographic Information System in Land Use Studies: A Micro Level Analysis

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Abstract: The knowledge of land use and land cover is important for many planning and management activities as it is considered as an essential element for modeling and understanding the earth's features. The development activities, dynamic usage of land, increasing growth of population and varying occupation pattern of the society has resulted in reduction of land devoted to agricultural activities. In this paper, an attempt has been made to demonstrate spatial analysis of agricultural land use changes at micro-level in Kashmir valley in village Wanpora with help of Geographic Information System (GIS). Cadastral map of the village was registered in GIS software MapInfo in order to georefrenced it, the boundary of each plot of land was digitized and subsequently land use data of two periods i.e. 1990 and 2010 were added to the base map in order to understand directions and magnitude of land use changes over the period of time. A comparison of general Landuse in 1990 and 2010 shows a remarkable increase in net sown area from 325.41 acres to 484.62 acres or about 28 percent of the total area of the village. The analysis of land use in Kharif 1990 and 2010 reveals that saffron cultivation which was introduced during 1980 on trial bases and covered just 0.77 percent of net cropped area and increased to 38.32 percent of net cropped land during 2010. The area under Saffron cultivation increased from mere 2.5 acres in 1990 to 187.5 acres in 2010 and therefore registered a +7330% growth rate.

Key words: Land Use · Saffron · MapInfo · Cadastral Map · Micro Level Analysis · GIS

INTRODUCTION

Agriculture is the dominant land use in the rural areas of many countries and the agricultural sector often underpins the economic viability and social character of these areas. Access to timely and accurate information about the type, amount and spatial distribution of agricultural land uses at appropriate scales is imperative for informing planning and policy for the sustainable management of natural resources in rural areas [1-4]. Land-use and land-cover change, a central component of global environmental change with direct implications for the Earth's climate, ecology and human societies, is of great concern to national and international policymakers [5]. Policymakers seek information on the root causes of Land-use and land-cover change from scientists so that policy may focus not on symptoms, but upon the fundamental processes that require remedial action. However, processes that drive Land-use and land-cover change are complex and require the use of multiple methods of analysis and critical interpretation of social data in order to understand the drivers and impacts of change through time and across spatial scales [6-8]. Due to synoptic view, map like format and repetitive coverage, satellite remote sensing imagery is a viable source of gathering quality of land cover information at local, regional and global scales [9-11]. The land cover / Landuse maps prepared using multi-date and multi-spectral data provides different levels of spatial information which are used in change detection studies [12]. Land use of an area is a resultant of human controls over the land resources in relatively systematic manner [13]. Techniques and methods of using satellite imageries as data sources have been developed and successfully applied for land use classification and change detection in various environments including rural, urban and urban fringe areas [14, 15].

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The lacustrine deposits, locally known as Wudur or Karewas which are ideally suitable for the cultivation of saffron, almond and zeera in the valley most particularly the famous Pampore has been under saffron cultivation for centuries [16]. The area under saffron has gone up from 4,000 hectares in 1989-90 to 4,383 hectares in 2010 with corresponding increase in production from 90.27 quintals to 130.65 quintals [17]. Due to congenial agroclimate and economic returns, saffron cultivation has been encouraged in the non-traditional areas like village Wanpora. Though the land under saffron cultivation in pampore Karewa the traditional home land of saffron cultivation area is declining but on the other hand in some other areas like Wanpora land under saffron cultivation is rapidly increasing. The present study is an attempt to understand land use change dynamics in rural landscape with help of geospatial tools, which in turn could be used for envisaging a suitable and appropriate planning for rural agricultural development.

Objective and Scope: The study was undertaken with the aim of analyzing changing land use patterns in Kashmir valley and also study spatio-temporal variation in land use /land cover with special reference to a cash crops, in Wanpora village, Budgam District of Jammu and Kashmir state, India. On the basis of micro-level study a suitable strategy to in the existing saffron growing villages has been suggested. Attempt has also been made to recommend the steps to be taken to make saffron as an economically viable crop in the unutilized Karewas of the Valley and to make its cultivation ecologically sustainable.

Study Area: The village of *Wanpora Nagam* lies in the Chadoora Tehsil of Budgam district. It is situated on the Budgam Chadoora Karewa series with deep ravines, gullies and streams. The village represents the Upper Karewas of western half of the Valley. It is bounded by the villages of *Chak-Sarder* in the north, *WahiBugh* in the south, *Zadora in* the east and *Hayatpora* in the west.

Date Base and Methodology: The present study is based on primary and secondary data obtained from the published records and gathered from the sample village in the form of structured questionnaires, field interviews, observations and participation. The cadastral map was obtained from the Patwari (land record keeper) of the concerned village and subsequently registered in MapInfo soft ware to georefrenced. Each plot of land was digitized then land use data of two time periods i.e. 1990 and 2010 was added to the base map for further developing different thematic maps which resulted in detecting the direction and magnitude of land use change over the period of time. Some information was obtained from the Gazetteers, Census Reports and District Census Hand-books, published by the Town and Village Directory, Director of Census Operations, Jammu and Kashmir.

The methodology employed in the present study is given in Fig. 1.

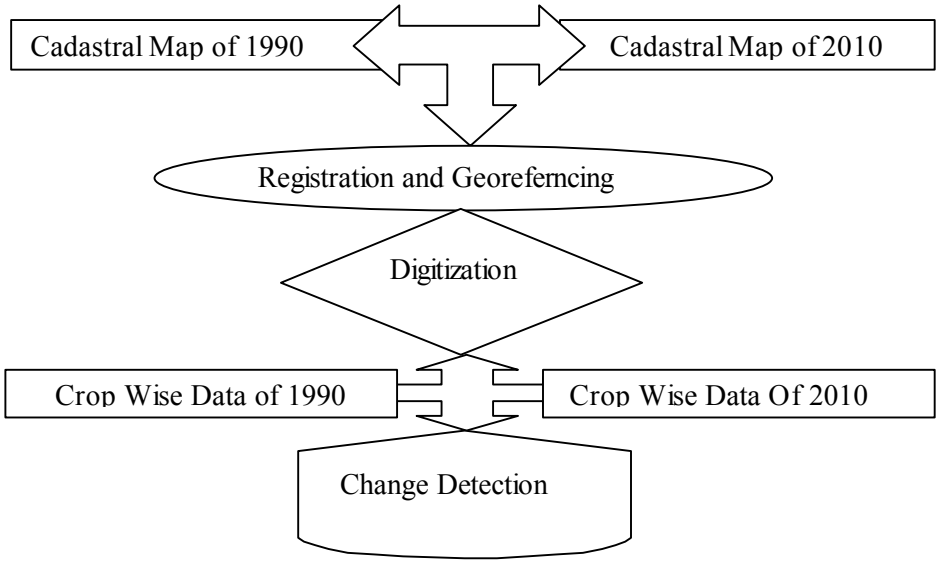

Fig. 1: Steps of Methodology

RESULTS AND DISCUSSION

Table 1 show that Land not available for cultivation in 1990 covered an area of about 22.00 acres and non-agriculture uses' occupied all the 22.00 acres. However Land not available for cultivation covered about 35.50 acres in 2010 and thereby registered a +61% growth. Interestingly, there is no barren or uncultivated land in the village. Other uncultivated land excluding fallow covered an area of about 37.5 acres and' decreased to 10.00 acres in 2010 and registered a -73% growth rate in area. Miscellaneous land use like trees and grove lands accounted for 28.75 acres in 1990 and in 2010 deceased to 4 acres and under gone -86% in arial extent. There is a remarkable increase in net sown area from 325.41 acres to 484.62 acres or about 28 percent of the total area of the village over the period of time. Land not available for cultivation, which includes settlement area, shows an increase of 13.50 acres or 61 percent however the forest cover the area under social forestry and grove area has diminished. During 1990 it covered an area of 28.75 acres has come down to mere 4.00 acres in 2010. The increase in net sown area is due to conversion of fallow lands into cultivated area. Culturable waste came down to 6.00 acres or 1.06 percent of the total area of the village Fallow lands were dominant land use in 1990 and covered about 181.5 acres and decrease to 36.25 in 2010 and registered -80% growth rates in spatial extent. Nearly 325.41 acres were sown in 1990 which increased to about 484.62 acres in 2010 amounting +48% growth rates in spatial extent.

Change Detection in the Cropping Pattern: In order to ascertain the variations in Landuse and cropping pattern, it is imperative to make a comparative analysis of Landuse scenario of the village between the time span from 1990 to 2010. Such a comparison will help in ascertaining the changes that have taken place in the Landuse patterns of the village during the last two decades.

The analysis of cropping pattern Kharif 1990 and 2010 as shown Table 2 reveals that saffron cultivation which was introduced during 1990 on trial bases and covered just 0.77 percent of net cropped area during 1990 reached to high degree of 38.32 percent of net cropped land during 2010. It shows that growers inclination towards this cash crop. Saffron cultivation increased from mere 2.5 acres in 1990 to 187.5 acres in 2010 and therefore

Table 1: Changes in General Land Use from 1990-2010

Category of Land	Area in acres 1990	Area in acres 2010	Change In Area	Percentage change
I. Land not available for cultivation	22.00	35.50	+13	+61
(a)Land put to non-agricultural use	22.00	35.50	+13	do
(b)Barren and uncultivated land	00.00	0.00	00	00
II. Other uncultivated land excluding fallow	37.50	10.00	-22	-73.33
(a)Permanent pastures and grazing lands	00.00	0.00	00	00
(b)Miscellaneous tree crops and grove land s not included in net area sown	28.75	4.00	-22.75	-86
(c) Culturable waste	8.75	6.00	-2.75	-31.4
III. Fallow Lands	181.50	36.26	-145.24	-80
(a)Fallow land other than current fallow	31.62	30.13	-1.49	-4.7
(b)Current fallow	149.90	6.12	-143.78	-95.91
IV.Net area sown	325.41	484.62	+159.2	+48.92

Source: field survey

Table 2: Change Detection in the Cropping Pattern

Crops	Area In Acres In 1990	Area In Acres In 2010	Change Detection From 190-2010	Change In Percentage
Saffron	2.50	185.75	+183.25	+7330
Almond	193.62	152.37	-41.25	-21.30
Apple Orchards	3.00	9.62	+6.62	+200.
Paddy (Rice)	116.00	94.38	-21.62	-100
Vegetables	2.50	2.38	-0.12	-4.8
Fallow	149.87	6.12	-143.75	-95
Maize	7.75	40.12	+32.37	+417.6
Total Cultivated Land	475.25	490.75	+15.5	+3.2

Source: field survey

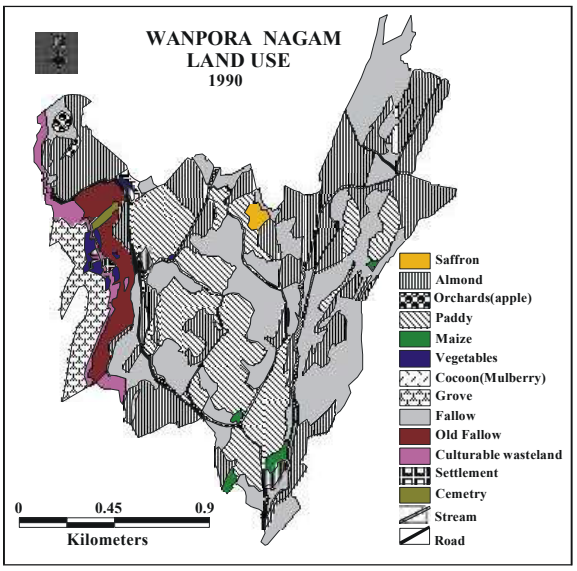

Fig. 2:

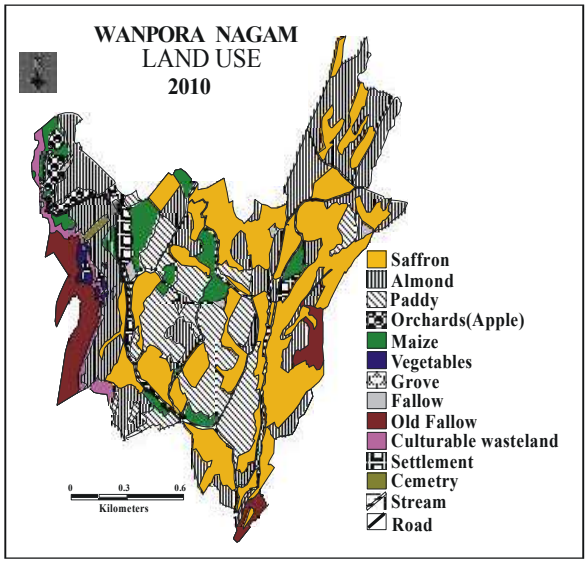

Fig. 3:

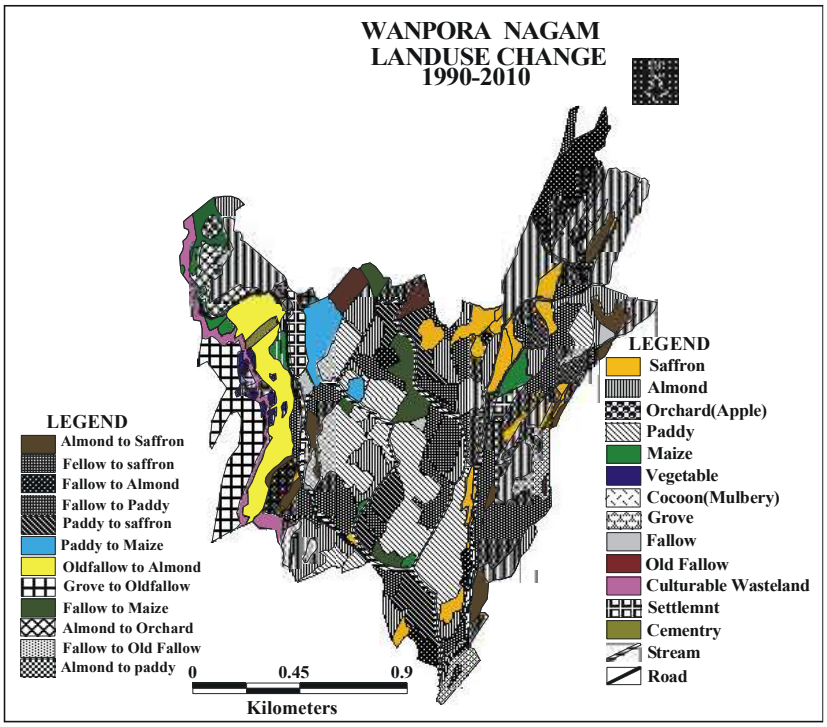

Fig. 4:

registered +7330% growths. The increase in saffron area was partly due to decrease in almond area. The decrease in almond seems partly due to low returns. Moreover saffron fetches better returns and therefore the farmers are devoting more area to saffron cultivation. This trend of decrease is quite significant in the case of paddy which decreased during this period from 116.00 acres to 94.38 acres. In between this period an increase in the land under maize from 7.75 acres to 40.12 acres has taken place. Although the change in the area under different crops are significant and seem to be owing to diffusion of innovations in agriculture, the decrease in area under almond cultivation may be attributed to the declining per acre yield and the vulnerability of the crop to natural

hazards, bad weather and pests and disease. However the increase in vegetable cultivation and land under fodder crops is mainly because of significant increase in live stock and population. The non-availability of fodder crops during the period of March-April season compels the farmers to sow fodder crops during Rabi season. During 1990 about 150 acres of the village was under fallow category and due to diffusion of other profitable crops it has been reduced to 6.12 acres only in 2010, which means fallow has registered a -95% growth rate over the period of time. The Fig. 2 and Fig. 3 shows the spatial extent of cropping pattern in the village in 1990 and 2010. Figure 4 shows crop wise shift and transformation over observed period of time.

CONCLUSION

Over the centuries saffron is being grown by traditional techniques, resulting into depletion of soil fertility. Geographic Information System (GIS) can be used effectively used in micro level studies to understand directions and magnitude of land use land cover over the period of time. A scientific rotation and diffusion of new agricultural innovations are imperative to enhance area and production. The arial extent of saffron has shown a phenomenal increase from mere 2.5 acres to 185.75 acres. There is a decrease in area of almond. The large trees of almond are however, not good for better saffron yields as saffron does not thrive well in the trees of almonds as their large roots create obstacles for the tender corms of saffron. Therefore development of new varieties of almond trees is very essential which may increase the yield per unit area of both these commercial crops. The area under food crops paddy and vegetables has decreased and the area has been shifted to saffron cultivation because of the high returns of cash crop there is decrease in food crops especially in rice and vegetables which needs to address for sustainable land use planning. The area under maize has increased to whopping 417% over a period of time. Under the growing pressure of population many of the good saffron fields are being brought under houses and settlements. This practice needs to be stopped for which enforcement of Saffron Act is to be implemented vigorously. Research Stations should be located at different saffron growing Karewas rather to keep them restricted to the lands of a few elite farmers and politicians. Besides, government should initiate the process of consolidation of holdings without further delay. The consolidated holdings can help in the fencing of the fields which shall ultimately leads to better management of the crop.

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