CHAPTER: 1

INTRODUCTION OF THE STUDY REGION

1.1: INTRODUCTION:

In 1906 Khandesh was divided into two districts called west and east Khandesh with headquarters at Dulia and Jalgaon respectively. Khandesh region was known with its culture, economy, agriculture and social custom. Before 1960 most of the farmers were irrigating their agricultural field with the help of “Mot” through bullocks. At that time very small piece of land was irrigated during a day. Therefore the proportion of irrigated land was very insignificant. During 1961 most of the agricultural motor pumps were electrified.

Jalgaon is one of the significant districts in the state, famous for yellow metal gold and banana yellow gold. This district is located near the hart land of India, occupied a position of great strategic important in the Tapi basin. In the north Satpura upland became the source region of groundwater recharge for piedmont plain stretching east-west direction between Satpura foot and Tapi river. Piedmont plain is famous for banana and sugarcane cultivation. Raver ranked first in the district of which about 92% of the net sown area is irrigated. Out of total irrigated area about 85% area is found under banana cultivation. Yawal Tehsil ranks second in respect of irrigated area. Most of the farmers prefer to cultivate sugarcane. Chopda Tehsil ranks third having both sugarcane and Banana perennial crops. Geographically and hydrologically this region is unique in respect potential groundwater resource. Southern part of Jalgaon district comprises twelve Tehsils having small water spots, hence small pockets of irrigated land is
discernible. Generally, in the study region proximately 72 crops are grown because of irregular behaving of monsoon rainfall. In the north extensive irrigated land and in the south small pockets of irrigated land is displaying imbalance agro-economic condition of farmers. To remove this agro-economic imbalance in the study region researcher has selected Jamda water project as study area for case study, located in Girna basin of southern part of Jalgaon district. Prior to 1978-79 case study area was famous for Banana. At present Banana belt is disappeared from the region only because of excess utilization of groundwater and ineffective attempts to recharge the groundwater.

Now-a days the tendency of farmers is to dig out new additional wells to get maximum supply of water, resulted into high density of wells. Depth of groundwater is going deep and deep, hence farmers are also increasing the depth of their wells. They are installing high capacity motor pumps on their wells. Due to such competition groundwater is diminishing. Hence southern part of the district is suffering by scarcity of ground water. On other hand government has attempted to enhance the rate groundwater recharge by constructing minor water projects and percolation tanks. But due to excess utilization of groundwater, all these attempts are worthless.

Present study focus the light on availability of groundwater, demarcation of groundwater counters, according to depth from the surface and planning to recharge the wells and groundwater. Therefore the main intention of the present study is to enhance area under irrigated crops by increasing recharge rate of groundwater recharge to develop economic condition of the farmers. The region selected for case study is located in southern part of Jalgaon district.
1.2: Significance of Water Projects in Agricultural Sector:

Irrigation happens to be one of the important components of farm technology promoting the agriculture production. Transformation of agriculture takes place where assured irrigation facilities are made available and the farmers those are provided with irrigation facilities can innate quick irrigation is one of the important components of modern agriculture. It is true that major, medium and minor water projects helped to increase agriculture production, hence land-cover gets transformed remarkably not only more area cultivated, but it is cultivated more insensitively.

Hatnoor dam is a major irrigation project built across the Tapi river near Hatnoor village in Bhusawal tehsil. In the north of the study region, especially near foot of Satpura upland Mangrul, Abora, Suki, More, Aner and Gul Medium projects are constructed. These projects help to irrigate the land as well as they are helping to recharge ground water and sub soil water in piedmont plain. Because of the construction of these projects, Raver tehsil ranks first in respect of irrigated area in the district having 10162 used wells and tube-wells irrigating the fields. All these wells and tube-wells are recharged by the Magrul, Abora, Suki and More and Hatnoor backwater projects.

In the south of district, Jamda, Titur, Manyad, Hiwara, Bahula, Ajani water projects are constructed across the Girna river and its tributaries. This is second ranking irrigated area in the district. In the command area of these projects vegetable, sugarcane, chilly and banana crops are successfully grown with the help of canal. It is noteworthy fact that in the southern part of the district less than 7.5 Hp motor pumps are installed on the wells. It is clear that sub soil water storage is found. Bori project is constructed on Bori
Location of Study Region in India

Source: Census Handbook of Jalgaon District
river help to irrigate the land for vegetable crops. Jamner tehsil is deprived of water projects. Hence, irrigated area is very insignificant in the tehsil.

This is clear that because of the construction of water projects banana, sugarcane, wheat, vegetable, are successfully grown in the small pockets of land in the vicinity of these water projects. Thus Major, Medium, and Minor, projects play a significant role in the agricultural sector.

1.3: Selection of the Topic and Study Region:

The Jalgaon district is stretching from $20^0 15'$ North to $21^0 30'$ North Latitudes and $74^0 45'$ East to $76^0 28'$East Longitudes. The region’s total area is given as 11765 sq. km. Jalgaon district is rich in respect of agricultural activities. This district consists of 15 Tehsils consist of 1510 villages. Three Tehsils are extended in the piedmont pain and rests of the tehsils are found in the southern part of Tapi. Jalgaon district is unique regarding variety of soils, physiography, and drainage pattern and crop culture. Northern piedmont is a monotonous flat plain from the foot of Satpura to river Tapi, having average slope of about $1$ to $2^0$ (Gentle slope), clayey soil, rich in potash, ample surface and groundwater promotes to increase the area under banana and sugarcane cultivation. Basically this is cotton crop region.

Jamda irrigation project is selected for case study of groundwater utilization and recharge. This project is constructed across the Girna river just near the village Jamda in Chalisgaon tehsil of Jalgaon district. This project has capacity to irrigate 17200 hectares of agricultural land through Left Bank and Right Bank canals. Total length of both canals is 75.83 km, covering an area of Chalisgaon, Bhadgaon, Pachora and Erandol tehsils. Out of the total estimated area only 318 hectares of land is irrigated. Considering the capacity of dam to irrigate the fields, a small watershed is demarcated
Chopda
Yawal Raver
Amalner
Parola
Dharngaon
Erondol
Bhadgaon Pachora
Chalisgaon
Jamner
Jalgaon Bhusawal
Bodwad
Muktainagar

Tehsils
Jalgoan District

Source: Census Handbook of Jalgaon District

Map No 1.2
and selected for detail study of groundwater fluctuation. Command area of Jamda water project is bounded by $20^0 30'\ N$ and $25^0 45'\ N$ latitudes and $75^0 0'\ E$ and $75^0 15'\ E$ longitudes, covering 539.2472 sq km of land (53924.72 ha). (Map of watershed selected for case study)

1.4: AIMS AND OBJECTIVES:

1) To examine the physical factors favorable for ground water recharge in the vicinity of water projects.
2) To display spatial distribution of irrigated crops.
3) To examine the overall impact of water projects on agricultural land cover.
4) To display the horse power wise motor pumps in the study region.
5) To assess the influence of water project to recharge the sub soil groundwater and aquifer.
6) To demarcate the area and depth of groundwater recharged by Jamda water project, percolation tanks, and canals.
7) To check ground truth of the area and depth of groundwater on the down slope of Jamda water project with the help of DGPS device.
8) To suggest measures to enhance recharging rate of groundwater levels

1.5 HYPOTHESIS:

1) “Ground water is one of the determinants of cropping pattern”
2) “Out of total number of water projects, very few number of projects are recharging the ground water level because of suitable geographic conditions”
1.6 : RESEARCH METHODOLOGY:

Data Base: To find out the identification of groundwater levels recharged by the major and medium water projects and their impact on agricultural land cover in Jalgaon district (A case study of Jamda water project), village wise primary and secondary voluminous data have been collected as below.

1) Village wise agricultural land cover data have been collected from fifteen tehsil offices of Jalgaon district. This data comprises total cultivated land, Net cultivated land, Net irrigated land, area under all irrigated crops etc.

2) Data regarding the location of Major, Medium, Minor and lift irrigation projects, area irrigated by the water projects, tehsil wise potential irrigated land etc have been collected from the “Tapi Patbandhare Vikas Mahamandal”; Jalgaon.

3) From the Divisional Office of Maharashtra Electric Board, Jalgaon, village-wise No. of used wells, village-wise three HP motor pumps, five HP motors pumps, 7.5 HP motor pumps, 10 HP motors pumps, and Above 20 HP motor pumps etc data are collected .

4) Geographical information of Jalgaon district, and water projects etc are collected from books, Gazetteers, GSD and through internet.

5) Census handbook of Jalgaon district, village code numbers, total geographical area of villages, village boundary map etc. are used for this research work.

6) Tehsil wise agricultural landuse data have been collected from Socio-Economic Review and Statistical Abstract of Jalgaon district.

7) Topographical maps No 46O, 46 K, 46P, 46L, 55C, and 55D, are used.

8) For the case study of command area of Jamda irrigation project 41 sample villages are selected. From each village approximately 10 farmers
are selected for personal interview, Thus researcher has approached to 410 farmers.

9) To locate surveyed wells percolation tanks and irrigation project recent Cartosat I - LISS 3 satellite data is downloaded from Bhuvan site.

**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.

- Resource sat I – LISS 3 image is processed for supervise classification considering Band Combination and Atmospheric correction through ERDAS Imagine 9.1.

**Cartographic Techniques:** Auto Desk Map, ERDAS Imagine 9.1 and Arc GIS softwares are used to prepare all maps. To digitize village wise map, V2R software is used. All maps are prepared in one file by using layer command system. With the help of layer command, Layer by layer all maps is prepared. These layer by layer maps have given overlay image to superimpose one theme on other. Thus findings are drawn. DEM, area under irrigated crops, drainage, slope, location of percolation tanks etc maps are prepared in Arc- GIS software.

Advance DGPS device known as Differential Global Positioning System is used to identify the geographical location of surveyed wells. Such data is attached to Arc- GIS software and all surveyed wells are located in the map.
Considering the village wise boundary maps, all maps are prepared cited below:

1) Dot maps are prepared showing spatial distribution of all crops and Horse power wise electrified motor pumps installed on the wells.
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.

1.7: REVIEW OF LITERATURE:

Various scholars have contributed to the field of Groundwater and Agricultural Geography. The review of literature in this discipline has been attempted in the foregoing discussion. However, major focus is given on the work undertaken by India scholars.

A. C. Omkar N, Ram Kishan Rao (1997) has stated that the impact of irrigation is manifold and is felt invariably in the land Utilization pattern. Any analysis of land use can be considered to be complete and comprehensive without an examination of the intricate and often interdependent relationship between land and man. Hence, it has been considered important to attempt as closer scrutiny of land use derived variables, such as land-man ratio, per capita net area sown, per capita total cropped area, per capita double cropped area and per capita arable land.

Land use derived variable in the Sriram Sagar command area are studied. The land use derived variables such as land –man ratio, per capita
net area sown, per capita total cropped area, per capita double cropped area and per capita arable land are examined. The study was based on secondary sources such as from census, Bureau of economics and statistics and also other relevant sources and it is processed according to the required manner. Land man ratio is calculated by dividing total agricultural land available in each mandal by population of the same mandal, Thereby, arriving at land-man proportion. The same technique is applied for other variable and correlation is calculated by employing product movement correlation.

The concluding remarks of the study clearly state that a study of the impact of irrigation with regard to land use derived variables, the steps that are to be taken to ensure agricultural development is carried out, with distribution of land in relation to population, though, the land–man ratio is little more than once acre in the study area it needs to be emphasized that the land available in Sriram Sagar command area is much more productive than the other areas, because of the provision of irrigation facilities.

Abbas Ali Abbunoori (1990) has made an endeavor to study the irrigation potential of drought-prone areas of Iran and to evaluate the possible ways of utilizing the available surface and ground-water resources. He states that the drought is a real problem in nearly all parts of Iran and it limits agricultural yield everywhere. The adverse effects of drought need be minimized by developing irrigation. Although the data available on the water resources and water use in drought prone areas of Iran is limited, yet, the available data roughly indicates the potential for development.

1. Surface Water Resources: More than 90 percent of Iran falls within the arid and semi-arid zones receiving an annual precipitation of less than 500 mm. practically, all the rainfall occurs during October-May or during the
winter months due to the passage of westerly depressions from the Mediterranean. Due to high annual variability and erratic distribution of rainfall cultivation of crops in hazardous without irrigation. In the Gilan and Mazandaran region, summer rainfall is generated by the depressions following a more northerly route from the Mediterranean, whilst in the south-eastern area of the country occasional monsoonal rainfall may occur.

**Bhagat Vijay (2008):**

According to Dr. Bhagat Agricultural wells have prime roll in irrigation system. It is more beneficial to farmers to arrange cropping pattern with the availability of ground water for this purpose ground water utility status area has been delaine considering depth of ground water and fluctuation by using GIS technique for this study of GUSA Purandar Tehsil of Pune Dist. Is selected constituting 108 villages, out of which 22.23% area is under irrigation Dr. Bhagat has use co-efficient of variance which is ratio of man to standard deviation .According to index value has classification the data in to three category’s’ (Low, Medium, High) he have also prepaid of map showing depth of ground water Dr. Bhagat has compare rainfall, ground water depth and fluctuation in the ground water and concluded that high depth of ground water has low fluctuation and vice-versa. He has also delineated ground water utility status in the area in to five classes.

**Deolankar S.B (1980):** has explained the basaltic flows contain variable quantities of ground water in vesicles, joints and weathered capping. On the basis of their structural and hydrological properties the Deccan basalts can be grouped into five classes. The storativity and transmissivity of these groups are the characteristics which determine their capabilities to perform as aquifers.
The present paper is based on the hydro geological data obtained for large–diameter dug wells tapping on confined aquifers in various part of Maharashtra and considers the potentials of the above five groups as aquifers. The concept of storativity is related to porosity. The porosity consist of two fractions specific retention and specific yield, “Porosity” represents the amount of water stored in the aquifer while “specific yield” represents the amount of water the aquifer will yield under the influence of gravity. Hence, it is necessary to establish a relation between total aggregate porosity and specific yield to determine the porosity effective in transmitting the water. In the case of unconfined aquifers, storativity defined by storage coefficient it equal to specific yield. The aquifer properties were measured by carrying out pump tests in the field. The specific yield was determined by using the Papadopoulos-Cooper method (1967) and Walton’s formula (1970). The transmissivity values were calculated by using methods given by Theis (1935), Cooper-Jacob (1946) and Papadopoulos-Cooper method (1967). The specific capacity of the dug wells was measured by using the Slichter recovery formula (1906).

**Das L. S. (1979)** has studied the problems of population and land use in the district of Bhagalpur, Bihar. The author studied the distribution of population, population growth and future estimate of population. He also studied unchal-wise cropping pattern and population pressure on agricultural land.

**Joydeb Ghosh(1989)** has made an attempt to find out the existing land use of Noapara village in Hoogly. The author has analyzed the conditions that are responsible for such development the socio-economic
problems especially relating to agriculture and the future pattern as predictable from ensuing trends.

The foregoing analysis shown that though the village is self-sufficient in food status the rapidly growing population would inevitably result in disguised UN employment. The village would get its impulse of widening the existing socio-economic horizons, if and only if a good soil management program together with a scientific crop rotation, artificial rejuvenation of river Saraswati, construction of transport lines, educational institutions, medical and banking facilities are undertaken by Government.

K. Shadananan Nair & H. S. Ram Mohan (1992) have studied “Water Resources Management in Karalla a Water Balance Approach”. In this research paper they have stated that the availability of reliable water supplies is a major factor in the economic and social development of a region. The uncommitted supplies of water have been decreasing when the demands for them have been increasing. This is especially true for the state of Karalla, where the topography of the Western Ghats produces very heavy summer monsoon rainfall, ranking the state among the heaviest rainfall regions of the World. There are 44 streams that origin Nate in the Ghat, 41 of which flow west to join the Arabian Sea. With these and a number of lagoons and backwaters, there exists a rich potential for harnessing water throughout the state. However, the improper temporal distribution of rainfall and the I’m proper water Management that permits the wasteful flow of the water into the sea produces water deficiencies in the state in certain periods.

In the present study, monthly water surpluses during the period 1901 – 1980 have been computed for six stations in Karalla for which temperature and rainfall data are available from the records of Indian Meteorological
Department, based on the water balance model of Thorn Waite (1948) and the modified book-keeping procedure of Thornthwaite and Mather (1955). According to the water balance concepts, water surplus (W.S.) represents the excess of drain fall over potential evaporation transpiration losses and that needed to recharge to soil storage and is the water available for runoff or stream flow. The possible extremities of surpluses (W.S. + 28 and W.S. – 38) in a period of 100 years are also worked out. From the monthly surplus values, Monthly runoff has been calculated using an index (Table – 1) based on slope, soil type and vegetation’s type of the station, developed by Subrahmanyam and Pardhasaradhy (1980) and modified by Ali (1982).

In alluvial layers 15 % of the total rainfall may be expected to reach the ground reservoirs. In graded sand-beds recharge is uniform. In clayey and other porous beds, it may be much less but in such cases recharged water does not seep back.

This recharge of rainwater is supplemented by surplus surface water flow during the monsoonal season. Wide spread open joints, fissures in hard rocks and even fault zones make good underground reservoirs. In alluvium, natural river beds can be turned into good recharging basins with the help of send-barriers, sausage dams, etc. A well-Defined pattern needs to be established in the method of well-selection so that available resources are not frittered away. In a special study based on yield through trial drillings, it was found that if one tube-well can irrigate 1.1/5 hectares (6 sq.km.) each tube-well should be 1.4 km away from the other.

**Kashinath Singh and Babban Singh (1970)** have stated that the agricultural land use study has acquired special significance in the realm of the growth and problem oriented studies of the growth and resource
utilization. As such, studies in this sphere have been made with a view to presenting analytically the different aspects of land use pattern so that the basis of the scientific land resource allocation to various agricultural crops and planning for maximum productivity may be attained. This problem attains special significance in an area dominated by agricultural land resources, such as that under the present study.

Inspired by the classical work of Stamp in U.K., geographers in many other countries have taken to the study of land use in their right earnest. But these studies were invariably conducted for a much larger area on sample basis and, as such, they do not reveal detailed realistic information on correlation between land use, crops and their ranking, moreover, their conclusions suffer from the element of subjectivity which becomes rather inevitable under sample bound studies. In the present work, data are plotted taking at village level for the whole tehsil.

The land use ranking has been compiled on the basis of selected scales in percentage. In order to correlate the land use with net sown area under each crop, scatter diagram has been drawn to present the distributional pattern of crops. Crop ranking has been done in order of the percentage occupied by each crop to total harvested crop land. An attempt to add precision to crop ranking has been made by histogram.

Summary and conclusion: The present land use pattern of the area is an outcome of the interaction of physical and social and economic factors. The cropping pattern of the area is typical of an underdeveloped agricultural economy. Viewed from the social and economic points; the agricultural system of the area needs to be given special attention to raise the fertility to its maximum capacity.
Majid Hussain (1969) has studied ‘The geographical basis of the well irrigation in the Upper Ganga-Yamuna Doab’. In this paper author has correlated geographical factors with drilling the tube wells. He has also considered the effect of tube well irrigation on changing cropping pattern of the study region.

Majid Hussain (1970) studied ‘Pattern of crop concentration in Uttar Pradesh, geographical review of India’. The object of the present study was to define the pattern, crop concentration of Uttar Pradesh applying location quotient method.

Limaye S.D. (2010) has explained the Ground water occurrence in the Deccan Traps is in phreatic condition in the weathered zone above the hard rock and in semi-confined condition in the fissures, fractures, joints, cooling cracks, lava flow junctions and in the inter-trapping beds between successive lava flows, within the hard rock. Dug wells, dug-cum bored wells and boreholes or bore wells are commonly used for obtaining groundwater. The yield is small, usually in the range of 1-100m$^3$/day. The average land holding per farming family is only around 2 ha. Recently, due to the ever increasing number of dug wells and deep bore wells, the water table has been falling in several watersheds, especially in those lying in the semi-arid region of the traps, so that now the emphasis has shifted from development to sustainable management. Issues like climatic change, poverty mitigation in villages, sustainable development, rapid urbanization of the population, and resource pollution have invited the attention of politicians, policy makers, government agencies and non-government organizations towards watershed management, forestation, soil and water
conservation, recharge augmentation and, above all, the voluntary control of groundwater abstraction in the Deccan Traps terrain.

M. Sambasiva Rao, K. Kalavathy (1983): has been studied the data pertaining to rainfall for a period of 50 years were collected from 27 rain gauge stations distributed in the district. Mean seasonal and annual distribution of rainfall, variability of rainfall and precipitation are analyzed. The temperature data required for calculating thermal efficiency are available only for eleven stations. With the help of PE index suggested by Thornthwaite is adopted. Using both precipitation and PE data, other relevant indices are computed and water balance graphs are then constructed for each station. Based on crop-acreage of 1976-77 at block level, the concentration indices of selected food crops and non-food crops are worked out. Annual distribution of rainfall in Madurai is more controlled by physiography. In general the distribution of rainfall indicates that the plain regions in Cumbum valley on the south western part of the district receive very low rainfall.

A study of water balance elements and the various crops cultivated in the district brings out that in the regions where there is high shortage of water (northern part of the district) the concentration of dry crops is high. In other parts of the district except in the areas where there is assured water supply by canal the concentration of dry food crops vary from moderate to high. Analysis of water balance elements denote that the northern part of the region is subjected to more droughts compared to the central and southern region and the aridity index in this region exceeds 50 per cent. From the study of seasonal and annual moisture adequacy it has been indicated that in North East Monsoon period, the moisture adequacy ranges from 95 to 100
per cent all over the district and thus this season is highly favorable for cultivation of various crops. The South West Monsoon period, however, shows low values of moisture adequacy ranging from 24 to 61% in the plain region denoting that this period is not highly favorable for crop culture for better yields. Therefore it has been suggested here that the various crops that are usually cultivated in the district are to be sown in the month of October for better yields. Short duration crops namely ragi, pulses, bajra, maize, onion, groundnut, vegetable etc. which require low amount of water ranging from 35 to 80 cm may be cultivated in the regions where there is high shortage of water.

Mrs. Iyer S. (1989) she has explained in alluvial layers 15% of the total rainfall may be expected to reach the ground reservoirs. In graded sand-beds recharge is uniform. In clayey and other porous beds, it may be much less but in such cases recharged water does not seep back.

This recharge of rainwater is supplemented by surplus surface water flow during the monsoon season. Wide spread open joints, fissures in hard rocks and even fault zones make good underground reservoirs. In alluvium, natural river beds can be turned into good recharging basins with the help of sand-barriers, sausage dams, etc. A well-defined pattern needs to be established in the method of well-selection so that available resources are not frittered away. In a special study based on yield through trial drillings, it was found that if one tube well can irrigate 1.1/5 hectares (6 sq.km.) each tube well should be radically 1.4 km away from the other. There is considerable groundwater potential in the alluvial tract between Jabalpur and Itarsi, more detailed geological survey in specific areas with latest
techniques available is likely to yield a clearly developed pattern in well selection and will enable optimum utilization of the available resources.

Ministry of Agriculture and Natural Resource (MANR) in Iran (1975) recognized that the deep scatted limestone aquifers in the mountain zones provide the base-flow of most rivers, but the main volume of run-off is derived from snow-melt which usually commences towards the end of March and continues into June. In the Central plateau, river discharges are small and generally confined to ephemeral streams. Ground-water recharge too is limited. Recharge may only occur during the periods of heavy rainfall or where surface run-off is concentrated in low lying depression. Precipitation in the Alborz and Zagros mountainous regions is undoubtedly the major source of water availability in Iran. Surface water run-off is usually negligible in areas with an annual precipitation of less than 250 to 300 mm. In most parts of Iran, rainfall is confined mainly to the winter season. During the remaining months the water requirements have to be met from ground or surface water resources. Irrigation required not only in low rainfall areas as well as during non-rainy season, but also during the long breaks of rainfall in good rainfall areas.

Groundwater Resources: Precipitation and around water is the main source of water supply in dry regions. In general, groundwater reservoirs are in dynamic balance with precipitation, evaporation, and drainage to the sea. Normally, the drier a region is, the smaller will be the proportion of natural precipitation that will reach the groundwater reservoir. In regions with less than 200 mm annual rainfall, rain usually falls on non-saturated ground, practically no precipitation. The groundwater recharge depends on the total amount of rainfall as well as the rain intensity, composition and texture of
the soil, the underlying rock, geomorphic features, the depth of the zone of saturation, vegetation, etc.

**Patil, N. A. (1995)** has studied ‘Spatio-temporal analysis of agricultural land-use in Chalisgaon tehsil, Dist. Jalgaon’. For this study he has used the agricultural data of three years data i.e. 1967-68, 1968-69 and 1969-70. This data is summed up and average data is calculated.

**Rajapange M.G., Wani P.R (2011):** has collected the data of rainfall and this data to make an assessment of variability of Beed District and to identify the assured rainfall zone in the study area with the help of Coefficient of variability statistic technique.

**Sampada Joshi, Vinit Phadnis, Gaurav Srivastava & Himanshu Kulkarni** have studied two watersheds located in southeastern and eastern parts of Purandar Taluka of Pune district of Maharashtra state covering five micro-watersheds admeasuring 14000 hectares are studied have carried out the case study for Pimpri-Pandeshwar watershed and Pondhe watershed has been carried out defining hydro geological regime based on geological mapping and field studies with emphasis on monitoring wells in terms of water table fluctuation and water chemistry (pH, conductivity, salinity & TDS). The work was carried out with the help of Arc GIS 9.1 which enabled faster and efficient data analysis and creation of various data sets which helped in modeling the regime.

The study indicates that in a typical Deccan Volcanic Province, similar looking aquifers show differing values in TDS which could be attributed to the presence of alluvium and anomalies caused by salinity. The water table contour maps generated over three months and subsequent field visit data helped indicate groundwater recharge and discharge zones which
would help guide new engineering structures and thus support decision making. Further characterization of these watersheds is being done through continued monitoring and pumping tests.

The data was collected from the wells was in form of water level in the well in meters, depth of the well in meters, surface elevation of each well, location of the well and pumping test. They have used instruments like measuring meter tape for taking the depth and water level for well inventory, GPS for taking the location and surface elevation. Other than these instruments, extensive work was carried out with the help of Arc GIS 9.1 to enable a faster and efficient data analysis. This exercise also aided in a better understanding of the Geographical Information Systems and its usage in earth science applications. The whole process was carried out as; georeferencing of the toposheets, digitization of the contours and drainage network with wells, creation of water level surfaces and spatial analysis.

In the present study various geospatial techniques have been used to find out hydrological investigation. Hydro-geology of the study area has been studied for the purpose. Geomorphology and drainage analysis has also been carried out in the present study. Data for location, elevation and depth of wells have been collected. Considering the above data she has prepared four maps showing surface elevation, water table elevation in the month of December, January and February. She has used contours techniques to interpolate the sample data.

Researcher has used such interpolation of contours to demarcate groundwater spots and groundwater elevation. She has used no. of parameters such as geochemical, geology and surface elevation to correlate with ground water table.
Saraf A. K. & Choudhury (1998): has studied the IRS-LISS II data along with other data sets have been utilized to extract information on the hydro geomorphic features of a hard rock terrain in the Sironj area of Vidisha district of Madhya Pradesh, India. The study exhibits reservoir induced artificial groundwater recharge downstream of surface water reservoirs. IRS-LISS II data have been supported by information derived from DEM, drainage and groundwater data analyzed in a GIS framework. The present study attempts to select suitable sites for groundwater recharge in a hard rock area through recharge basins or reservoirs, using an integrated approach of remote sensing and GIS. Criteria for GIS analysis have been defined on the basis of groundwater conditions in the area and relative contribution towards the desired output. The integrated study helps in designing a suitable groundwater management plan for a hard rock terrain.

Sulbha Khanna (1994) in her research paper has given good profile regarding the role of dams in the development, expansion and improvement of agriculture. According to her Irrigation dams have some positive roles in development process, but they have many negative and hazardous impacts on the society and the environment. Generally, positive aspects of irrigation dams are highlighted by the planners and irrigation engineer, but negative aspects are not brought in to the knowledge of people. Instead of one large dam, a series of small dams can be built. In the command areas of small dams a forestation should be undertaken. The micro–level planning in any irrigation systems is appropriate for the balanced development of society and environment. She has designed the hypothesis as, “Big dams: a mixed blessing to the agricultural development, expansion and improvement”. This paper has
taken examples at regional, national and global levels on adverse effects of irrigation in the light of change in cropping pattern, water-logging, land and infertility, silt deprivation (situation), health hazards, loss of forest resources and displacement.

The hypothesis posed at the beginning, has been compressively tested and has been fully accepted. Instead of one large dam, a series of small dams can be built. So a huge water body at one place does not prove harmful to the people of the area. Along with the construction of small dams forestation can be undertake. The forest will store water underground through the roots of tress and nourish agriculture too. In order to have balanced development between people and environment, it is better to do planning of irrigation system at the micro-level instead of macro level, which is difficult to manage.

Todkari G.U. (2012): has explained average annual is tremendously varies year to year and tehsil to tehsil which is directly affects on agriculture land and also affect human activities in Solapur district. The present paper is displaying spatio-temporal variation of rainfall in Solapur district.

1.8: DESIGN OF THE WORK:

The entire research work is divided into Ten Chapters.

First chapter deals with introduction to study region in which significance of water projects, selection of study region and topic, aims and objectives, hypothesis, research methodology, review of literature and outlook of overall research work are explained.
The Second chapter deals with the geographical background of the study region, in which physical setting, geology, slope and soil, drainage, climate in relation with groundwater, etc are discussed.

In the third chapter general landuse in which total cropped area, area under forest, cultivable waste land, area not available for cultivation and cropping pattern etc categories are discussed.

The Fourth chapter deals with the significance of well irrigation in which concentration of wells; tehsil wise density and proportion of wells are discussed with the help of maps, graphs and charts. The main focus of the study is given on the spatial distribution of village wise and HP wise agricultural Motor pumps installed on wells.

Chapter No. five is devoted for the introduction of all water projects constructed in the study region. Location, significance, canal network, and area irrigated by Major and Medium water projects are displayed and discussed.

The sixth chapter deals with identification of groundwater level with the help electric horse power motor pumps installed on wells. In this chapter distribution of HP wise motor pumps installed on wells, intensity zones of HP wise motor pumps etc are explained with the help of cartographic techniques.

The Seventh is devoted for the case study of Jamda irrigation project. In this chapter introduce of Jamda Irrigation Projects, identification and demarcation of groundwater levels, are explained with the help of various methods. Data obtained from MSEB, farmers and GSD, is analyzed and draw groundwater contours. This chapter also evaluates and explains the
relation between availability of groundwater levels, depths of rocks, effect of water spots, drainage etc.

The eighth chapter deals with the seasonal fluctuation of groundwater level in command area of Jamda dam. In this chapter pre-monsoon and post monsoon groundwater level is identified. To find out fluctuation in the groundwater levels, CV is calculated and displayed in the maps.

The ninth chapter deals with the impact of groundwater on cropping pattern. In the study region seasonal irrigated crops are grown where storage of groundwater is observed. To find out the relationship between irrigated crops and groundwater, different crop belts are demarcated in the region.

The last chapter gives few broad generalizations and concluding remarks of analysis and results.

At the end of every chapter, an attempt has been made to compile references of books, articles and reports.

1.9: SCOPE OF THE STUDY:

The scope of the present work is significant in any country. Therefore the results and conclusions of such work can be applied as guidelines for the planning of cropping pattern in relation to groundwater. In the study region storage of groundwater varies from place to place. Therefore irrigated crops are governed by storage of groundwater. Where groundwater is available farmers have cultivated cash crops like banana and sugarcane. Some areas have of shortage of groundwater due to excess of utilization need to increase the rate of recharge. It is obvious to note that if farmers, planners and government consider suitable sites for the construction of percolation tanks
and minor projects, rational use of groundwater and crop management, it
would be fruitful to enhance the economic condition of the farmers.

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