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Socio-Economic Status of the Warna Basin Villages: Analysis using GIS Techniques

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***Abstract*: The assessments of the socio-economic impacts of the Warna dam for the villages of basin area have been attempted. The secondary data in the form of census data and revenue data has been used for all the villages of Warna river basin. Besides, this to cross check the actual status of the villages in terms of socio-economic development, field investigations have undertaken in some sites likely to be impacted by Chandoli dam . During the field work and even number of visits in the villages of the study area, it has observed that prior to dam construction the agricultural activities were totally dependent on the natural rainfall. Now after dam construction the water is being used for agricultural activities and agro based industries. Agricultural productivity also increased in the study area after the dam construction. GIS based differentiate techniques have used for the analysis of socio economic characteristics in the present research work..**

***Index Terms*: Chandoli dam, Composite Socio Economic Index, GIS techniques, Socio-economic development..**

I. INTRODUCTION

The present research has attempted to study the impact of Chandoli dam (Warna dam) on the socio-economic activities of the population in the Warna river basin (Maharashtra). Warna River is a major river in the region, a tributary of the Krishna River, which forms the northern boundary of Kolhapur, and rises in Sahyadri ranges of Maharashtra. It flows with a straight south-east direction along the northern borders of Malkapur, Panhala, Alta and Shirol for a distance of about 129 km and meets river Krishna at Haripur, which is just 3 kms from Sangli city. River Kanasa and river Kadvi are the major tributaries of Warna River. The Chandoli dam has constructed on the Warna river that benefited in terms of its irrigation system to 105 villages in the basin [1], [2], [3]. In India most of the agriculturist depends on the good quality soil and available water resources. Naturally, the crop production depends on the supporting weather conditions, significantly on the amount of rainfall. But, the climatic condition in the recent years shows unpredictable circumstances in view of the agricultural systems. The changing climatic condition is not supporting the today's farmer for agricultural activities. In some regions there is a problem of water scarcity. Therefore, there is a need for the proper management of agricultural systems by providing water through various sources.

Water is a basic need on the earth surface, which is available in the differential forms. Now water becomes more precious, as the population increased rapidly. Management of water resources is the urgent priority to minimize the water scarcity problem in the drought prone regions. Proper management is also required, where the water resources are more, i.e. in flood prone areas. Naturally, on the earth surface the suitable location to accommodate the inland water resources are the depressions/dips on the landscape or the rivers. Shinde M.V (December, 2006) examines that, the farmers have adopted new farm technology due to development of irrigation facilities that increases use of biochemical fertilizer and land holding percentage. The percentage of sugarcane cultivation has increased from 156.62 acres (31.37%) to 209.25 acres (50.07%) in Chandgad Taluka of Kolhapur district [4]. Bhosale Shivaji Murlidhar (March, 2007) has observed the socio-economic impact of water conservation in Sangali district. His main objective of his study was to find out the social and economic condition of farmers after water conservation. The benefit of water conservation have got the availability of drinking water, increase employment and area under irrigation , prevent soil erosion and use of modern farm technology. Now-a-days irrigation facilities have provided in most of the agricultural regions, but there is a need for proper management of the irrigation systems. Due to seasonal variation water sources are highly influenced [5]. Ward, and Pulido-Velazquez, in 2008 have also stated that, "Climate change, water supply limits, and continued population growth have intensified the search for measures to conserve water in irrigated agriculture, the world's largest water user"[6]. To increase the agricultural productivity some sustainable practices should be adopted with proper management of land and water resources. Pretty et.al, in 2003 have also observed that, "the farmers have improved food production in recent years with low investment, locally available and environmentally sensitive practices and technologies [7].

In the present study the analysis and preparation of various maps for socio-economic parameters have carried out using advanced GIS techniques. Nowadays, urban environment, its development can also be assessed by using advanced techniques like GIS and Remote sensing. Bell et.al. in their research work have reveal that GIS based multicriteria analysis (MCA) techniques can be used to support the value of deprivation indices constructed from qualitative data sources. They have uses an Order Weighted Average (OWA) weighting algorithm, which was selected based on its ability to represent both the original and a data-driven ranking of the selected variables [8]. Swetnam et. al., in 2011 have used GIS method to understand qualitatively expressed socio-economic circumstances in quantitative map-based conditions [9].

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Temporal and spatial resolution needs and information can be used using high resolution remote sensing data as well as for extracting urban/suburban infrastructure and socio-economic characteristics of any region can be studied by various GIS based remote sensing data [10].

II. METHODOLOGY

Secondary data and statistical information regarding re-settled villagers, affected population due to dam, various maps have been collected (partly) from various government offices and irrigation departments. Some information was also collected from the leaders of the displaced people at primarily level. Besides this, for the better evaluation of socio economic assessment, three specific periods has also been considered for comparative study of the all villages of the Warna river basin ; the year 1991 has considered just near to the dam construction and the other has been the year after the dam construction i.e. the year 2001 and year 2011. The study has also highlight the disparity in the socio economic structure among the village level. Various parameters on different socio economic aspects has been selected to judge socio economic progress in the study area. The important parameters considered for the analysis were – primary health centers, drinking water, literacy rate, sex ratio, concrete house, per capita income, agriculture with irrigation facility, employment, road transport etc. These parameters have been used to construct disparity Index. The weightage score i.e. High to very low or on the basis of quartile groups have been be assigned to various parameters. The composite weighted score/index has computed for each village/sample to obtain the index of level of socio economic development and a Composite Socio Economic Index has formulated for three different years. The composite weighted score have computed for each village to obtain the index of socio economic development and a Composite Socio Economic Index formulated for all the years by Kundu's method (Ramotra, 2008). The data for the said period have collected from secondary sources that includes the related Government Published documents, Economic surveys, statistical abstracts, census reports etc. The same procedure were adopted to find the relative variation of the respective parameters across different sample villages of the region.The present research is related to get an insight into the levels of literacy and occupational development in the Warna basin for the years 1991 , 2001 and 2011. The level of literacy development is calculated by considering male and female literacy rate. The levels of occupational development have calculating by considering total main worker population. The occupational development is measured by considering following indicators. as per 1991 census:

Percentage of main cultivators, Percentage of main agricultural labourers, Percentage of livestock and forestry, Percentage of mining and quarrying, Percentage of manufacturing related to household industries, Percentage of manufacturing related to other than household industries, Percentage of construction, Percentage of trade and commerce, Percentage of transportation, storage and communication, and Percentage of other services.

As per 2011 census, 4 indicators have selected for computing level of occupational development. i.e. Percentage of main cultivators, Percentage of main agricultural labourers, Percentage of main household industries , Percentage of main other than worker.

For assessing the composite index, the method of normalization has used that is suggested by Kundu's method. For constructing the composite index at village level, the different values of indicators are added directly may affect the overall development index, therefore, before aggregating such values the biasness or scale affect has removed by applying the above said method of normalization. In this case the observations for each indicator have been divided by their corresponding mean values without affecting their relative position of the village. There after the obtained normalizes values of indicators have been added together to give rise to component scores of development for each village. The composite index values of all the villages are arranged in descending order. On the basis of composite index value villages are divided into four categories of development by using quartiles method like high, moderately, low and very low level of development (Ramotra, 2008).

The collected data has been analysed with the statistical and GIS softwares, also presented through tables, maps and diagram. In future, the analysed data using the GIS tool will provide a scientific framework for storage and analysis of thematic and attribute data, this will also utilized to develop prediction models to counter the problem arises in the study area.

III. RESULT ANALYSIS

Socio-Economic Impact of Chandoli Dam

Literacy 1991

The map of 1991 (fig.1) depicts the literacy of the Warna basin that includes the villages from districts of Kolhapur and Sangali for the year 1991. Herein, the literacy rate of the Warna basin is categorised into high, moderate, low, very low.

The villages that fall under high literacy rate are more pronounced to the right bank of the river Warna and some villages are on both the banks of the river towards the eastern and south-eastern part of the basin. Also, the villages that lie in the moderate literacy rate are stretched from upper part of north-west to south-east. On the other hand, there are very few villages that are comprised in the Low literacy rate. In contrast, the villages that lies in very low literacy rate are situated in the north and north-eastern part of the basin, most of these villages are around the Chandoli dam. Uninhabited region are around dam built area and some of the villages lie to the left bank of the river far near boundary of the basin.

Literacy 2001

The given map depicts the literacy of the Warna basin that includes the villages from districts of Kolhapur and Sangali of the year 2001. The villages that fall in the category of high literacy rate are stretched from lower middle part of basin to the south-eastern

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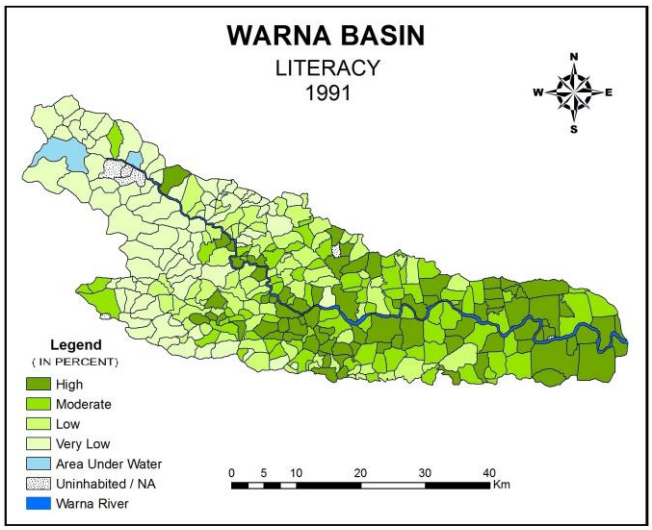
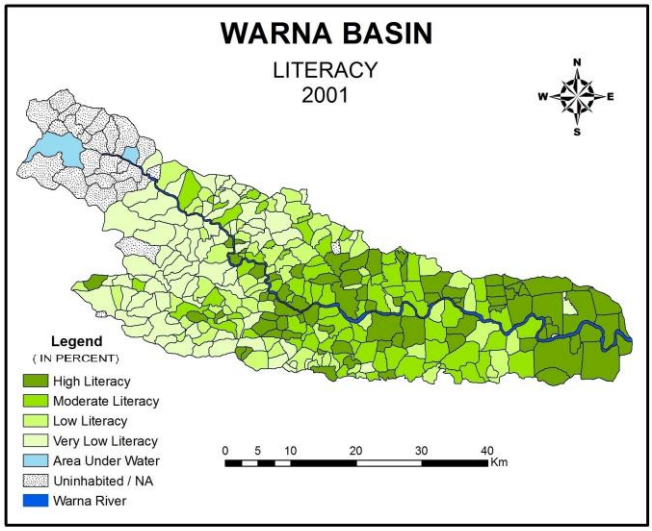




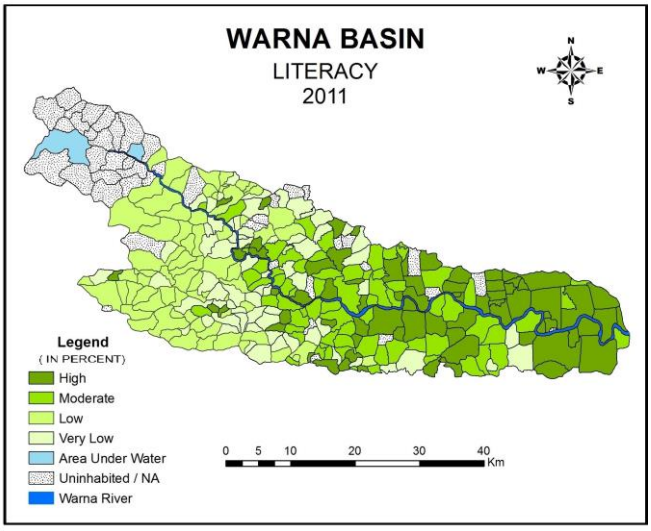


Fig. 1- Average Literacy : Warna Basin villages

part of the basin. These villages are on both the banks of the river, more prominently to south –eastern part of the basin. On the other hand, villages that are ramified in the moderate literacy are in the lower part of the basin on the side of the river bank. Also, there are very few villages that come under category of low literacy rate and are many situated on the left bank of the river. Similarly, villages that fall under very low literacy rate are on the right bank of the river. Uninhabited area have increased in comparison to map of 1991. Some villages to the boundary line of the basin area comprised in this category. Moreover, there is only one village that lie in the south-eastern part of the basin which comprised in uninhabited area.

Literacy 2011

The villages that fall in the category of high literacy rate are stretched from lower middle part of basin to the south-eastern part of the basin. These villages are on both the banks of the river, more prominently to south –eastern part of the basin. On the other hand, villages that are ramified in the moderate literacy are stretched from lower middle part of the basin on the side of the river bank. Also, there are very few villages that come under category of low literacy rate and are many situated on the right bank of the river and some are on the left bank on the river.

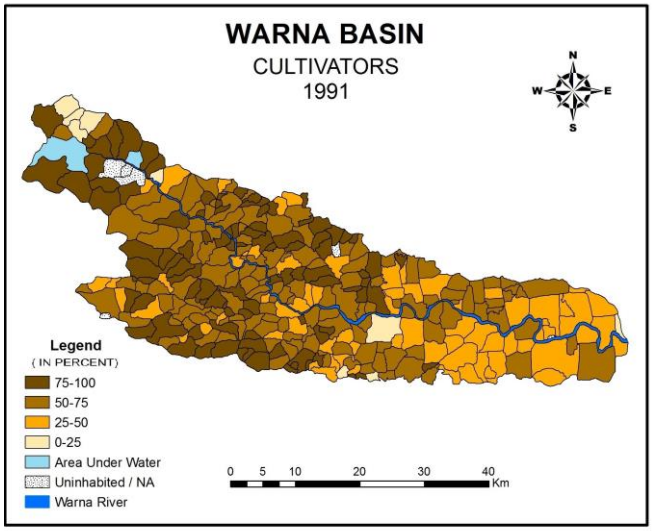
While comparing the map of 1991,2001 and 2011 (fig 1) one can see markedly changes in the Warna basin. The uninhabited area of the basin have increased drastically in two decades. Also, most of the high literacy rate region have shifted towards the south-western part of the basin. Similarly, Low literacy rate villages are on the right bank of the river. Therefore, the construction of the dam have led to increase in uninhabited area (which is now under the control of forest department) of the Warna basin. The impact of dam in connection with the literacy is positive.

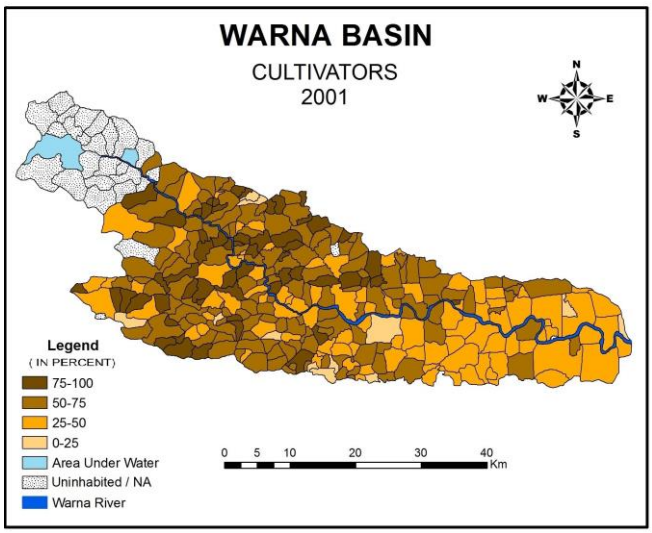
Cultivators (1991):

The map-1991 (fig.2) of Warna Basin is the manifestation of cultivators in the same basin including the villages of Kolhapur and Sangali districts for the year 1991. This map shows the ratio of cultivators to the total workers of basin villages in the percentage.

Most of the cultivators that lie in the 75-100% are situated in the north-western part of the basin and some are situated to the left bank and right bank of the river. The significant reason behind the pronounced cultivators situated in the north-western part of the Warna basin is Chandoli Dam which supplies surplus water for irrigation.

On the other hand, the villages that lies in the range of 50-75% are situated in the middle part of the basin area. These villages are stretched along the basin to east and the south-eastern part of the basin. The villages from south and south-western part of the basin pronouncedly fall in the category of 25-50% of cultivators. These villages prominently utilise “lift irrigation” for cultivation. There is only one village near to right bank of the river to the down flow of the basin towards the south. Whereas three villages lie to the upper part of the basin near the Dam area in the north-western part of the basin. Similarly, the villages those lie in the category of 0-25% are mainly situated in the north-western part of the basin, these are only three villages which fall apart from the flow direction of the river. Due to scarcity of water the cultivation land is minimal and hence cultivators are very subtle. Chandoli dam have foster irrigation facility and varied other facility to the villages that lie in this basin.





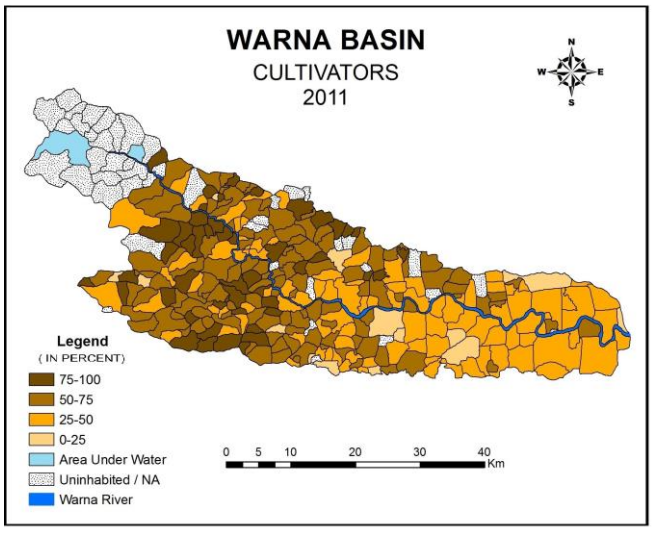


Fig. 2- Cultivators : Warna Basin villages

Cultivators_2001

The given map demonstrates the data of the year 2001. The villages that lies in the range of 75-100% are very subtle and are spread around the lower part of the basin. Most prominently these villages are situated in the lower part of central middle part of the basin. Similarly the villages that lies in the range of 50-75% are situated in the middle part of the basin and very few villages are stretched towards the eastern part of the basin. All these villages in two specific categories as above mentioned lies on right and left bank of the river.

On the other hand , the villages that are in the range of 0-25% are situated to the far left bank i.e. to the boundary line of the basin. Significantly, there is only one village that lies to the right bank of the river in the Warna Basin. Chandoli dam is situated in the north-western part of the basin and the village around these dam explicitly shows the uninhabited area in these year. Also, one village to the right bank of the river near the boundary line of the basin shows uninhabited area.

Cultivators_2011

The villages that lies in the range of 75-100% of cultivators are situated densely in along the right bank of the river Warna very near to the downward flow. Most of the villages those are included in this range are spread all over the middle basin. Similarly the villages that are comprised in the range of 50-75% are in the middle basin area and very subtle villages are stretched to the eastern part of the Warna basin. Moreover, the villages those are comprised in the 25-50% of the cultivators are situated near to the Eastern and south-eastern part of the basin and very few of them are stretched in the upper middle part of the basin. Whereas, the villages that lies in the category of 0-25% of cultivators have significantly increased as compared to the map of 1991 and 2001. These villages are to the eastern part of the basin along both bank of the river. Similarly the uninhabited area in the basin of Warna have drastically augmented from the north and north-eastern part to left and right boundaries of the basin. Due to the construction of dam the migration of the people from these region have too upsurge dramatically. Hence one could conclude that dam have significant ill effect in the Warna basin on the cultivators.

While comparing the map of 1991, 2001 and 2011 one can denote that the percentage of cultivators are declining drastically. These have led to increase in the uninhabited area in the Warna Basin. The villages around the Chandoli shown uninhabited area in 2001 and which successively augmented in the year 2011. Moreover downward side of the basin markedly exhibits the changes in the cultivation pattern which induced changes in the cultivators. Therefore, the construction of dam have led to some ill effects in the Warna Basin comparatively.

Agricultural Labourers-(Workers)_1991

The Fig 3- map demonstrates agricultural labourers in the year 1991 in percentage. This map incorporate the substantial data of Warna basin which includes villages of Kolhapur and Sangli districts.

The map clearly depicts very few villages that lie in the 75-100% of agricultural labourers. Three of the villages are in the north-western region near the dam site area. Some villages lie away from the right bank and some near the right bank of the river. Whereas, more than 70% of villages fall under category of 50-75% of agricultural labourers. These villages have occupied in the Warna basin on the great extent. Agricultural land is available

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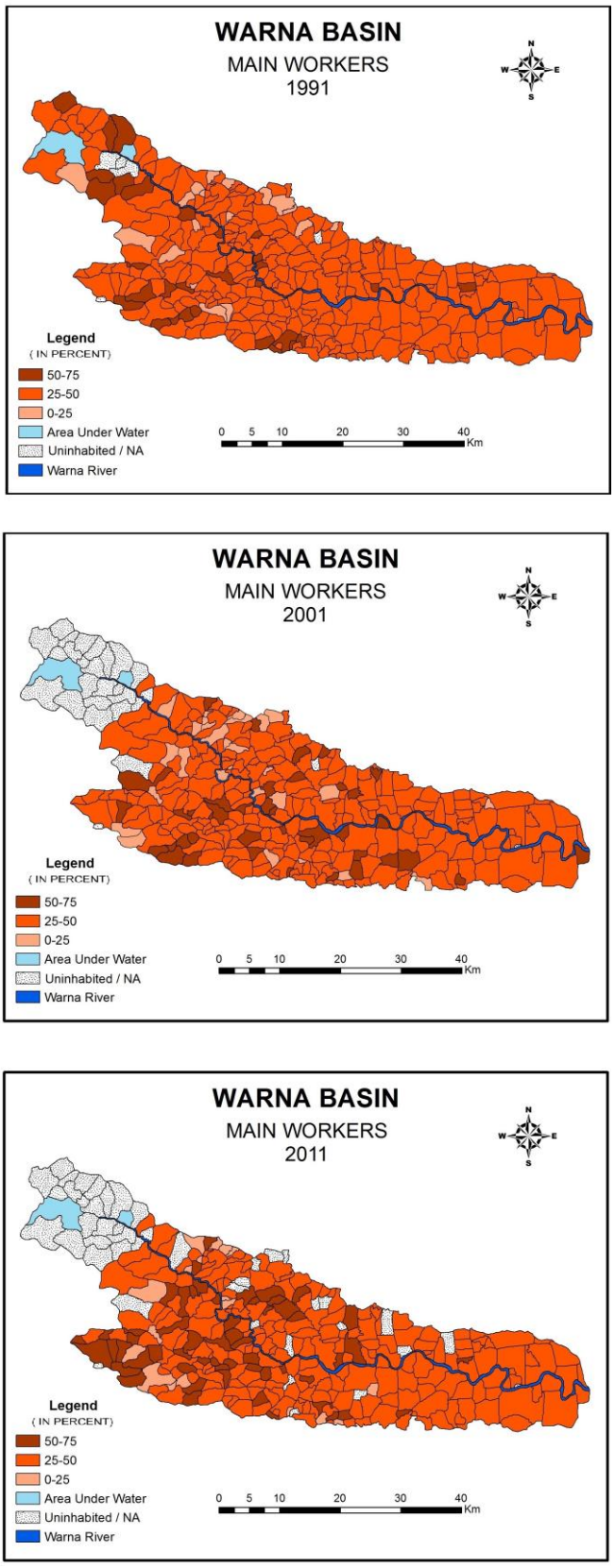


Fig. 3- Main Workers : Warna Basin villages

in the top upper basin area. On the other hand, some of the villages those are in south-eastern part and eastern part lies in the 25-50% of the agricultural labourers. Whereas, subtle villages lie in the range of 0-25% of agricultural labourers. All these villages are situated around the left and the right bank of the river Warna.

North-eastern peak of the basin incorporates Chandoli dam project, especially on the right bank near to these project shows uninhabited villages. Whereas, on the other hand , some area is under water due to the project.

Agricultural Labourers-2001

The generated map depicts agricultural labourers (in percentage) for the year 2001. Also, this map shows the changes in the Warna basin due to Chandloli dam.

The given map shows only one village to the left bank of the river having agriculture labourers in the range of 50-75%. These villages lie in the eastern part of the Warna basin. Whereas, many villages to left bank of the Warna river comprises of 25-50% of agricultural labourers. Some of these are in the southern and northern part of the basin. These villages utilizes lift irrigation as source of irrigation in agricultural field. Similarly, more than 60% of the villages in the Warna basin incorporates 0-25% of agricultural labourers. Whereas, almost villages around dam area are uninhabited, also, one village towards the south western region of this basin shows uninhabited area. Chandoli dam is constructed to provide water facilities to these villages.

Agricultural labourers-2011

The given map illustrates agricultural labourers in percentage in the year 2011. The map depicts very few villages that falls in 50-75%of agricultural labourers. There is only one village on the right bank of the river in south western region of Warna basin. Three villages lies on the left bank of Warna basin which shows highest agricultural labours in comparison to other villages on the same bank.

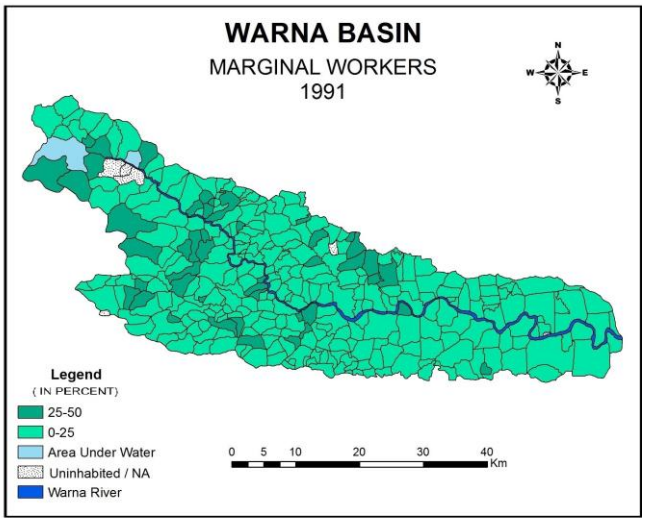
On the other hand, along the river from west to east most of the villages shows 25-50% of agricultural labourers. Similarly, in the north western region only two villages falls under this category. Also, in the basin area some villages depicts this percentage. Whereas, eastern part of riverwherein almost all the villages fall under this category. These villages utilize lift irrigation for agricultural purpose.

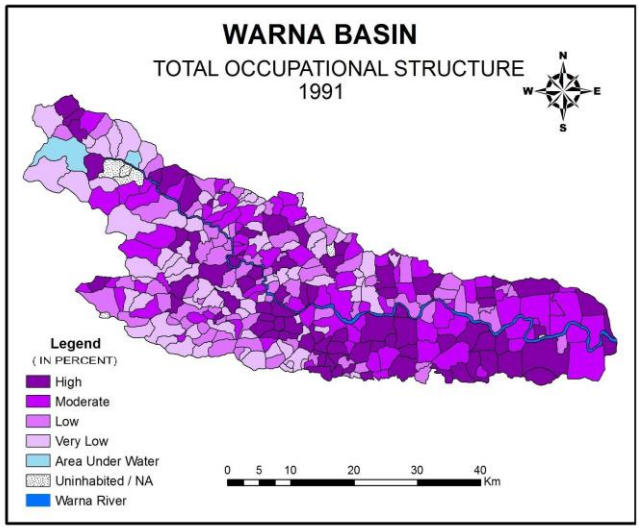
More than 60% of the villages in this basin explicitly shows agricultural labourers in the range of 0-25% , these villages are stretched in all the basin amongst which very subtle lies along the river bank. To the north western part of the Warna basin lies Chandoli dam and the area around that dam is uninhabited. Whereas, many uninhabited villages lie on the left bank of the river.

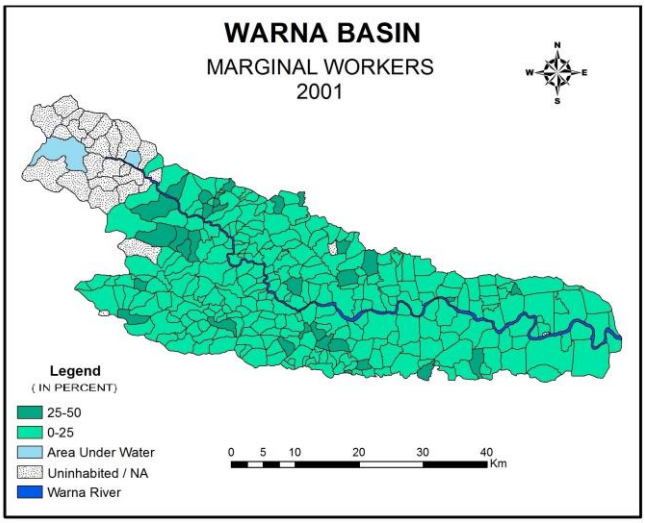
While comparing three maps, it gives distinctly that forest level is decreasing similarly, agricultural labourers are decreasing too in the Warna basin. In the eastern area the agricultural labourers have remained same with slight fluctuations . Uninhabited area is upsurged in 2011 than compared to other two maps of 1991 and 2001 respectively. Only villages showed uninhabited villages in 1991 which successively increased in 2011.

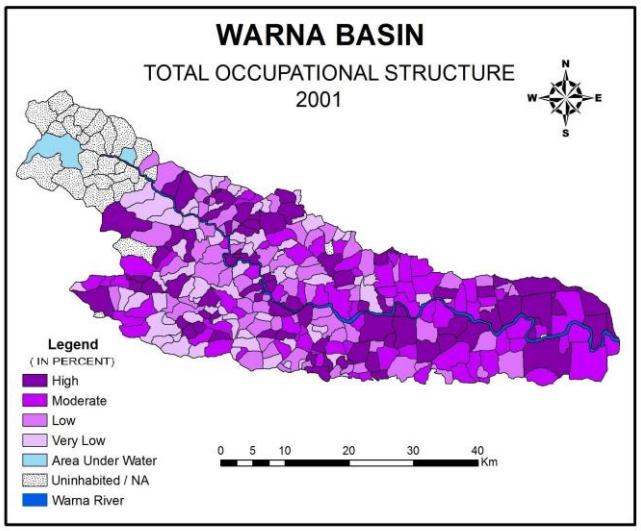
Marginal Workers _1991

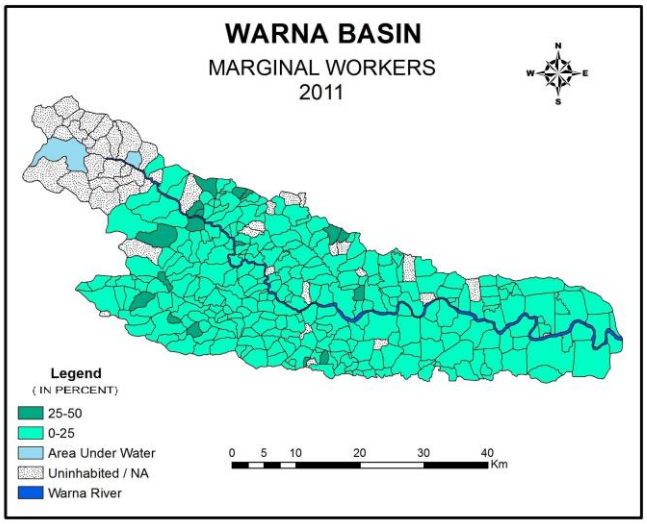
In this map (fig 4) the villages that fall under category of 25-50% are very few as compared to the other categories. Herein this, some of the villages are around Chandoli dam area in the north-western part of the Warna basin. As moving down to south-eastern region of the Warna basin one can distinctly denote that these











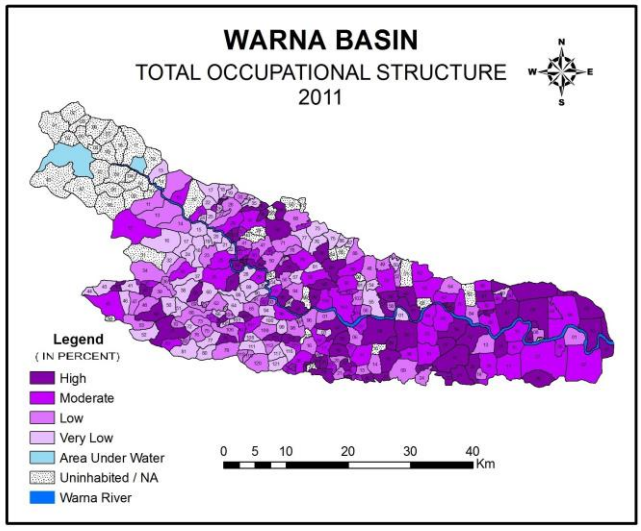


Fig. 4- Marginal Workers : Warna Basin villages

Fig. 5- Total Occupational Structure

villages are located on both banks of the river Warna till the middle basin part. On the other hand, the villages that come in the category of 0-25% covers more than 65% of the basin. This villages are stretched from north-west to the south-east of the basin. In contrast the villages that represent area under water is only the Dam built area in the north -western part of the basin. Very near to the Chandoli dam in north-western part of the basin comes the uninhabited area along the right side of the river Warna.

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Moreover there is only one village on the far left bank of the river in the middle-basin area.

Marginal Workers _2011

The map shows the villages that falls in the category of 25-50% are very meager on both banks of river. These villages are stretch from north-eastern region to the middle half of the basin area. Whereas, more than 70% of the villages comes under 0-25% of the marginal workers. These villages are stretched from north-eastern to south-western part of the region. These villages dominates more in the Warna basin as compared to the other categories. In contrast, uninhabited area have pronouncedly increased in the northern part of the basin and this villages have augmented from north to south in the Warna basin. Most of this newly bloomed villages lie on the far left bank of the river on the boundary area. On the other hand only three villages lie on the right bank of the Warna basin.

The area under water lies in the north-western part of the basin area, due to the Chandoli dam. This dam is built to provide water facility for the given villages.

IV. CONCLUSION

While comparing both year (the map) 1991 and 2001 respectively , One can denote remarkable changes throughout the basin villages in respect of overall development. First of all, the villages that falls under the category of 25-50% have pronouncedly diminished by the 2011. Also, the uninhabited area have increased distinctly in 2011 from north-west to middle of the basin area. Moreover the region of the Warna basin that exhibit marginal workers in the range of 0-25% have upsurged in the same year. This changes are denoted after the Chandoli dam construction. So whether or not it's leading towards the development of the Warna basin or not? But it is clear that the villages of middle and downstream part of Warna basin are developed more than the villages of upstream basin. There occupational structure is also changed and development trend in the downstream basin villages have increased..

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