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Dr. Kailas S Nile
Assistant Professor, Pratap
College Amalner, Dist.
Jalgaon, Maharashtra, India

Impact of Bhokarbari irrigation project on irrigated cropping pattern in its command area in Jalgaon district

Dr. Kailas S Nile

Abstract

Cropping pattern means the proportion of area under different crop, while changes in cropping pattern refer to change in proportion of area under different irrigated crops at different periods. The present paper tries to investigate the impact of Bhokarbari irrigation project on irrigation cropping pattern in its command area in Jalgaon district. The data about area under different crops as well as area under irrigation are obtained from tehsil records of Amalner tehsil (T20). A simple methodology is used to correlate the proportion of area under irrigation and area under different irrigated crops. It revealed that, TN the central part Intensive irrigated area are observed in the command area of the project. The central part of the study area is having good amount of groundwater. Therefore, more than 16 irrigated crops are successfully growing. Cropping pattern, irrigation system and small size of farm display economic condition of the farmers.

Keywords: Irrigation, cropping pattern, Landuse, Jalgaon district, Groundwater

1. Introduction

Irrigated cropping pattern means the proportion of area under different irrigated crop at a point of time, whereas changes in cropping pattern refer to change in proportion of area under different irrigated crops at different periods such changes, though governed by ecological situation, socio-economic and technological factors also determine which of the feasible crops the farmers will choose. In case of irrigated crops, the choices are directly governed by the specific purpose for which the irrigated crops are to be grown and these are also conditioned by the geographical factors and modified by the emergent, social and economic circumstances (Memoria, 1979). In the study region more than 16 irrigated crops are grown during last 3 years. Farmers are cultivating these crops traditionally.

The command area of Bhokarbari irrigation project is a part of rain shadow zone, behavior of irregular rainfall, shortage of groundwater and imperforate irrigation facilities are a major cause of reduction in area under unirrigated crops. Study area is exceptional in respect of different crops zones. In the Parola and Amalner tehsil small pockets are found irrigated for cotton, wheat and vegetables crops. Entire Bori basin is suitable for vegetables and fruit crops cultivation. The cultivation of land for different crops indicates the relationship between dominant natural conditions and economy of farmers. Farmers of the study region try to get maximum crop production with minimum rainfall and short supply of groundwater resources. In this study area cropping pattern, irrigation system and small size of every farm are display economic condition of the farmers.

2. Objectives

The main objective of the present work is to assess the Impact of groundwater on irrigated land cover of the study region. To achieve this aim of the study, the following objectives are kept in mind.

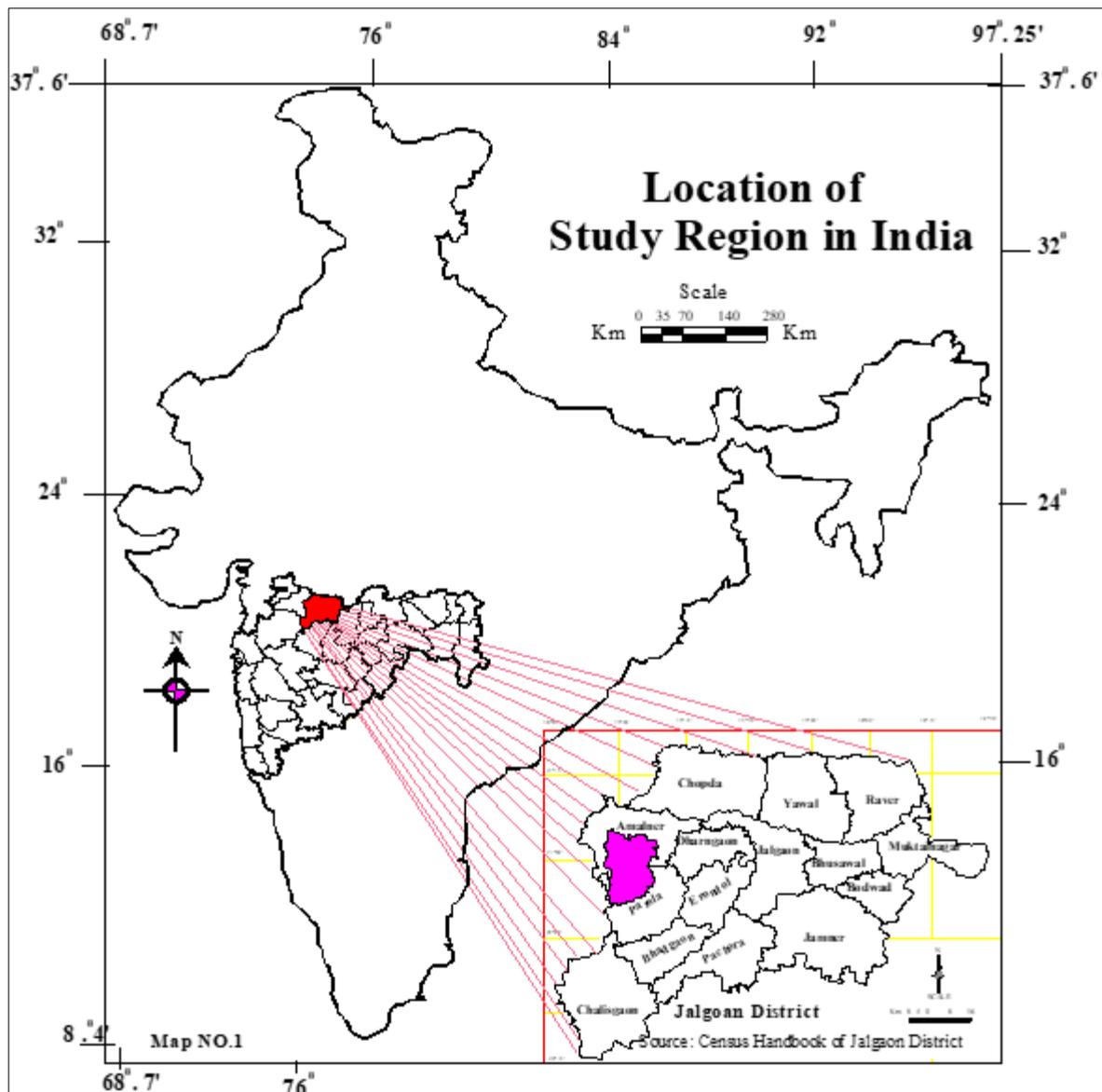
1. To examine the overall impact of Bhokarbari irrigation project on irrigated land cover.
2. To display spatial distribution of irrigated cropping pattern.

Corresponding Author:
Dr. Kailas S Nile
Assistant Professor, Pratap
College Amalner, Dist.
Jalgaon, Maharashtra, India

3. Study Region

The study region includes a small watershed of Bhokarbari irrigation project command area, which is a small part of Boribasin in Jalgaon district selected for detailed study. Bhokarbari irrigation project contracted on small watershed

its tributaries of river Bori in Parola tehsil near bhokarbari village. The overflowing and excess water was released from the Girna irrigation project into the Girna river and then through the Jamada water project,



Map 1: Location of study in India

water was diverted to the Jamada left bank canal which connected to the Parola branch canal; then the water reached the Mhaswa water project. From here, water received in the Bhokarbari dam. This extensive expedition of the water of 132 km has enriched the Bhokarbari projects. Command area of bhokarbari irrigation project is an upper part of Bori basin in eastern part of Jalgaon district bounded by $20^{\circ} 52' N$ and $21^{\circ} 00' N$ latitudes and $75^{\circ} 5' E$ and $75^{\circ} 10' E$ longitudes, covering 137.2300 sq km of land (13723.00 ha). This region includes 27 villages.

4. Methodology

4.1 Data Base: The present work is based primary and secondary data. Primary data are collected through the personal interviews of the farmers in rural areas. To collect primary data of 27 villages of the study region, estimating about 100% of the total villages are selected. From each

village approximately 10 farmers are selected for personal interview.

The study of village wise agricultural land cover data has been collected from tehsil offices of Parola and Amalner Jalgaon district. The data regarding the area under all different irrigated crops in 27 villages of the tehsil was collected from the tehsil office TF20 record.

4.2 Data Analysis Techniques: This research work is entirely completed with the help of computer. Considering the nature of voluminous data, it is not possible to analyze such data manually.

1. Microsoft Excel software is used for the analysis of village wise data of cropping pattern. For data analysis "IF condition command", "Advance filter command", "Conditional formatting" commands are used.

4.3 Cartographic Techniques: Auto Desk Map software are used to prepare all maps. Considering the village wise boundary maps, all maps are prepared cited below:

1. Dot maps are prepared showing spatial distribution of all crops
2. By considering the scale, per sq km grids are superimposed on dot maps.
3. Dots are then counted in each grid.
4. Counted numbers of dots are placed in respective grids.
5. With the help of these values of dots, isopleths are drawn.
6. According to the intensity of zones, hatching command is used to show the intensity zones of a particular crop. Thus, all maps are prepared showing intensity zones.

5. Discussion

In the study region more than 16 crops are grown during last 3 years. Farmers have cultivated these crops traditionally. It is observed that there are four major crops. Cotton ranks first covering 39.67% of cultivable land followed by jowar 21%, millet 12.68% and pulses 11.04%. This all crops are grown on normal rainfall. It is clear that about 85% area is cultivated depend on natural rainfall. These crops fulfill the requirement of fodder for their cattle and grain for family. Remaining 15% of the total cultivated land is used for other irrigated crops.

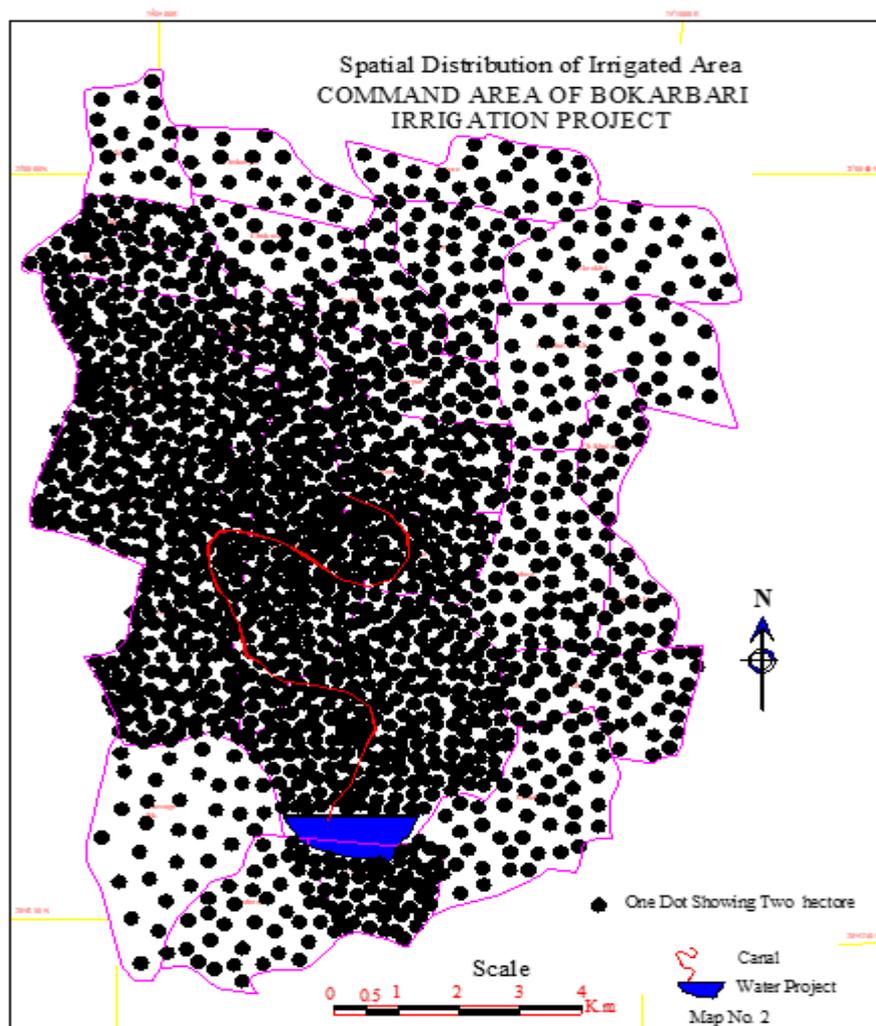
In the study region cotton, wheat, vegetables, groundnut and

fruits are significant irrigated crops. Different types of crops require different amount of water in specific seasons.

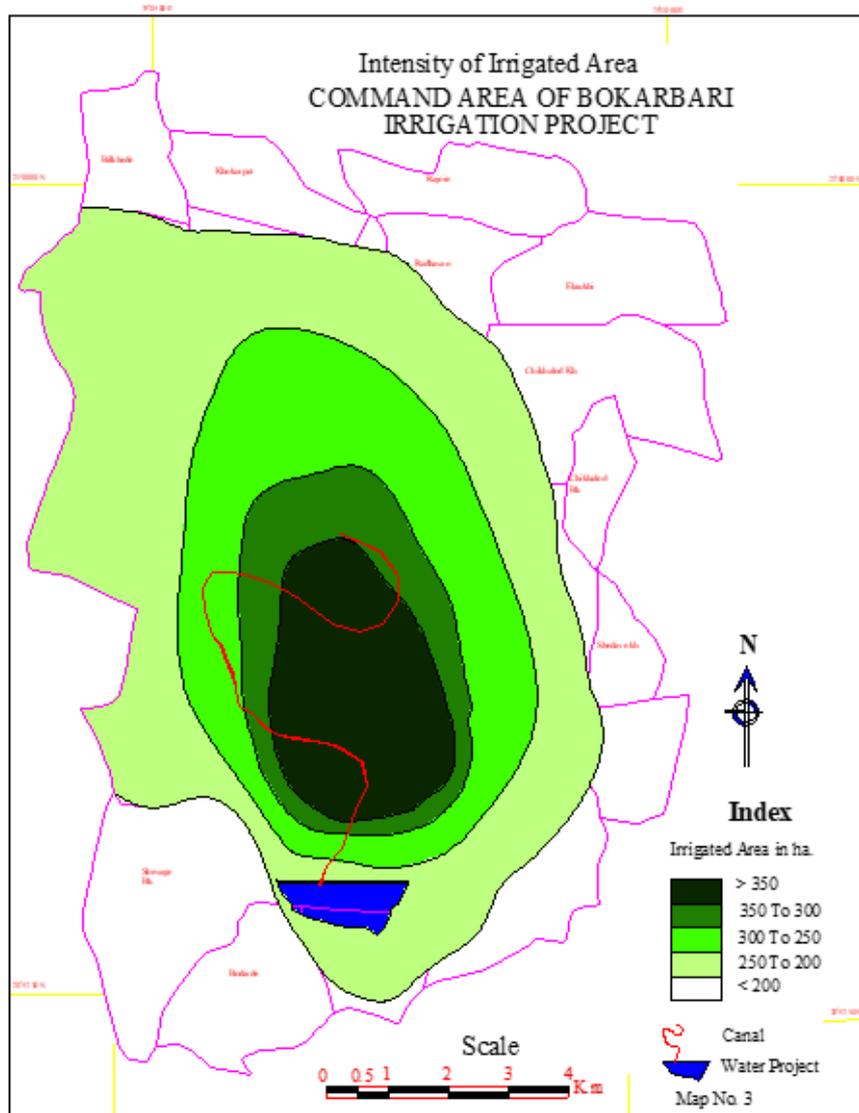
5.1 Spatial Distribution of Irrigated Area

In the command area of Bhokarbari irrigation project out of total geographical area about 59.32% area of the total cultivated land is irrigated during the study period. These figures clear that irrigated land is significant. To display spatial distribution of irrigated area, village wise dot map is prepared (Map No.2) On this dot map 5 sq. km grids are superimposed and dots are counted from each grid. Counted figures are placed in respective grids and isopleths are drawn to display intensity wise zones of irrigated land. Thus, dot map is transformed into isopleths map showing belt of irrigated area. (Map No.3) In this map main belt of irrigated area is found South to North direction in central part and eastern part near bhokarbari irrigation project of command area of Bhokarbari irrigation project.

Map No.3 is showing extensive irrigated area is located around the canal and away from 4 Km in north near the Bhokarbari irrigation project of the region. This extensive irrigated area circular zone is 5 km long and width is 3 km. in the central part near the Bhokarbari irrigation project of the region. The total geographical area of this zone is measured as 4.0738 sq. km. (407.38 ha). It is clear that out of 407.38 hectare of land near about 350 hectares is irrigated.



Map 2: Spatial distribution of irrigated area command area of bokarbari irrigation project



Map 3: Intensity irrigated area command area of bokarbari irrigation project

Out of total geographical area of this extensive irrigated area about 85.91% land is under irrigation. Around the central extensive irrigated area medium intensive of irrigated area has stretching South - North direction. In this area 350 to 300 ha of land is irrigated covering 1.9436 sq km.

In this area depth of rock sheet below the surface is found near about 10m deep. Therefore, in this area depth of ground water level is near about 10 m. In this irrigated area by wells imitates groundwater position as well as recharging rate of groundwater. Bhokarbari irrigation project helps to recharge the wells located on down slope which are up to 5 km long from the dam and when one goes away from this Bhokarbari irrigation project irrigated area, and recharging capacity of wells is found decreasing. In this area covered of village Bhokarbari, Holpimpri, Dabapimpri and Ratnapimpri is included.

5.3 Spatial Distribution of Significant Irrigated Crops:

In the command area of Bhokarbari irrigation project near about six to eight crops have occupied maximum cultivated

area. These significant crops Cotton, Wheat, Vegetables, Other Grain crops, Groundnut and Guava crops have covered near about 88% of the total irrigated area.

Farmers of the study region try to get maximum crop production with minimum rainfall and short supply of groundwater resources. In the study area cropping pattern, irrigation system and small size of every farm display economic condition of the farmers.

In the study region Cotton, Wheat, Vegetables, Other Grain crops, Groundnut and Guava are dominant irrigated crops. Different types of crops require different amount of water in specific seasons.

5.4 Cotton: This study region famous for white gold like us cotton crop. Cotton is first ranking irrigated cash crop in the command area of Bhokarbari irrigation project because of Alluvium and deep black soil has created favorable edaphic condition for the growth of cotton crop. Farmers grow this crop with the help of supplementary irrigation during few days before the arrival of monsoon season.

Table 1: Proportion of Irrigated Crops in the Command Area of Bhokarbari Irrigation Project

Irrigated Crops	% To Total Irrigated area	Status
Cotton	42.82	Significant
Wheat	17.17	
Vegetable	13.09	
Other Grain crops	8.58	
Groundnut	3.76	
Guava	3.56	
Chilly	2.41	Insignificant
Other Fruits	2.35	
Banana	1.23	
Lemon	1.16	
Onion	0.70	
Corn	0.12	
Yellow Gram	0.05	
Chickoo	0.04	
% To Total Irrigated Land	100	

Source: Tehsil Office- Record No 20

Table No.1 is showing proportion of cropped land under irrigation. This table clears that out of total irrigated land about 42.82% area is found under cotton this crop is the leading position. To find out real distribution of cotton area dot map prepared. This dot map is transformed in to isopleths map showing different intensity zones of cotton cultivation. Thus, cotton belt is demarcated. It is interesting to note that entire cotton cultivation belt is observed in the central part and NE and NW part of study region. There are three most intensive pockets having more than 250 hectares of land under cotton crop. Approximately more than 80% of the total geographical area is found under this crop. It is clear that cotton crop requires very short amount of water to irrigate fields and such short supply of water is available in the wells located in the north part of Bhokarbari irrigation Project. In this area covered of village Bhokarbari, Holpimpri, Dabapimpri, Ratnapimpri, Kankaraj Bilali,

Ekrukhi and Fapore is included.

5.5 Wheat: Wheat is second ranking important seasonal irrigated crop generally farmers cultivate this crop during in the months of November & December. In the study region, an approximately 676.72 hectare of land (49.31%) is found under wheat crop. It is observed that during survey period farmers cultivate wheat crop those have medium storage of water in their wells. The total period required for wheat production is 4 months. It is clear that before the middle of March, farmers harvest this crop. During the survey farmers have reported that the supply of water in their wells remain up to the March. In the study region are showing five intensity zones of wheat belt. All intensive zones of wheat are stretching SE-NW direction in the central part near the Bhokarbari irrigation Project of study region, there are two intensive Zones cited as below.

Table 2: Proportion of Area Occupied by Wheat Crop (Ave. of 2016-17 to 2018-19)

Intensity of Wheat Cultivated Area (ha)	Geog. Area Covered in the intensity zone (sq.km)	% To Geog. Area Covered by Zone
> 170	30.20	4.45
170 To 130	43.21	6.38
130 To 90	59.17	8.74
90 To 50	78.32	11.58
50 To 10	213.34	31.52
< 10	252.25	37.25
Total Area	676.27	100.00

Source: Tehsil Office- Record No 20

Table No.2 is prepared by measuring the area of all intensive zones cited as below.

High Intensive Zone: The area covered by this intensive zone is about 21.16% of the total area under wheat crop. In this zone more than 160 ha of land are found under wheat crop. This zone is located in central part near the Bhokarbari irrigation Project of the region, constant supply of groundwater during pre and post monsoon period, low depth of rocks sheet beneath the surface etc favorable condition is found.

Medium Intensive Zone: This zone is found around the intensive zone, covering about 20.56% of the total wheat cultivation. It clears that, in the north of Bhokarbari irrigation Project of the region, Bhokarbari project and Canal help to recharging groundwater to wheat belt, that's

why wheat belt is thrives well there. In this area covered of village Bhokarbari, Holpimpri, Dabapimpri, Ratnapimpri, Kankaraj Bilali, Ekrukhi, Fapore, Kolpimri, Vanjari and Sadawan are included.

5.6 Vegetables Belt: In the study region vegetables is third ranking position. This region is famous for vegetables in the district. In the group of vegetable crops leady figure, chilly, bringer, tomato, onion, guar, coaly flowers and leafy vegetables are included. This group has occupied, an approximately 514.10 hectare of land (37.46%) is found under of vegetables. All these crops require short period. There are vegetables crops like leady figure, chilly, bringer, tomato, onion, guar, coaly flowers and leafy vegetables help to increase the income of farmers in short duration. In the study region is only one pocket having intensive cultivation

of vegetable having more than 40 hectares of area under vegetable.

Table No.3 is prepared by measuring the area of all intensive zones of vegetable belt shown in the map. This

table clearly reveals that high intensity of vegetable (more than 160 ha) is found in 21.23 sq. km. area. This intensive belt is found in the North of Bhokarbari irrigation Project.

Table 3: Proportion of Area Occupied by Vegetables crop (Ave. of 2016-17 to 2018-19)

Intensity of Wheat Cultivated Area (ha)	Geog. Area Covered in the intensity zone (sq.km)	% To Geog. Area Covered by Zone
> 160	21.23	3.82
160 To 130	35.56	6.40
130 To 100	45.12	8.13
100 To 70	83.48	15.04
70 To 40	176.89	31.88
< 40	192.54	34.70
Total Area	554.12	100.00

Source: Tehsil Office- Record No 20

It is clear that where ground water is insufficient, farmers they prefer short duration vegetable crops grown successfully on short supply of water and this vegetable crop helps to increase the income of farmers.

5.7 Other Grain Crops: In the study region, out of total irrigated land about 8.58% area is found under other grain crops. In the group of other irrigated crops rabbi Jowar, yellow gram, corn etc are included. These crops are grown both as *kharif* and *rabbi* crop. All these crops are cultivated during winter season; require supplementary irrigation after monsoon season. The total period of these crops is about 3 to 4 months. It is clear that these crops require short amount of water to irrigate the fields. In the study region are one intensity zones. This Zone one is found 5 km in the central part of the region, north of Bhokarbari irrigation Project, this intensity zones stretching along canal. In this zone more than 90 hectare of land is observed under other irrigated crops. This zone is benefited by groundwater recharged by Bhokarbari irrigation Project and canal. In this area covered of village Bhokarbari, Holpimpri, Dabapimpri, Kankaraj, Bilali, Shevage and Kolpimpri is included.

5.8 Groundnut: Groundnut is fifth ranking crop cultivates during winter period (December- January). This crop also requires a period of 4 months. April and May are the harvesting months. At the time of harvesting, short supply of irrigation is needed. Where live supply of groundwater during summer period is available, groundnut is cultivated there. In the study region about 3.76% land is found under groundnut crop. It is clear that groundnut crop requires sufficient supply of groundwater during summer. Out of total irrigated land about 3.76% area is found under groundnut crop. In the study region Shedave Bk, ShedaveKh, Chikhalod, Holpimpri, Kanhere, Fapore villages are producing groundnut where more than 30 hectare of land is found under this crop. All these villages are located nearby the East and West Boundary of study region.

5.9 Guava: Guava is sixth ranking fruit crop grown successfully in the study region. This crop is perennial requires short but continuous supply of groundwater throughout the year. Where scanty supply is available, farmers cultivates guava. Most of the farmers growing guava, are irrigating the fields using drip irrigation. Out of total irrigated land about 3.56% area is contributed by this crop. In the study region are one intensity zones in which

more than 20 hectares of land is found under guava plants. This intensive zone of guava is stretching N-E direction. In this zone covered of village Sadawan, Kolpimpri, Kanhere, Fapore and Chakave is included.

5.10 Spatial Distribution of Insignificant Irrigated Crops

In the study region this group of insignificant crops Banana, sugarcane chilly, corn, lemon, onion, yellow gram, chickoo, other fruits etc are included. Out of total irrigated land about 8.06% area is found under these crops. There is only three villages Bhokarbari, Holpimpri, Dabapimpri having more than 30 hectare of land under these crops. Medium concentration is found in 9 villages namely Sadawan, Kolpimpri, Kanhere, Fapore, Chakave, Kankaraj, Bilali and Ratnapimpri etc. It is interesting to note that Fapore, Bilkhede and Kankaraj is only three village having ample source of groundwater on which Banana and sugarcane are successfully grown.

6. Conclusion

It is clear that Bhokarbari irrigation Project is recharging the sub soil groundwater. storage. Depth and dip of rock sheet plays a significant role to recharge sub soil groundwater storage. Depth of rocks is gradually decreasing toward north, east and west direction. Near the Bhokarbari irrigation Project of the study area, depth of rock is very near to the surface.

Due to overall effect of Bhokarbari irrigation Project, central part of the study region has potential groundwater storage. Therefore, intensive irrigated land is observed South to North direction in central part of the study region. Hence farmers prefer to cultivate seasonal irrigated crops such as Cotton and Wheat in the central part of study region. Those crops require short time irrigation during winter season; they are concentrated around the high potential zone of groundwater.

It is noteworthy fact that the in the study region perennial significant irrigated crops are absent. Here scanty supply groundwater is available, farmers cultivates seasonal irrigated crops. Fapore, Bilkhede and Kankaraj are only three villages having ample source of groundwater on which perennial irrigated Banana and sugarcane are successfully grown.

It is concluded that where groundwater is ample farmers prefer perennial irrigated crops and where ground water is insufficient, farmers they prefer short duration crops. The central part of study region suitable for growing cotton, wheat, Groundnut and vegetable crops successfully on short

supply of water and these crops help to increase the income of farmers are always substantial.

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