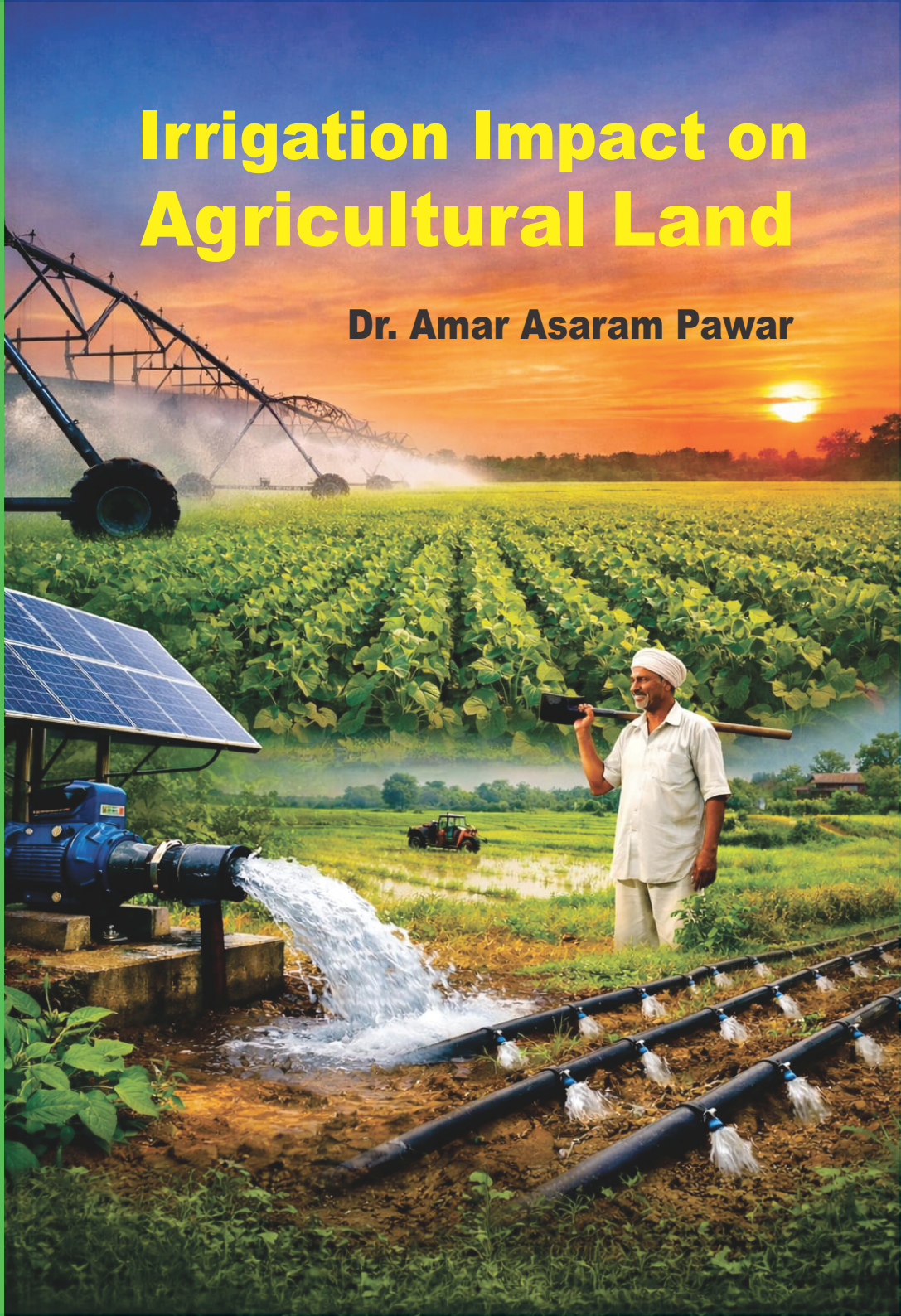
# Irrigation Impact on Agricultural Land

Dr. Amar Asaram Pawar



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# * PREFACE *

Agriculture has always been the backbone of human civilization, playing a vital role in ensuring food security, economic stability, and overall societal development. Among the various factors influencing agricultural productivity, water stands out as the most essential resource. Since rainfall is often irregular, unevenly distributed, and unpredictable, the concept of irrigation has emerged as a crucial practice in agricultural systems. The study of the "Impact of Irrigation on Agricultural Land" is therefore significant, as it encompasses not only water management but also its effects on soil health, crop productivity, environmental sustainability, and socio-economic development.

Irrigation refers to the artificial application of water to the soil in order to meet the water requirements of crops. It ensures that plants receive adequate moisture during critical stages of growth, especially in regions where rainfall is insufficient or erratic. Over time, various irrigation methods have been developed, including surface irrigation, canal irrigation, well irrigation, drip irrigation, and sprinkler systems. Each of these methods has its own advantages and limitations, and their impact on agricultural land varies depending on factors such as soil type, climate, and crop patterns.

One of the most significant positive impacts of irrigation on agricultural land is the increase in crop productivity. With a reliable and timely supply of water, farmers can culti-

vate crops more efficiently and consistently. Irrigation reduces dependence on monsoon rains and enables multiple cropping throughout the year. This leads to higher agricultural output and improved food security. Additionally, irrigation supports the adoption of high-yielding varieties (HYVs) of seeds and modern farming techniques, which further enhance productivity.

Another important impact of irrigation is its influence on soil quality and fertility. Proper irrigation helps maintain soil moisture levels, promotes nutrient availability, and supports microbial activity in the soil. This contributes to healthier plant growth and better yields. However, improper irrigation practices can have adverse effects. Over-irrigation may lead to waterlogging, which reduces soil aeration and harms root development. Similarly, excessive use of irrigation water, especially in arid and semi-arid regions, can result in soil salinization and alkalization, making the land less productive over time.

The environmental impact of irrigation is also a critical aspect of this topic. Large-scale irrigation projects, such as dams and canals, often alter natural water flows and ecosystems. They may lead to deforestation, loss of biodiversity, and displacement of local communities. Furthermore, excessive extraction of groundwater for irrigation can deplete water tables and create long-term sustainability issues. On the positive side, well-managed irrigation systems can help prevent soil erosion, support vegetation growth, and mitigate the effects of drought.

From a socio-economic perspective, irrigation plays a transformative role in rural development. It increases agricultural income, generates employment opportunities, and improves the standard of living of farmers. Regions with well-developed irrigation infrastructure tend to have more stable agricultural economies compared to rain-fed areas. However, disparities in access to irrigation facilities can lead to inequality among farmers. Small and marginal farmers often face challenges in accessing sufficient water resources, which can affect their productivity and income.

In the context of climate change, the importance of irrigation has increased even further. Changing rainfall patterns, rising temperatures, and frequent droughts have made agriculture more vulnerable. Efficient irrigation systems can help farmers adapt to these challenges by ensuring a stable water supply. Modern techniques such as drip irrigation and sprinkler systems promote water conservation and enhance water-use efficiency, making them essential for sustainable agriculture.

In countries like India, where a large portion of the population depends on agriculture, irrigation is a key factor in achieving agricultural growth and rural prosperity. Government initiatives and policies aimed at expanding irrigation coverage and promoting water-efficient technologies have played a significant role in improving agricultural outcomes. Programs such as “Per Drop More Crop” emphasize the need for efficient water use and sustainable irrigation practices.

In conclusion, the impact of irrigation on agricultural land is multifaceted and far-reaching. While it significantly enhances crop productivity and supports economic development, it also poses challenges related to soil degradation, water management, and environmental sustainability. Therefore, it is essential to adopt a balanced and scientific approach to irrigation. Sustainable irrigation practices, efficient water management, and the integration of modern technologies are crucial for ensuring long-term agricultural productivity and environmental conservation.

**- Dr. Amar Asaram Pawar**

# INDEX

# 1. Introduction

It is very necessary to explain here in the beginning that agricultural geography is a major branch of human geography. Agricultural geography can be considered as a science in view of its techniques as analysis, method of interpretation &its approaches to the investigation of agriculture and agricultural activities.

"Agricultural geography" is a matter of considerable debt among professional geographers[1]. Some of the important definition of agricultural geography has been given below.

1) Symons (1970) defines agricultural geography as "Mans husbandry of the land a part from the above definition agricultural geography has also been define as the science of a real arrangement of agricultural phenomenon."

2) According to Andrea (1981) opines that agricultural geography is the science of agriculturally transformed earth surface[2] will as it's associated physical, social and economic interrelationship as reflected specially. The main focus of this definition is on the point that over the period of last 12000 years man by his deeds has transforms the natural vegetation. He has modified the natural ecosystems into agricultural ecosystems.

3) Bernard (1915) defines Agricultural geography as the study of regional variations in agriculture[3] and the factors responsible for them. It is a relatively more rational definition

of Agricultural geography as it takes into account the regional distribution of agricultural activities. It also attempts to identify the Physical and cultural factors which control the special distribution of Agriculture pursuits.

4) In the opinion of Read (1964) – Agricultural geography deals with the description and explanation of regional differentiation of Agricultural characteristic there are numerous Agricultural topologies and systems in the work the main characteristics of these Agricultural systems differ from each other[4]. According to Read Agricultural geographers should examine, analyze and interpret main causes of special variations in these attribute e.g.the rice region differs from the bajara region in India. There may be geoclimatic, pedagogical and socio economic regions for the cultivation of these crops into different parts of the country.

5) According to Copock (1969) in Agricultural geography Agricultural facts are arranged in an orderly manner[5]. He emphasized that the main task of an Agricultural geography is to collect data for the testing of hypothesis and to provide adequate explanation for the special distribution of Agricultural Activities. Coppock in his definition has given adequate emphasis and the methodology to be adapted for the formulation of Agricultural models, pradigrus, theories and generalization.

These definitions clearly show that the geographers differ much in their opinions about the definition of Agricultural geography. In fact like all the other discipline of knowledge the definition of this sub branch of geography is

also changing in space and time. What so ever the differences in the definion may be the subject matter of Agricultural geography is the plants and animal husbandry[6]it would be of great interest to know the nature, methodology & approaches to Agricultural geography. A brief description of these aspects of the discipline has been major trust of geographers is to investigate. The special variability of Agricultural activity land use is the most obvious spatial variable and much effort has gone into describing and classifying land used. In the explanation of land used other farming variables such as land tenure, field size of holdings and labor supply must be taken into consideration along with the physical variables and the value of outputs for comprehensive study of Agricultural geography a unified approach based on physical, social, cultural, economical and infrastructural variables has to be adopted.

# 2. Nature of Agricultural Geography

There is unanimous agreement on the scientific nature of geographic investigation of agriculture i.e. the study of the regional variations in agriculture determination of the geographic relationships and of the changes there in. in the discussion on the nature of agricultural geography the main emphasis has all along been on its concern with the study of regional variation in agricultural patterns. Agricultural geography according to Hillman (1911) constitute a comparative study of the agriculture of countries and continents[7] Bernhard (1915) attempts to justify the postulate that agricultural geography is concern with bringing to light the regional variation in agriculture and the factors responsible for them. Otremba (1964) argues that the area studies can be comprehended only through the knowledge of agricultural activities. Reads (1964) however sum up by saying that agricultural geography seeks to describe and explain regional differentiation and interrelationships on the basis of agriculture characteristics.

The primary purpose of agricultural geography is to undertake a geographical enquiry into the regional differences and spatial variations in agricultural formations and geographic associations and it lends itself to a greater qualification in the description of regional distribution[8]. In agricultural geography facts are arranged in an orderly manner. Each investigation involves four stages.

i) Identification of the problem

ii) Collection of relevant data

iii) Formulation of Hypothesis

iv) Testing and modification of the hypothesis

To provide an adequate explanation (Coppock 1969) Authors of the present study strongly feel that a fifth style, namely the formulation of generalization must be added to explain the different agricultural characteristics in various areas. The scientific approach to explain the distribution and location variables in agricultural activities is very clear[9]. It means that an agricultural geographer should answer the three questions.

What type of agriculture is it?

Where is it located?

Why is it there?

Such a scientific approach to the analysis of spatial distribution and interrelationship in agriculture involves two aspects both equally important there in-

1) The collection of facts or data of agricultural relevance and

2) Collecting them in to a meaningful relationship which could constitute a hypothesis.

Facts may be collected at various levels, global, national, and regional down to the level of operation holding.

# 3. Scope and significance of Agricultural Geography

Agricultural geography is one of the most highly developed branches of geography of the twentieth century. A few decades ago it was almost at the primitive stage of its development. In recent years it has made considerable progress towards maturity as agricultural geographers have begun to treat data concept and interpretation quantitatively[10]. It is now fully alive to the changing economic, social and political situations which have resulted from progress in science and technology. Its study is considered essential to fulfill man's resistible desire to know, understand and investigate the arrangement and distribution of agricultural phenomenon at spatialtemporal scale more over the emergence of agricultural geography as an independent distinct and a leading pivotal event in agricultural land use planning and development.

The main objective of the study of agricultural geography is

i) To explain how different kinds of agriculture are distributed over the earth and how they function in spatial arrangement.

ii) To understand how particular types of agriculture have developed in particular areas and how they are similar to or different from farming in other areas.

iii) To analyze the operation of farming systems and the changes they undergo.

iv) To highlight in what direction and with what volume the changes in agriculture and taking place.

v) To demark the crop production regions or the crop combine region or agricultural enterprise[11] regions.

vi) To measure and examine the level of differences between the regions.

vii) To identify weaker areas in terms of agricultural productivity.

viii) To delimit areas of agricultural stagnation, transition and dynamism or properly, parity and prosperity. All these fall within the scope of agricultural geography.

The significance of agricultural geography is that it provides help and guidelines for decision makers and is useful for -

i) The agricultural specialist who wishes to improve the structure of agriculture.

ii) The food economist who wishes to increase the production of foodstuffs.

iii) The irrigation engineer who plans to introduce new irrigation schemes.

iv) The regional planner who is on the lookout for the most favorable location for recreation areas.

v) The transportation engineer who has to lay the new rail road lines.

vi) The demographic planner who plans public services and utilities.

vii) The numerous other specialists.

# 4. The place of Agriculture in National Economy

After independence the government paid special attention to rural development as over 70 percent of our population is living in the village. Consequently a series of programs have been designed and implemented since them. The various policies initiated during the five year plans have been presented briefly in the following pare.

**First five year plan 1951-56:-**

The first five year plan was initiated with a resolve to reconstruct the country economically and socially. The immediate and ultimate objectives of the planned development programs were to provide for a production and that two to initiate a process of integrated change including change in the outlook of rural masses. Thus increasing production and reducing the existing inequalities were the two main objectives of this plan. The main feature of agricultural planning in the first year plan was.

1) The object of the plan was not to increase agricultural production alone but to bring about all round development in rural life.

2) The main emphasis was on long term projects the full advantage of this planning was to be realized after a period of fifteen to twenty years.

3) Formulation and implementation of various schemes related to the agricultural irrigation and power the central government was to co-ordinate and to provide general assistance

**Second five year plan (1956-61):-**

The approach of second five year plan was based on the concept of a socialist pattern of society. The strategic objectives of the second plan were.

1) To increase the annual national income by 5 percent.

2) To provide additional employment to about 10 million persons.

3) To promote rapid industrialization.

4) To bring about a more even distribution of income wealth and power. Thus helping the creation of socialistic pattern of society. Panchayat Raj was first introduced in Rajasthan and A.P. in 1959.

**Third five year plan (1961-66):-**

The third five year plan rendered that the development of agriculture based on the utilization of the manpower resources of the countryside and the maximum use of local resources held a key to the rapid development of the country crop yields were low and therefore with adequate irrigation, supplies of fertilizers on a large scale, improved seeds and implements supply of credit through cooperatives linked with production and marketing education of farmers in better method, mobilizing the rural community through community development organization and reform of lands tenures and

development of the agriculture economy on co-operative lines large increases in levels of production could be achieved over relatively short period

**Fourth five year plan (1969-74):-**

The fourth five year plan mentioned the crucial role of agricultural in view of the fact that 60 percent of the total household consumption and 85 percent of the commodity consumption comprised agricultural products or industrial products based on agricultural raw materials. Also price stability was a function of the growth of agricultural production. The fourth plan envisaged a 5 percent growth rate in order to eliminate dependence on imported food grains. The fourth plan also mentioned shortfall in pulses, animal products, oil seeds and cotton as the major problem areas. Another problem area was the fluctuations in output due do uncertainly of weather. In its review of previous plans. It mentioned that the eight year period between the commencement of the third plan and the fourth plan had been the period of great significant of Indian agriculture with the following elements.

1) The I.A.D.P. started in 1960-61 in three districts and subsequently extended to another thirteen district with its package plan approach and concentration of specific area.

2) The introduction of HIV and hybridization techniques for wheat, maize and millets on a selective basis. HIV paddy seeds of exotic varieties introduced in 1965.

3) The role of agricultural technology as a major input for agricultural production.

**Fifth five year plan (1974-79):-**

The fifth five year plan described agriculture as the most vital sector. The approach of the fifth plan was based on studies of growth of output and pattern it displayed which showed that in certain regions of the country the growth in production of food grains was primarily explained by of irrigation and multiple cropping while in others due to water

**Table no.1.1**

**Patterns of government outlay on agriculture in the plans.**

| | Total plan outlay in crores | Outlay on agriculture& irrigation in crores | Percent of total outlay |
|---|---|---|---|
| **First plan** | 1960 | 600 | 31 |
| **Second plan** | 4600 | 950 | 20 |
| **Third plan** | 8600 | 1750 | 21 |
| **Fourth plan** | 15780 | 3670 | 23 |
| **Fifth plan** | 39430 | 8740 | 22 |
| **Sixth plan** | 109290 | 26130 | 24 |
| **Seventh plan** | 218730 | 48100 | 22 |
| **Eight plan** | 434100 | 93600 | 22 |
| **Ninth plan** | 897800 | 201780 | 25 |
| **Tenth plan** | 1956000 | 454790 | 27 |

Source computed by author

**Table no. 1.1**

Indicates that the investment on agriculture development. The Researcher indicates the ten plans in table no. 1.1 the highest percent of total outlay is in first plan in which 31% investment for agricultural development and the lowest is in second plan 20% and the expense is 950 crores on agriculture and Irrigation. Means though Government investing on agriculture year by year though it is less at the view of developing ratio of population.

seeds and fertilizer technology in plan the strategy for long term planning in the agriculture sector was about the extension of ground water and surface water intensification in application of new technology. In the agriculture sector the extension mechanism and programs to regulate and ensure the supply of inputs. The trends of diversification to commercial crops was expected to be maintained expansion of area under HIV of paddy was to be further intensified during the fifth plan period various new programs were added while the areas of the existing programs were expanded during this plan.

**Sixth five year plan (1980-85):-**

The sixth plan aimed at an annual average increase of 3.9% in the gross value added in agriculture and 5 percent in agriculture production as compared to the past frend of little less than 3 percent in gross value added the agricultural development was considered crucial for attaining 5.2 percent growth in gross domestic product (GDP) similarly the success in the exploit efforts also depends on augmenting the

agricultural production. Therefore agriculture was given a high priority in all policies and programs. Four years were mentioned in the sixth plan in reference to the objectives.

**a) Ecology :-**

Integrating ecological consideration in land use patterns dealing with problems of water logging use patterns dealing with problems on and erosion and contingent plan for different seasons.

**b) Economics :-**

Dealing with the entire production trade consumption chain.

**c) Energy :-**

Optimum use of non renewable resources.

**d) Employment :-**

Meaningful employment through subsidiary occupations.

**Seventh five year plan (1985-90):-**

The central trust of the seventh five year plan was to accelerate the growth of rural areas. Rural development means an attack on rural poverty. An amount of Rs.52000[15] cores was earmarked in the seventh plan for the development of the rural areas. It occupied for yearly 65 percent of the total plan outlay excluding the outlay on industry, energy and transport which accounted for more than Rs. 10253 crores. The central element in the development strategy of the seventh plan was the generation of productive employment there has

been achieved by an increase in cropping intensity made possible by increased availability of irrigation facilities extension of new agricultural technology especially to law productivity regions and small farmers.

**Eights five year plan (1990-95):-**

The strategy and thrust of the eighth five year plan is to consolidate the grains from the base built over the years in agricultural production, sustaining the improvement in productivity and production to meet the increasing demands of the growing population, enlarging the incomes of farmers and realizing the countries potential by stepping up agricultural exports while the production of several commodities has shown significant increase a cause of major continuing concern is that the growth rates in agricultural production are highly skewed in terms of different regions and crops. Rapid improvement in productivity and production of a few of agricultural crops. Since the introduction of HIV from the mid sixties has been conspicuous only in small pockets of well endowed irrigated areas. Eastern India lying in the rainfall zone the vast rained and tract in the country and the hill regions have not been able to adopt the technologies for achieving high growth rates.

**Ninth five year plan (1997-2002):-**

In this plan agricultural production was increased this year food grains output is likely to be 209.2 million representing on increase of around 13 million tons over the previous year production of 195.9 million tones many states of India has been under moisture trees and drought like

situation is some areas last year received adequate rain this year. In this period many crops downtrend but cotton production would be higher by over 2 million rates and given the down trend in international prices the domestic prices would trend to remain depressed.

**Tenth Five Year Plan (2002-2007):-**

The approach paper of the tenth plan recognized the importance of agriculture in the present context of globalization and so the national agricultural policy 2000 envisages a growth rate exceeding 4 percent annual in the agricultural sector. The target of growth rate is fixed at a 3.97 percent under national agricultural policy the following type of growth has been investigated.

1) The first point of issue is to have growth with equity stands for the growth which is widespread across regions and covers all farmers.

2) Growth that is suitable technologically environmentally and economically for all.

3) Growth that is efficient use of resources that saves at soil water resources and bio-diversity.

4) And growth that is demand driven and suitable for domestic market and competitive for foreign markets with a view to face the challenges arising out of economic linearization and globalization.

**Eleventh Five Year Plan (2007-2012):-**

The overall and comprehensive picture of the growth and plan performance during the eleventh five year plan

(2007-2012) and performance of various flagship programs being implemented.

The state has been implementing a number of farmer friendly imitative to encourage farming in the state. The state economy as measured by growth in the real gross state domestic product (GSDP) on an average is expected to grow at 8.33% during the 11th five year plan period (2007-2012) even surpassing the all India's GDP growth of 7.94% for the same period interestingly the state economy grew faster than all India during the 9th, 10th and 11th five year plans in which the state registered average annual indicated in brackets pertain to all India. The state had set for itself a growth target of 9.5% for the 11th as compared to the target both at the state level and at the national level, the growth achievement especially of the state during the 11th plan could still be considered awesome, keeping in view of the fact that three year of the 11th plan period (2008-09, 2009-10, 2011-12) got adversely impacteither by global slowdown unfavorable seasonal conditions and floods.

**Twelth Five Year Plan (2012-2017):-**

The twelth five year plan of the government of India has decided for the growth rate at 8.2% but the national development council (NDC) on 27 Dec. 2012 approved 8% growth rate for 12th five year plan with deteriorating global situation, the Deputy Chairman of the planning commission Mr.Montek Sing Ahluwalia[17] has said that achieving an average growth rate of 9th percent in the next five years is not possible. The final target has been set at 8% by the

endorsement of plan at the national development council meeting held in New Delhi.

It is not possible to think an average of 9 percent (in 12th plan). I think somewhere between 8 and 8.5 percent is feasible Mr. Ahluwalia said on the sidelines of a conference of state planning books and departments. The approached paper for the 12th plan approved last year tiled about on annual average growth rate of 9 percent. Earlier addressing a conference of state planning boards and planning departments he said the rate decline in poverty doubled during the 11th plan. The commission had said, while using the Tendulkar poverty line the rate of reduction in the five years between 2004-05 and 2009-10 was about 1.5 percentage points each year which was twice that when compared to the period between 1994-95 to 2004-05.

In short with the help of twelfth five year plan agricultural production increasing year by year and the development is also in progress related to lifestyle of farmer, equipment, system of farming and so on.

# 5. Agricultural Development in Jalgaon District

Maharashtra state government has also made remarkable agricultural progress through five years plan. During 1991 about 1.85 crores people were engaged in agricultural activities. In 1961 there were 2319 tractors in Maharashtra while 1992 the number of tractors increased to 46631 and in 2005 above 100000 tractors in the state during 1980-81 about 12 lack hectare of land was under irrigation but in 2000-01 about 25.7 lack hectare of land was under irrigation.

As for as the development of Agriculture is concerned we found that some areas are still backward in Agricultural development[18] in the state i.e. Konkan region, Kolhapur, Nasik , Pune, Sangali, Solapur, Aurangabad district have made good progress in agricultural sector as compared to the other district of state.

Jalgaon & Dhule district is known as khandesh there are two regions in khandesh. East region & west region Jalgaon is come in east region Jalgaon district has 15 tahsil agriculture is main business in Jalgaon district. They are producing Banana, Cotton, Wheat Jawar, Oilseeds in the basic of Tapi River. Banana is basic crop in Jalgaon district. Jalgaon district is first rank of banana production of India. Agricultural development of Jalgaon district is very fast due to new

technology used in agriculture such as for machine, irrigation facilities high yield variety seeds chemical pesticides etc. Jalgaon district is famous for Banana Production and Cotton Production in state & Country.

# 6. Choice of the region and topic

The choice of the area& the topic under investigation has been influenced by several considerations.

In Jalgaon district there are 15 tahsil of Maharashtra state. Jalgaon district also prominent district in Maharashtra state. Jalgaon district is also known as khandesh. Jamner Taluka is one of the biggest Taluka in Jalgaon district.

But for the study only Jamner Taluka is considered. Major area of the district and sub-rivers of Tapi come into the Jamner Taluka. A soother part of Jalgaon district also comes under Ajanta hills. So researchers choose this topic for his research work.

**A) Location :-**

Jalgaon district area under study of the state of Maharashtra is one of the agriculturally developed regions.

The Jamner tahsil lies between $20^0$ 10' north and $21^0$ 25' north latitudes and $75^0$ 15' east to $75^0$ 35' east longitudes.

**B) Physiography :-**

Jalgaon district is located in the upper Tapi basin it forms district topographical unit separated from neighboring Madhya Pradesh state by stapuda and from south by satmala hill ranges for whole of the region is drained by Tapi River

because about 80% of the annual rainfall is received in the south west monsoon period July is the rainiest month.

There are main three rivers run in the study region Jamner Taluka. They are 1) Waghur river, 2) Kang river, 3) Sur river. These rivers cover the study area and created drainage pattern of these region. All these rivers originated in the Ajanta Mountain ranges run from south to north. These entirerivers join to each other at the site of Waghur dam area. Actually the Waghur dam reservoir collects the water from all three rivers. All these rivers are the tributaries of Tapi River.

**C) Climate :-**

Climate refers to the index of environment include number of elements like temperature, humidity, rain fall etc. The climate of Jalgaon district is affected by its location and relief one of the whole the climate of the region is dry except during the south west monsoon season. The cold season from December to February is followed by the hot season from March to May the period from June of September is the southwest monsoon season while October and November constitute the post monsoon season. There are a number of elements of the climatic conditions they are as follows.

The description of the temperature and other meteorological conditions in the Jamner Taluka which follows is based on the records at the meteorological observations in the neighboring taluka's and the meajer records for Jalgaon.

The cold weather commences towards the end of November when temperature begin to fall. December is the

coldest month with the mean daily minimum at about 8.3$^0$C and mean maximum at about 28.5$^0$C in the last twenty five year.

In the summer season the temperature monsoon during June to September influences the agronomy of the Jamner Taluka to a very great extent. The rain fall during the north east monsoon i.e. October to November is very helpful for the rabbicrops and also augments water in the wells and tanks some showers in the first quarter of the year have also beneficial effects on the growth of rabbi crops and summer crops.

# 7. Aims, objectives and Hypothesis

## * Aims, objectives :-

1) To study the geographical and manmade factors from the view point of agriculture.

2) To study the general land use pattern of the region study.

3) To study the irrigation and its impact on agriculture.

4) To study the agricultural cropping pattern and its variation in the region.

5) To study general land use and cropping pattern of selected villages and market the agricultural problems and suggest suitable remedies to solve them.

## * Database and methodology :-

Primary and secondary data will be used for the study. Secondary data will be used for the period 1980-81 to 2010-11 special questionnaires will be prepared to collect date of selected villages. It is not possible to select every village from tahsil only 20% villages will be selected.

Secondary data will obtained from social economic review district census hand-books, Gazetteer, agriculture epitomes, periodicals and from development of agriculture various statistical techniques maps and diagrams will used to represent the data for studying the population pressure on agricultural land various densities such as crude, rural,

agriculture and caloric density will be calculated from studying the changes in land use pattern five measure land use categories i.e. area under forest area not available for cultivation, other cultivable land, fallow land net sown area will be considered. In order to smooth but usual fluctuation quinquennium average data for the year 1980-81 and 2010-2011will be used for studying loan use efficiently and index of land used efficiency will be used.

Land use efficiency index =

$$\frac{\text{gross cropped area}}{\text{Net sown area}} \times 10$$

Indices of selected agricultural crops annual area variation wearer's standard deviation method will be used to work out the crop combination of every selected village. In order to determine the village-wise concentration of crops Bhatias (1965) following formula will be used.

Index for determining …….

Jasbir Singh's following formula will used to calculate the index of crops diversification[12].

Index of crop diversification = percentage of total area under 'n' / number of 'n' crops

Indices of production yield of selected crops will calculated to study the changes in production and yield composite Indices will be calculated to identify the level of agricultural development

## * Hypothesis :-

1) The area of irrigated land will increase.

2) The productivity of land will increase.

3) The economic condition of farmers will develop.

# 8. Importance of Dam, Irrigation and Water Resources

Irrigation plays a vital role in the progress of agricultural in India 70% of the populations of our country depends on agriculture. In view of irregularity of the monsoon, agricultural productivity becomes more dependable.

Moreover the introduction of green revolution in the country which is based on high yielding varieties of seeds and heary doses of chemical fertilizers cannot be sustained without irrigation as the population is increasing day by day agriculture production must increase and the achieve this increase of irrigation facilities are must[13]. In the state of Maharashtra the uncertainly of monsoon highly affects the agricultural business specially the khandesh area, Jamner Tahsil is more affected. The yield of this area is very low[14]. It can be increased with the help of irrigation which is likely to available in future due to river Waghur project.

The scarcity of water for irrigation in this area may be removed due to Waghur project fortunately the Waghur project will be helpful for irrigation facilities in Jamner tahsil area.

The river Waghur project is a major project and multipurpose project by which not only irrigation facilities will be available but canal facilities and hydro-electricity will be generated in future. This dam will provide permanent water supply facility to Jalgaon city and all around the area. Jamner

city also worked out a plan for water supply scheme from the reservoir of Waghur dam for Jamner city.

The irrigation from the river Waghur will not only increase but also develop agricultural productivity and bring about a balanced use of land in the form of drinking water, agriculture, horticulture and tree plantation, fisher ponds, supply of water for industries etc.

It may be well hoped that irrigation will change the whole agricultural landscape of Jamner Taluka water management is a basic condition for the development of agricultural for increasing the land productivity.

Water is natural resource and abundant available as surface and ground water[15]. Oceans cover about ¾ of earth's surface as per United Nations estimation the availability of water on earth is about 1400 million cubic k.m.

Surface water resources consists of frozen water in polar regions, oceans, seas, lakes, rivers, canals reservoirs, tanks and ponds derelict water and brackish water etc. whereas ground water resources as extracted from the surface of the earth besides these resources of water is also available as moisture in atmosphere soil and vegetation water resources in India are a combination of above mentioned sources of water.

Inland water resources are classified as follows. Rivers, canals, ponds, reservoirs, oxbow lakes, derelict water and brackish water[16]

The water resources are exploited for irrigation, hydro power, drinking purpose navigation water ways, industrial water supply[17]. Transformation of natural water resources for above specific purposes loan to creation of large number of industries in different socio-economic activities and generates direct employment to the specific industry under water resources sector as well as trigger of chain of indirect employment in water related and other sectors of the economical growth[18].

# 9. Review of literature

**1) N. P. AYYAR (1969) [19]**

Has studied crop regions of Madhya Pradesh. He used statistical approach to the study of crop combination regions. He has suggested maximum distance method to group important crops into associations.

**2) MAJID HUSSAIN (1969)[20]**

Studied the geographical basis of tube well irrigation in the upper Ganga Yamuna Doab. In this paper the geographical factors. Helpful in the drilling of tube-well in the area have been assessed and the effect of tube-wells irrigation on the changes in the land use patterns have been shown. The paper includes four maps, showing the surface configuration of the area and the area under commands of canals and tube wells. The proportion of the cropped land irrigated by tube wells also have been depicted in a map. The study is useful for the further extension of canals and small irrigation project in the area.

**3) SHINDE S. D. (1974)[21]**

Worked on "Agricultural Geography of Konkan" In his study he has used twenty years data (1950-51 to 1970-71). He has used chorographic and chorologic methods for interpretation of data. He has studied general land use, cropping pattern, village crops, Horticulture, animal husbandry crop, crop combination regions of Konkan and

problems of agriculture by applying various statistical techniques such as co-efficient of rainfall variability, percentage, volume of change in percent, ranking method, minimum deviation method for crop combination etc.

The study of Konkan's agricultural geography has been organized in to three sections: (i) Physio-Soci-Economic setting

(ii) Spatial distribution of agriculture and (iii) Regionalization of agriculture. He found that there is vast variation in agricultural land use cropping pattern in Konkan region. Agriculture is not developed in this region and facing various problems like, lack of irrigation, lack of use high yielding variety seeds and chemical fertilizers etc.

**4) ALI MOHAMMED (1975)[22]**

Studied Agricultural land use and Nutrition in Kheri, Sitapur and Baravbnki District (U.P.). The entire study is divided into four sections consisting of fourteen chapters. In the first part researcher has endeavored to make a comprehensive study of the natural environment (Physiography, climate, soil) of the region with a view bringing out the extent of influence of these factors on the existing crop-land use. A study has also been made on spatial patterns of general land use, agricultural land use and crop combination regions. The principles of the selection of villages for intensive study of land use and pressure of population have been logically discussed in one chapter.

The entire area has been divided into five homogeneous strata and representative villages have been

selected from each stratum on the basis of the systematic purposive cluster sampling. Part II, which is entirely based on fieldwork, includes the study of land utilization and pressure of population in the twelve-selected village of the region. Certain classification about the selected village has been studied. A detailed account of the costing land use and the selected villages of each stratum as well as amount of caloric intake per head per day obtained as the basis of cropped area, yield of crops and the total number of persons dependent on the village produce. Potential production units calculated on the basis of land productivity have also been given in each village which shows the extent of agricultural development as attained by the present method of technological advancement.

The third part deals with the supply of various element of diet to village people, the deficiency or surplus of these elements and the resulting nutritional deficiency diseases. The work is based on a direct survey of the sample households. The work provides a few suggestions for the future developments of agriculture and standard of living in the region, as in all the villages unbalanced nutrition's has played

On adverse role to bring about numerous among the rural population and measure lies in the important in agricultural production.

**5) VATS P. C. (1977)[23]**

Examined influence of macro geomorphologic units on land use and crop production, a case study of village Dundli, the study was conducted with the help of aerial photographs of 1:25000 scale Toposheet of 1:63360 scale and by the subsequent detail field surveys. The land utilization

data and the village maps were collected from the Revenue records soil samples from each geomorphic unit were collected and analyzed to determine the physical potentialities and limitations of each unit. Relationship between landforms and land use also established.

On the basis of field survey, it was concluded that geomorphology which controls the distribution of soils, surface and surface water, vegetation and cropping pattern has influenced the crop production. Author found the crop production at Dundli village was very low during the period of investigation. The major factors which limit the agricultural productivity were shallow soil, saline soil, presence of carbonate pan at shallow depth, shallow granite rock (weathered at top) mineralized ground water, wind erosion and depositional hazards.

**6) DAVA RAM (1977)**

Analyzed Relationship of rainfall, weather balanced and crop maturity in western Haryana. The secondary data was used for the study. Author has calculated correlation co-efficient of seasonal rainfall and crop maturity, relative variability, correlation co-efficient of monthly rainfall and crop maturity and correlation of water balance and crop maturity for the study area. Author found that the seasonal water balance was more suitable for the maturity of bajara and cluster bean than cotton- desi in kharif season. In the Rabi season, it was more suitable for maturity of mustard and taramira than gram during the period of investigation.

Author observed that the crop maturity observed to be directly related not only to the seasonal rainfall but also rainfall and water balance in certain months of the related harvested season.

**7) SHAHID HASAN S. M. (1982)**

Examined Agricultural land use in Kumaun Hills. In this study an attempt has made to land Kumaun Hill used for different crops. In the region of Kumaun the districts are very important that is Almora and Nainital. Sufficient land for agriculture is not available in this region. Farmers used whatever land available or useful for the farming utilized for Rice and wheat. Other minor crops are Barely, oils seeds, potatoes etc. Hasan studied the agricultural land use in Kumaun region.

**8) PRATIBHA MISHRA AND R. BHATTACHARYA (1983)** [24]

Studied "cropping pattern in Alwar District (Rajasthan). Authors used data for the period of 1956-1975. Authors have studied percentage, triennium averages, crop combination crop Pradesh for individual talukas of the district from two points of time i.e. 1973-74. Author has converted data into percentages for meaningful comparisons. He used Bhatia's method for computing crop concentration index.

He found very high concentration of rice in Metapally, Sircillay and Karimnagar Talukas during 1973-74. The predominance of rice was continued right from the beginning. During 1973-74 out of the seven talukas accept peddapally and Manthani where green grass and jowar respectively were dominant corps, in the remaining talukas rice occupied a very high important position comparatively to other crops.

**9) SHARMA T. C. AND COUNTINNO (1983)[25]**

Analyzed growth of Irrigation and its impact on crop land use and crop yield in Karnataka (1960-61 to 1976-77). The chief objectives of the study were (I) to measure the growth of the irrigated area and its components (II) to measure the changes in the crop land use, cropping patterns and growth in yields and (III) to measure and explain the impact or irrigation on crop yield.

They used secondary data of irrigation and cropping pattern for the period of 1960-61 to 1976-77. To measure the growth in the irrigated area and crop productivity compound growth rate was calculated by the Author's. They have also calculated co-efficient of variability correlation for the study region.

The study indicates that the bulk of the created potential in irrigation has been used by farmers for raising a few intensively irrigated crops and has led to multiple cropping in any significant measure. Shift in favor of high productivity irrigated crops like maize, wheat; sugarcane and paddy were common in all irrigated tracts in the state. Low yield crops like jowar, pulses and oilseeds have lost heavily. Unless their yield rates improve these crops may be eliminated from the cropping patterns in the coming years in the irrigated tracts. Productivity has considerably gone up in the state in several irrigated and unirrigated crops particularly cereals and sugarcane in most of which it was above the national average during the period of investigation. Increased irrigation observed to have played a key role in raising it in many crops

particularly paddy, maize, wheat, and sugarcane Author's observed that the weather influenced annual fluctuations in the yields were also considerably jower in the irrigated crops.

**10) DAS M. M. (1984)[26]**

Studied crop combination regions of Assam: A quantitative analysis. Author has collected district wise crop hectare data for three year ending with 1975-76 and the average hectare of crops in each district is derived. From the average data he has calculated percentages of hectare under all crops for each district.

He used Weaver's method to find out crop combination regions of Assam state. Particularly author has find out the crop combination pattern of Assam with the help of four selected techniques- Weaver's simple percentage, Ranking and Nelson's crop combination method. In weaver's method Dibrugarh appear to be the most diversified with five crop-rice rape seed and mustard, sugarcane, wheat and potato. But the proportion of hectare under each of sugarcane, wheat and potato is below 2% of the total cropped area of the district. Therefore, there is no justification to include these three crops as principal crops in the crop combination of Dibrugarh. On the other hand, while sugarcane occupies 2.42% of the total cropped land in Now gong, Weaver's method fails to highlight it be in included in crop combination of the district.

Author observed that Weaver's method is not suitable for finding out the crop combination regions of Assam state. He found that Nelson's technique is the most suitable one for finding out crop combinations and delineating cropping regions. He suggested Nelson's techniques for the Assam.

With the help of this technique, seven crop combination regions are derived in Assam. He also suggested that separate strategies should, be adopted for the seven regions, for agricultural development of the state.

**11) DATE V. S. AND GUPTE S. C. (1984)[27]**

Studied, Association between Agricultural land use and physic-Socio- Economic Phenomena a Multivariate approach. In this paper an attempt is made to explain how and to what extent do the factors of physisocio-Economic environment influence the agricultural land use in Puna district? In order to investigate the association between land use types on the one hand and physioculturals elements on the other. The fourteen variables like net sown area, gross cropped area, rice, jowar, bajara, cash crops , irrigated area, accessibility, owner cultivators, density of population, slope less than $3^0$, slope greater than $20^0$ distance from the crest and distance from Major streams were used as dependent and independent variables. First seven variables were used as dependent variables and next seven variable used as independent variables.

The relationship were studied and analyzed by applying quantitative techniques like simple correlation, multiple regression and principal component analysis. The correlation analysis brings out clearly the importance of physical factors like slope and distance from crest (rainfall) and economic factor like irrigation and accessibility as major factors influencing the land use pattern.

**12) SHAFI M. (1985)[28]**

Studied. Farm power and productivity in Indian agriculture. The paper makes an attempt to examine the productivity of Indian agriculture, deviating from traditional approach of yield per unit area/ per unit worker or in terms of

Monetary of caloric value. It aims to judge the productivity of Indian agriculture in terms of farm power and points out that half the energy in Indian agriculture was supplied by draught animals. Power supplied by human labor was one tenth and only forty percent of the power comes from tractors, pumps and machinery during 1970-71.

The paper examines the areal distribution of the total power availability in Indian agriculture and concludes by pointing out that it was not correct to think that with every increase in h/p, yield to h/p ratio will increase. If finally refers to the picture that may emerge in respect of power in agriculture in the country when it enters the 21st century.

**13) VIDYANATH V. (1985)[29]**

Examined crop productivity in relation to crop land in Andhra Pradesh, A spatial Analysis. Author has considered district wise gross cropped area, gross irrigated area, gross irrigated area and total production of crops for the study. He has considered 1980-81 data for the study. He has used Bhatia's (1967) and Jasbir Singh (1976) methods for the calculation of crop productivity of Andhra Pradesh. Author found very high crop productivity in the coastal districts of Visakhapatnam, East and west Godavari and Naziabad

districts. The productivity was due to high fertility of alluvial and red soils, intensive cultivation and assured water supply due to canal irrigation. Low crop productivity was of served in Mahaboobnager, Kurnool, Prakasum, Nalgonda, Khammam, Adilabad, Ananthpur and Hyderabad. It was low due to the low rain fall and poor irrigational facilities.

**14) B. B. SING (1987)**

Studied Land use, cropping pattern and their ranking. This study was undertaken on a micro regional basis taking a Development Block of 54 villages in western U.P. The main objectives of the study were as follows: (i) to analyze the various aspects of land use and crops. (ii) To correlate the land use and crop pattern village-wise and (iii) to find out crop hierarchy in the area.

Author has drowns land- use ranking maps on the basis of selected crops. Crop ranks have been formulated in order of the percentage of the total harvested cropland occupied by each crop ranking first, second, third and forth and they have been mapped village-wise for the year 1965. He has also used scatter diagram to show the distribution of various crops. Histograms have also been prepared to give further precision to crop ranking.

The author found that the bigger villages have proportionately more cultivable land, as future potential, rather than the smaller ones which have almost reached saturation point. Out of 54 villages, 17 have tilled more than 90% of their total area, 8 have not yet brought even 80% and the

remaining ones fall in between. The author observed that the area sown under kharif was approximately

Double that of Rabi. The findings suggest that sugarcane was the predominant and most lucrative crops during the period of study. As regards crop hierarchy author found that sugarcane, wheat, maize-millet, pulses and cotton and rice stand first, second, third, fourth, fifth and sixth respectively.

**15) TIWARI P. D. (1988)**

Studied, a geographical analysis of the calories available from different crops in Madhya Pradesh. His main objectives were (I) To analyses the item wise share of calories (ii) To analyze the caloric availability of the area and (iii) To classify the districts in to deficits/ surplus categories.

**16) THAKUR RAMESHWAR (1989)** [30]

Examined, an agricultural productivity in south Bihar plain: A spatial Analysis. Author has selected 146 Anchals from south Bihar plan for the measurement of agricultural productivity, secondary data was used for the study. The nature of agricultural output was based on 16 major crops, rice, wheat, maize, ragi, gram, tur, rape seed, mustard, sesamum, tisi, khesari, urad, moong, lentil, sugarcane and onion. Together these account for more than 80% of the total cropped area.

He used Hussain's and Enyedi's method for the calculation of agricultural productivity. He found high productivity in 31 Anchals, moderate in 60 Anchals, low

productivity in 28 Anchals, very low in 20 Anchals and extremely low productivity in 7 Anchals. This paper has examined the regional variations in land productivity in south Bihar. To increase agricultural productivity over large areas in the south Bihar plain author suggested some remedies. Firstly, there is an urgent need for expanding irrigation resources and fertilizer supply and improving capital or credit facilities in order to allow small farmers to benefit from the availability of physical inputs. Secondly, there is need to transfer of population from agriculture to non- agricultural activities.

**17) MOHMMAD SHAFI (1992)** –

Studied changing role of agriculture in the economic development of India. Author mentioned how agriculture plays a very important role in the economic development of India. Shafi divided the agriculture of India in to three phases i) from 1951 to 1956 is marked by a low level of efficiency. Second phase (1966-1980) is regarded as a phase of new agricultural technology. After 1980 there is phase when agricultural began to be diversified through such allied activities alike animal husbandry poultry, horticulture and fisheries. Agricultural came to be considered is an essential element in the overall rural development. He also discussed how all India soil and land use survey organizations survey and remote sensing technology is useful for agricultural development.

He also mentioned for the fulfillment of energy requirement in the rural areas with the help of bio- gas to

prevent deforestation. Shafi also explained about the export agricultural commodities and import commodities.

**18) ABHA LAKSHMI SINGH AND SHAHEB FARAL (1992)**

Studied the changes in cropping pattern due to variations in prices in upper Ganga, Yamuna, and Doan: Authors analyzed how area under different crops is largely affected by physical, cultural, technological and economic factors. They also examined how change in price and area of crops in upper Ganga Yamuna Doab 1960 -61 to 1985-86. Authors calculated the relationship between price and area of crop in upper Ganga Yamuna Doab. With the help of regression equation and correlation coefficient. They are selected Saharanur, Muzaffarnagar, Meerat, Bulandshar and Gazibad district for their study.

**19) A. KRISHNAKUMARI AND E. SWAMINATHAN (1993)** [31]

Examined levels of agricultural modernization in Nellore district, Andhra Pradesh. In this study an attempt has been made to bring out the level of modernization among farmers and its spatial variation in Nellore district of Andhra Pradesh. This study was based on Primary and secondary data collected from 11 villages. Choosing 20 farmers in each village drawn from all the size farmers. In the first instance an attempt was made to establish the empirical relationship among the parameter of agricultural modernization by multiple correlations.

This formed the basis for factor analysis, which in turn bring out the underlying dimensions among 25 variables on the basis of association among the modernization variables in the nine talukas of Nellore district. In order to bring out the spatial patterns of levels of modernization, author has computed factor scores and was subjected to cluster analysis to group the 9 talukas of Nellors district. Author found high level of modernization in Nellore, Kovur, kavali, Venkatagiri and Rapur talukas. In sullurpet and Udayagiri Taluka the level of agricultural modernization was moderate. In rest of the talukas such as Gudur and Atmakar the level of agricultural modernization was identified to be low. It was concluded 'that due to the diversity in physical, social, economic and institutional factors, the farming activities and ultimate outputs were not uniform within the district. Further, because of the difference in the awareness, availability of the modern inputs of agriculture, the spatial variations were surfacing up.

**20) SAPTARSHI PRAVEEN AND PARKENE GULABARO (1993)[32]**

Examined correlation between sugarcanes and other crops in Junnar Tahsil; A micro- level study. They used secondary data for the period of 1989-90 they have calculated correlation and regression between, sugarcane and other corps like Jowar, bajara, rice, wheat, pulses, fodder crops and oilseeds.

It is attempted in the paper to analysis the impact of spatial growth of sugarcane cultivation in the Junnar Tahsil of Pune district. (M.S) Author's found that area under

sugarcane has increased from 1980-81 to 1989-90 and due to the increasing area under sugarcane agricultural cropping pattern has shown greater change in Junnar tahsil of Pune district.

**21) CHATTERJEE NANDANI (1995)[33]**

Studied, irrigated Agriculture; A case study of west Bengal. Author has collected official as well as field data. The main objectives of the studies were I) to high light the basic problems that have made irrigation a necessity. ii) To assess the physical setting of irrigation by a detailed resources as well as their influence on the types of irrigation in the state. iii) To assess the impact of irrigation on land use, cropping intensity, cropping pattern as well as on agriculture efficiency by macro land micro-level analysis.

Author has used linear regression technique for calculating trends and probability of rain fall in West Bengal. Impact of irrigation on land use cropping intensity and crop yield have been depicted by the peasonian correlation coefficient. She used Wilkinson ranked pair test to test the significance of change between 1960 to 1980. Nandani Chatterjee has not only carried out a comprehensive study of the irrigated farming now practiced in West Bengal but also undertaken an in-depth analysis of irrigated agriculture in selected villages of the state. The researcher has

Considered the problems not only from the physical point of view but also assessed the Socio- Economic aspects of the problem.

Author found that the irrigation potential of West Bengal was not fully utilized. During the period of investigation only 36% of gross cropped area was availing irrigation facilities. Author has pointed out that the growth rate of irrigation during the period of investigation was somewhat sluggish.

**22) P. K. SHARMA (1995)**

Studied, agricultural development in the state of Punjab during the last two decades. The paper reviews the recent development of agriculture in Punjab. Authors also studied the adverse impact of over irrigation faulty agricultural practices and indiscriminate use of chemical fertilizers. Authors also examined the land utilization in Punjab from 1979-80, 1984-85, 1989-90 and 1992-93. Area under wheat, rice and cotton was increased and area under pulses, groundnut and oilseeds are decreased in the study region during the period 1979-80 to 1992-93. He has also studied the net irrigated area, tube wells in Punjab, consumption of chemical fertilizers in Punjab during the period 1960-61 to 1992-93. The utilization of water in Punjab is excess and area of salt affected soils in Punjab is increased from 1973 to 1988. Author also studied the district wise area of salt affected soils in Punjab.

**23) N. NAGABHUSANAM, K. HARINATH REDDY AND UGANDRA RAJU (1996)-**

Examined agricultural land use efficiency of Nellor District, Andhra Pradesh. In this study an attempts has been made to bring out the level of land use efficiency in Nellor

district. Andhra Pradesh. This study was based on secondary data. Out of 46 Mandals. 11 Mandals had high efficiency Jaladhakari, Bogolu, T.P. Gunder, Kovvuru, I peta, Chejerla and Manubolu. In the Mandals like Varikutapadu, Kavelli, Rapur, Dgadarth; Muthukur, Vakadu, sulurpeta and Podalakpur observed moderates level efficiency. Low land efficiency. Low land efficiency is found in Udaygiri, Marripadum Dakkili, and Pellamur. D. Satram and Kaluvoya

**24) NINA SINGH (1998)** –

Analyzed recent development in agriculture the Haryana experience. The paper endeavors to examine the post green revolution developments in agriculture in Haryana. With the extension and intensification of agricultural infrastructure base the disparities have declined. Associated with the changes is the transformation of the cropping pattern but the crop structure has failed to diversify. Agricultural productivity. Both land and labor has increased in real terms but with widening disparities. Author studied the land utilization of Haryana from 1950-51 to 1995-96. Within period of forty five years net snow area increased 3.73% area snow more than once increased by 27.57% and gross cropped area increased by 32.23%. He has also examined the salient features of agriculture transformation from 1966-67 to 1995-96. Author also studied the disparity in agricultural infrastructure 1966-67 to 1995-96.

**25) SHAMSUL HAQUE SIDDIQUI MUMTAI AHMED AND MD. TAUFIQUE (1999)** –

Examined trends of agricultural development in U.P. Himalaya. In this study an attempt has been made to bring out the level of agricultural development in Himalaya

Uttar Pradesh Particularly in the district of Uttar Kashi, Chamoli, Deharadun, Tehri garwhal, Almora, Nanital and Pithograph district. This study was based on secondary data. The period of the 1979 to 80, 1984 to 85, 1989 to 90 and 1994 to 95. Authors mentioned how agricultural land utilization is transferred from one crop to another crop during the period under study. Lastly they conclude due to continue growth of population of U.P. Himalayas forced farmers to engage directly or indirectly in agriculture of fulfill the demands for more and more food grains. There for the farmers are compiled to pay special action towards the implementation of their agricultural output. The Author has suggested some improvements for these regions.

1) Irrigation facilities should be provided in Upland and Low land areas.

2) Total cultivation area should be brought under multiple cropping particularly in favorable topographic area.

**26) SHERYL LUZZADAR – BEACH ( 2000)** –

Emphasized on water resources of the chunchucmil Maya, on the Yucatan peninsular (Mexico) in 1900, hydralogic investigations were conducted to determine weather ground water could have met domestic and agricultural needs. He

also collected and studied the samples of water from different wells of an area 990 km 2, in July, 1994 and an area 420 km 2, in 1997 served and what are the problems to use water for domestic and agricultural purposes.

**27) R. B. SINGH AND B. N. SINGH (2000)** –

Analyzed land use transformation and crop substitution in per- Urban fringe of Varanasi. The paper makes to examine the land use information in shahabuddinpur, pachhipur and chaman villages. They are chosen period for study from 1977 to 2003. Period divided into three periods i.e. 1977, 1997 and 2003. He mentioned how net irrigated area was shown more than once was in all the three villages. Due to the impact of Varanasi city area under grains was decreased and area under vegetables and fruits was increased tremendously. Area under potato and flowers was increased. The net sown area and the total area and the total area cultivated decline because of increase in built up area, some development of non- farm nature and introduction of orchards and perennial crops.

**28) K. S. SOHAL (2003)**–

Studied Development of Irrigation and agriculture transformation in Punjab 1951- 2001. He has chosen period for the study from 1950-51 to 2000-2001. In 1950-51 out of total cultivated area nearly 52.6% area was under irrigation in 2000-2001 nearly 95.00% area was under irrigation. In 1960-61, 1694 tube wells were in Punjab and in 2000-2001 nearly 9, 50,000 tube wells were in Punjab. Within the 50 years i.e. 1950-51 to 2000-2001 nearly 25 lakshectare of area

under irrigation was increased. The author also studied the effect of irrigation on Agricultural transformation. He has divided the effect the 7 division first effect on area effect. First effect was on area effect, second shifts in cropping pattern, third yield per unit area, forth total food grains production, fifth effect was crop combination, sixth effect was the degree of agricultural commercialization and seventh environmental degradation. Lastly he concluded that overall effects of irrigation development are found positive in Punjab during the study period. The crop intensity has been increased significantly from 117.2 percent to 185.9 percent during 1951 to 2001.

**29) MADHUMITA DEBNATH (2004)** –

Studied the changes of the utilization of land in the North Tripura district. He has chosen period of forty years i.e. 1961 to 2001 for his study. He analyzed changing pattern of land use forest products and changes in the land utilization in North Tripura district. The Geomorphic divisions of North Tripura district also have been depicted in map. He has also trace on extraction of timer in North Tripura district. Author also calculated the crop combination in North Tripura district for the period 1993-94 and 1997-98.

**30) PRABHAT SINGH (2004)** –

Systematically studied 'A perception survey for planning irrigation water in sonbhadra district. Uttar Pradesh. As per opinion 26% area of Sonbhadra district is under irrigation, out of which nearly 92 percent is done by canals. He has chosen period for his study from 1971 to 2001. There

are four major irrigation project and 120 small dams are constructed in the district. He also calculated to the need of irrigation block wise. He has collected primary irrigational data with the help of questionnaire. He also highlights the help needed from Government for self irrigation development and measure to be adopted to check wastage irrigation water.

**31) S. K. SHARMA (2005)** –

Examined 'agricultural innovations and their impact on agricultural productivity' in Madhya Pradesh. He also studied HYV of seeds, irrigation, and use of fertilizers and impact of agricultural productivity. He has chosen two period for his study i.e. 1856-57 and 1999- 2000. Due to impact of these three innovations nearly 153.3 percent production was increased from 1957-58 to 1999-2000. He also co- related the innovations and agricultural productivity.

**32) NAGESHWAR PRASAD AND MALAVIKA SINHA- ( 2005)** –

Worked on 'Hydrology and irrigation in the North West Bankura district, West Bengal.' The paper considers the quality of irrigation water and the relationship between irrigation and cultivation of the North West Bankura district. Some proposal is being made for the betterment of the study area because irrigation is taken at present not only as a measure of drought relief, but also to increase agricultural production. The study reveals that the area is not highly potential with regard to water, but it is not as poor as casual observer feels it. However, it is true that the area requires some development programmers and their honest implementation for further development of

irrigation and their by better agriculture prospects. Authors also examined the Lithological Zones Geological characteristics, Principal surface Runoff in North West Bankura district. They also studied the watersheds, groundwater and irrigation changes in 1971 to 1991.

Authors also have shown surface elevation, geological units, surface runoff, watersheds and groundwater potentially with the help of colored map of Northwest Bankura.

**33) K. S. SOHAL AND SHIVJEET KAUR (2006)**–

Examined regional Disparities in Agricultural modernization in Punjab: 1971 to 1999. Shoal and kaur studied how agriculture of Punjab modernized with in the period of twenty years. How land implements, tube wells, tractors, fertilizers, HYV of seeds are transformed from 1977 to 1999 and how agriculture of Punjab is modernized within 1977 to 1999. They also calculated the degree of agricultural modernization. They examined spatial variation and temporal changes in agricultural modernization in Punjab in 1971 to 1999.

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