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Impact of Pradhan Mantri Krishi Sinchai Yojana (Watershed Development) on Land Use and Cropping Pattern in Madhya Pradesh

AGRO- ECONOMIC RESEARCH CENTRE
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.)

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PREFACE

The rain-fed agriculture contributes 58 per cent to world's food basket from 80 per cent agriculture lands. As a consequence of global population increase, water for food production is becoming an increasingly scarce resource, and the situation is further aggravated by climate change. The rain-fed areas are the hotspots of poverty, malnutrition, food insecurity, prone to severe land degradation, water and poor social and institutional infrastructure. Watershed development program is, therefore, considered as an effective tool for addressing many of these problems and recognized as potential engine for agriculture growth and development in fragile and marginal rain-fed areas. Management of natural resources at watershed scale produces multiple benefits in terms of increasing food production, improving livelihoods, protecting environment, addressing gender and equity issues along with biodiversity concerns

In India several Ministries namely, Ministry of Agriculture, Ministry of Rural Development and Ministry of Environment and Forests have been involved in Watershed Development Programs with substantial variation in their approaches.

The main objective of the Integrated Watershed Management Programme (IWMP) is to improve water conservation, irrigation facility, and land use pattern leading to increased agricultural productivity in drought prone and desert prone areas. Poverty reduction, better livelihoods and improved bio-physical and socio-economic environment to bring sustainable development.

This study contains an analysis of the primary data collected from 1285 farmers across 33 IWMPs of 32 districts of the State encompassing various dimensions such as physical, social and institutional among others. In the present study, the efforts have been made to assess the impact of IWMPs in the context of effectiveness of the programme, identification of issues and lacunae in project implementation across the state.

The study noticed changes in ground water level, surface water, irrigation facility, water regeneration capacity, land use pattern, cropping pattern, etc. These changes are observed in all IWMPs with certain variations. But the changes like land use pattern, cropping pattern, crop productivity; diversification, etc. are more prominent in the watershed regions. Some areas need further attention such as greater involvement of the communities during implementation & post implementation phases, training & capacity building, social audit, women participation. The programmes have been examined from the structural and functional dimensions and their effectiveness has been measured from the benefits accrued to various stakeholders over the period of time.

On behalf of the centre, I express deep sense of gratitude to Dr. V. S. Tomar, Hon'ble Vice Chancellor and Chairman (Advisory Body) of Agro-Economic Research Centre (AERC), Jabalpur, Dr. S. K. Rao, Director Research Services, Dr. S. S. Tomar, Ex-Director Research Services, Dr. P. K. Mishra, Dean Faculty of Agriculture, Dr. P. K. Bisen, Director Extension Services, Dr. D. Khare, Director Instruction, Jawaharlal Nehru Krishi Vishwa Vidhyalaya, Jabalpur for providing all facilities and valuable guidance during various stages in successful completion of the study of high importance.

I express deep sense of gratitude to Dr. N. K. Raghuwashi, Honorary, Director (CCS)/Prof. & Head and Dr. R. M. Sahu, Principal Scientist (CCS) for not only providing valuable guidance but also their field staff for collection of primary data from various locations of Madhya Pradesh.

I wish to express my deep sense of gratitude to the team members namely; Mr. Shrikant Upadhye, Mr. C.K. Mishra, Mr. S.C. Meena, Dr. Santosh Kumar, Mr. S. S. Thakur, Mr. H. K. Niranjan, Mr. R. S. Bareliya and Mr. Ravi Singh Chouhan, for their untiring efforts in bringing this important study to its perfect shape.

I am once again extremely grateful to the Rajiv Gandhi Mission for Watershed Management, Department of Panchayat and Rural Development Government of Madhya Pradesh for providing the opportunity to AER-Centre to take up the present study and develop the report for further improvement in the state.

I am delighted that this AERC report for "Impact of Prime Minister Agriculture Irrigation Project (Watershed Development) on Land Use and Cropping Pattern in Madhya Pradesh" is filling an important information gap to build and maintain a long term prospective of the food sector and to ensure India's food and nutrition needs through increasing the access of protective irrigation to all farms and achieve the major goal of IWMPs i.e. "Per Drop-More Crop". I look forward to work closely with MoRD and other departments of Govt. on this important setup of policy challenges.

Date : 18.04.2016 **(Hari Om Sharma)**

Place: Jabalpur Prof. & Director

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CHAPTER I

INTRODUCTION

The India is classified as water stressed country, because available water supply in the country is between 1000 and 1700 cubic meters per person per year (Harris and Roach, 2013). About 20% of rainfall is utilized and as much as two-thirds run off as floods in the country. The rainfed areas have substantial production potential which is not yet fully tapped, due to limited availability of water conservation and utilization of in-situ rain water and water harvesting. (Swaminantan, 1987). More than 90 percent of sorghum, pearl millets and pulses are grown in these areas (Khaper & Rao, 1987). Rainfed agriculture added about 44 per cent of total food production and 75 per cent of oilseeds and pulses production in India (Ranbabu, 1987). The most limiting feature i.e. water can be improved through watershed technology.

Watershed management can be defined as an integrated area development approach in rainfed/dry land areas of the country to promote rainfed/dry land farming system under multifarious, different and risk prone environment for sustainable production of bio mass for food, fodder, fuel, fiber and wood. These are brought about scientific utilization of land, water, plant and human resources in a geological area that drains at a common point in the natural drainage lines (Anonymous, 1993). Watershed is a natural drainage area of a river, tank, lake or a nala. In the watershed approach a watershed is used as a unit for efficient planning and management of natural and manmade resources and all interrelated factors such as physical, biological, technological, economic, social cultural and managerial considered together in a system of frame work (Singh, 1991). In a broad sense, it is area having common drainage. The rainfall of the area within the ridge line can be harvested and drained out by a common drainage point. Thus, the watershed accomplishes both arable and the non-

arable land managing for its development irrespective of the administrative or ownership boundaries. There must be a comprehensive plan for use of land within integrated approach in both arable and non-arable land based on their capability, to result in higher productivity. The watershed programme endeavour to improve, optimize and sustain production and productivity of all categories of land. The specific object of the programme include, promotion of in situ soil and water conservation, optimum use of land to minimize risk in rainfed farming, increase productivity of land and provide higher returns to the farmers on a sustainable basis through adoption of better technology, cropping pattern and diversification of sources of income, proper management to non-arable land, improvement of ground water recharge and production on food, fodder, fuel, fiber, fruits and timber to maintain the ecological balance (Ramana, 1991). Most of the watershed projects in India are implemented with the twin objectives of soil and water conservation and enhancing the livelihood of rural poor (Sharma and Scott, 2005).

The major land mark in the evolution of watershed approach in India includes. (a) A centrally sponsored scheme of soil conservation in catchment of river valley projects in 1974. (b) 46 model watershed projects by Indian council of agricultural research in the dry land areas of the country launched in 1982, (c) world bank aided rainfed watershed development projects of Andhra Pradesh, Karnataka, Madhya Pradesh and Maharashtra in early and mid-eighties (d) a national watershed development programme for rainfed agriculture by the union ministry of agriculture in 1988 (Singh, 1988), and (e) Integrated Watershed Development Programme has been under implementation since 1993-94 with the name of Rajiv Gandhi Water shed Development Programme. New Pradhan Mantri Krishi Sinchai Yojana (PMKSY) aimed at ensuring access to water to every farm ("Har Khet Ko Pani") and improving water use efficiency ("Per Drop More Crop") in the year 2015. Pradhan Mantri Krishi Sinchayee Yojana ensures access to some

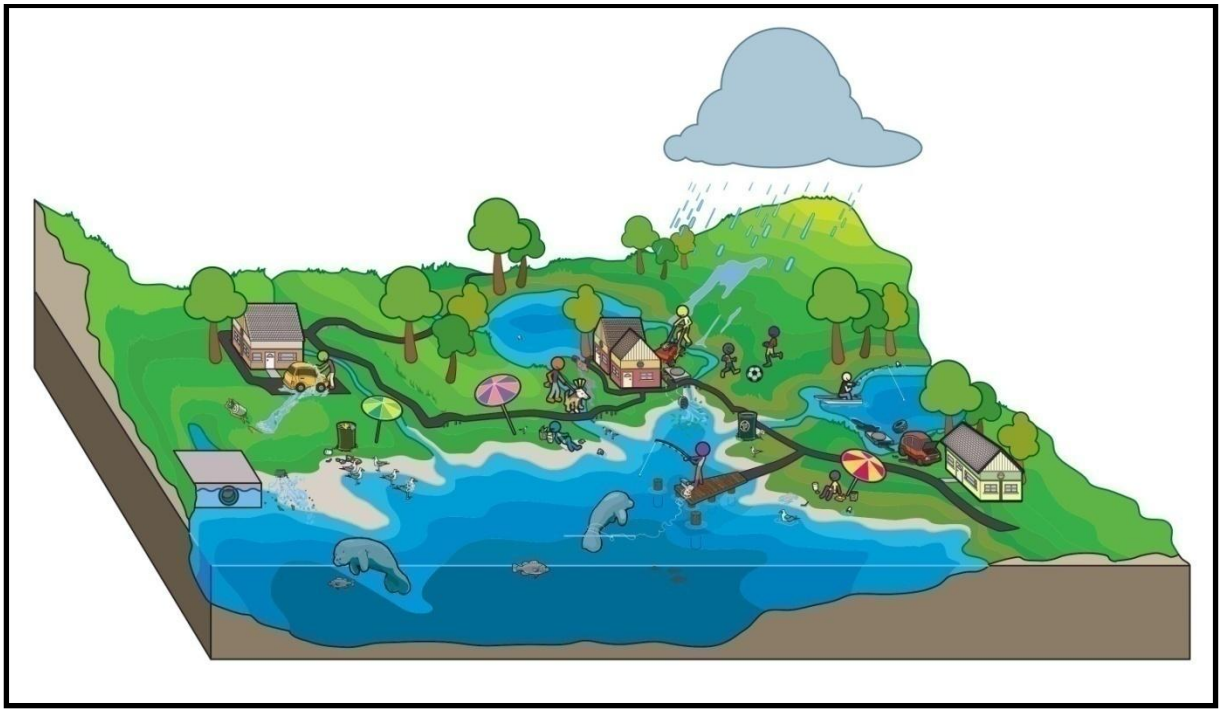

Fig. 1.1: Integrated Watershed Management Programme- A Holistic Approach for Overall Development of the Area

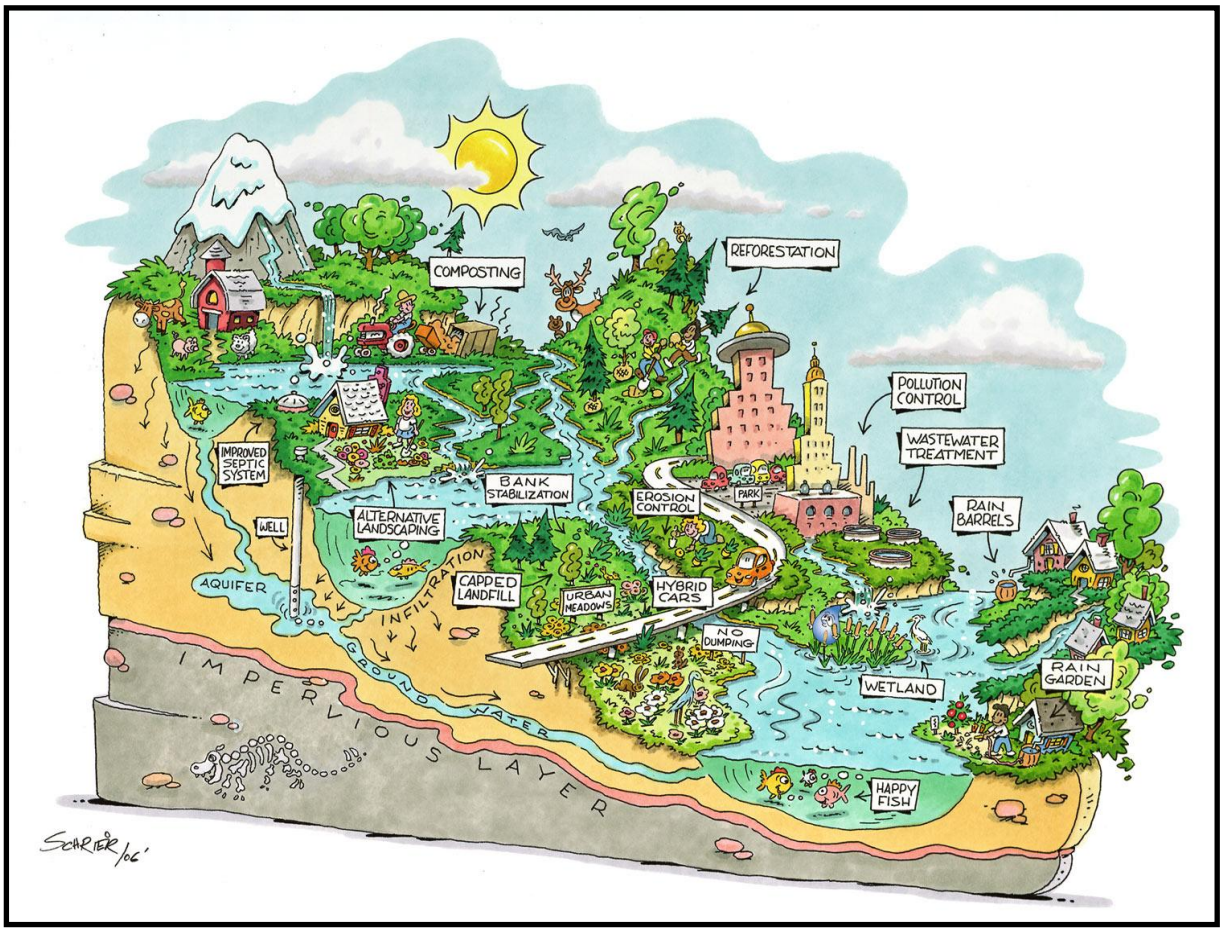

Fig. 1.2: Different Components of Integrated Watershed Management Programme

means of protective irrigation to all agricultural farms in the country in order to produce 'per drop more crop' to bring desired rural prosperity.

This can be achieved successfully through watershed approach, besides bringing synergy between different irrigation schemes especially in rainfed agro-ecosystem of the country.

The future of Indian agriculture lies in rainfed farming because this type of farming constitutes majority of cultivated area in the country and it is from these areas that higher production will have to be expected. Despite the creation of huge irrigation potential at present, more than 55 per cent of the area in country is under rainfed condition. These further increase the importance of rainfed in decade to come. Concentration on these areas would help not only in removing regional disparities but would also insure greater stability of agriculture production and income. To meet out the increasing demand of the food grains, output from rainfed farming will have to be raised to about 69 per cent over the present level of 42 per cent. A proper strategy should be to utilize present irrigation facilities to the fullest possible extent and concentrate on the better management methods for rainfed area. The dry land farming technology involves crop rotation, adoption of verities and practices adjusted to moisture regime of agro climatically homogenous region - more specifically, it consists of making the best use of limited water supply, storing in soil as much rain water as possible and growing suitable crops by methods that makes the best use of this moisture. Thus, our future planning for agriculture must give concentrated attention on development and transfer of techniques for rainfed farming and watershed development.

The Madhya Pradesh State Government also gave too much emphasis on watershed development programme and taken it in mission mode. Rajiv Gandhi Watershed Management Mission is registered as a society under the Madhya Pradesh Societies Registration Act, 1973. As a registered society, it is mandated to coordinate the watershed development efforts of various line

departments in the state; pool resources and expertise readily available to create synergy and lend focus to interventions; and work towards building an appropriate environment for sustainable people-centred interventions.

There are institutions for watershed development at three levels: the state, district and village. At the state level, the Mission Coordinator is the Secretary to the Chief Minister and therefore, the project is supervised directly by the Chief Minister himself. At the district level, the Collector is the mission leader and is responsible for fund flow and project progress. The Chief Executive Officer (CEO) of the Zilla Panchayat (District Council) is directly responsible for the project and reports to the Collector. There are two committees at the district level the District Watershed Advisory Committee (DWAC) and the District Watershed Technical Committee (DWTC). The milli-watershed is the planning unit for RGWM activities and is identified by the DWAC. At the level of the planning unit, programme activities are managed by a Project Implementation Agency (PIA) selected by the DWAC. The PIA is normally a government department or an NGO's, corporate sector and is responsible for operationalizing the programme at the level of the planning unit. PIA members facilitate and coordinate village-level activities. At the village level, village watershed committees (VWCs) plan and execute the programme. VWC members are usually from user groups (UGs), self-help groups (SHGs) and water thrift and credit groups (WTCGs), as well as from the panchayat. Programme activities in a district commence with the formation of DWAC and DWTC. The DWAC plays a central role in selecting milli-watersheds for intervention. Milli-watersheds span an area of 5,000-10,000 ha and are divided for operational purposes into micro watersheds of 500-1,000 ha. They are selected on the basis of low availability of drinking water, declining agricultural productivity, increasing fallow lands, higher SC/ST population and lower wage rates, using geo-coded maps. Proximity to treated watershed areas is another recommended criterion for milli-watershed selection. The PIA manages programme activities at the milli-watershed level. There is provision for undertaking entry point activities in

the village during the preparatory phase, in which immediate and pressing village-level concerns are addressed, to gain public confidence.

Participatory rural appraisal (PRA) is instrumental in identifying programme activities at the village level and individuals likely to benefit from them. These individuals are organised into groups.

Fig. 1.3: Self Help Group- A livelihood Security Component of Integrated Watershed Management Programme

Typically, three types of groups are identified: UGs of beneficiary farmers; SHGs; and WTCGs of women who wish to undertake savings, credit and income-generation activities. The VWC is the key programme-specific institution at the village level and is registered with the District Rural Development Agency (DRDA). Among its key activities are the preparation and implementation of village-level plans; collection of contributions from villagers for a fund created for maintenance of programme assets; developing appropriate benefit-sharing arrangements; promotion of WTCGs; and assisting community mobilisation and other efforts of PIA members.

Villagers make a certain minimum contribution, in the form of cash, labour or material, to the programme activities. Contributions for community works on public lands are provided for at 5 per cent of the estimated cost of works. A similar contribution is expected from SC/STs and persons below poverty line (BPL) for works on private lands. Contributions expected from other categories are higher, at about 10 per cent. The contribution is deposited into a development fund for maintenance of programme assets.

In IWMP the several location specific activities have been taken under consideration in the watershed area. The irrigation potential in these area has been increased up to 10 -15 percent due to these activities in the state. A productivity component combined with following activities has been introduced in the year 2011 in these watersheds with the objective to enhance agriculture production at their optimum level.

1. Introduction of suitable varieties of Crops suited to respective Agro-climatic Regions of the state.
2. Promotion of New varieties of crops and Seed Production in farmers' fields
3. Encouragement to Local Cultivars.
4. Introduction of Best suited Cropping System for watershed areas according to water availability
5. Land use according to their Land Capabilities.
6. Enhancement of Seed Replacement Rate
7. Encouragement to Seed Treatment Technology
8. Soil Testing and Integrated Nutrient Management Programme
9. Integrated Plant Protection Management
10. Efficient Irrigated Water Management

It is also clear in the instructions circulated to all the Mission leaders that these various agriculture production technologies should be

implemented in these water shed thorough field demonstration viz. method and result Demonstrations.

How far these activities have been implemented in these watersheds and what are their level of adoption of these to enhance production of crops in the different locations of the state, the present study has been formulated to evaluate the Impact of Pradhan Mantri Irrigation (Watershed Development) Project on land use and cropping pattern in Madhya Pradesh with following specific objectives:

1.1 Specific Objectives of the study

1. To analyze change in irrigation potential in different categories of farms
2. To determine the impact of watershed mission on land use and cropping pattern in different categories of farms
3. To analyze adoption gap between technology disseminated and adopted by the farmers
4. To identify constraints in adoption of technology and suggest ways and means for improvement of watershed area.

1.2 Review of Literature

There were so many studies have been carried out by the various research workers in this particular aspect. The following studies have been taken into consideration before conduction of the study and classified into 3 subheads i.e. a) Planning & Policies b) Extension Strategies and c) Monitoring & Evaluation.

1.2.1 Planning and Policies

The integrated watershed development approach can be formulated through participation of various committees related to project planning, implementation and sharing of benefits. The development works not only generate employment but also increase productivity of all the classes of land

and hence, integrated approach has been accepted as a suitable model of growth for upliftment of backward area (Sandhu and Kumar, 1986). The identification of scientifically sound traditional practices area helpful to the scientist in technology blending programme and in generation of low cost location specific appropriate technology modified to suit the dry land farmers (Pandaria and Singh, 1990). The major programme initiated in the project includes contour bunding, submergence bunding, still trap bund, afforestation and digging of wells, which cause significant shift in land use pattern due to reduction in the area under barren, cultivable waste land and permanent fellow (Singh, 1991). The farm yard manures and the fertilizers are the major items of energy input factors under watershed programme while, human labor and bullock labor were identified as a major energy input factors in non-watershed villages (Rao, 1991). Participatory watershed development approach that allows the creative potential and wisdom of the people to assert it as a result to timely and appropriate exogenous inputs and leading to the unfolding of a "development dynamics" which creates possibilities for the change in the village (GTZ, 1995). The factors like increase in net sown area and gross sown area, area under assured irrigation (tube well and wells) and annual agricultural income will help in diversification of crops in the cropping pattern resulted increased the area under commercial and more remunerative crops. (Nahatkar, 2008). Draft interim report of working sub group II of watershed plus policies for the development of rainfed areas, Ministry of Agriculture, GOI, 2006 suggested that there is a need for revisiting the investment need of watershed since the life of one programme can be no longer than 10-12 years (Deshpande, 2008). Further convergence of various rural development programmes in around the watershed could be ensured to promote holistic development of watersheds (Palanisami and Kumar, 2009).

1.2.2 Extension Strategies

The considerable potential was found to increase crop yield by fertilizer use for most of the dry land crops (Hebber and Shaspurkar, 1990)

specially bajra, jowar, groundnut and safflower by mentioning optimum plant population (Verma et al. 1990). But it will not turn in to sustainable agriculture. To create awareness before execution of water management programme and enlist participation while planning and execution, the number of informal meetings, discussions be arranged with the farmers (Algumani, 1991). The training should be given to large number of farmers about improved dryland practices was significantly associated with extension participation. The extension agencies should implement the dry land practices on watershed basis (Bavalatti & Sunderswamy, 1990). High priority is needed for transfer of technology related to use of improved seed varieties, fertilizer application so that the yield of *barani* wheat can be doubled in Malwa Region of Madhya Pradesh (Saxena et al, 1990). The information about cultural practices of crops, plant protection and new verities are needed by the tribal farmers of rainfed area (Singh, 1990). These tribal people need special training and education programmes. The extension agencies and mass media influences knowledge, attitude and adoption behavior of the farmers. Lack of proper communication pattern is the main reason for agricultural backwardness of the area. The need for management support for watershed development, credit supply, and infrastructural facilities for supply of seeds, fertilizers and the need for farmers' participation in training has been stressed (Krishirsagar and Ghotake, 1991).

1.2.3 Monitoring and Evaluation:

The farm income of the dry land areas can further be increased by adoption of optimum crop plan in watershed areas (Tilekar et al. 1986). The watershed management development programme significantly increases the production and income of beneficiaries (Sandhu, 1988). The increase income generated by soil and water conservation measures is rather low, compared to the quantum jump experienced when coupled with improved crop production techniques, but soil is a natural resource, such programme should therefore be heavily subsidies from the point of view of economics and ecology because the cost can go as high as Rs. 4000/ha (Tarol, 1988). The

implementation of the watershed development programme has considerably increase the socio-economic status, land productivity and annual income of the small and marginal farmers (Gowda and Jayaramaiah, 1990). The implementation of watershed development programme through reclamation of soil drained, soil and land development activity increase par ha gross income by 88 per cent (Alshi et al. 1991). The watershed development approach in Gukbarga, Karnataka increased crop yield by 80 to 100 per cent and double the income of farmer within three years (Biradar, 1991). The average yield of all crops is higher in command area of watershed project than in non-command areas. The intensity of labor use as well as productivity of labor in command area recorded a marked increase over the time (Ghose, 1991).

The watershed programme depicted following impacts (Singh, 1991).

- As a result of land development, the area under irrigation increased from 189 ha in 1984 to 1979 ha in 1990 without lowering the water levels.
- Increase in adoption of improved technology
- Increase use of fertilizers
- Increase in cropping intensity due to increased availability of water.
- Increase in productivity and production of crops and
- Increase in areas under oilseed and pulses.

The programme had given a very favourable response in agriculture as well as dairy sectors by increasing employment opportunity. Improved agronomic practices which were the major part of the programme, led to increase in the gross income from agriculture crops from 44.85 to 73.70 per cent (Mahnot, et al. 1992). The watershed programme in addition to increase labor employment can increase productivity of farm land up to Rs. 1829/ha, the forestation has also improved the fuel resources (Mishra, 1991). The intensity of cropping in treated watershed was higher by 13 to 20 per cent

than those in the non-treated area. More than 50 per cent of the farmers have adopted improved technology in command area (Nema, 1991). The watershed technology significantly raised water level in the area at the rate of 3.7 m per year after the implementation of the National Watershed Development Project in Bundelkhand region of Uttar Pradesh which significantly increased the intensity of cropping (Singh & Thapaliyal, 1991). The productivity level, cost- benefit ratio, additional cost-benefit ratio and employment in crop production increase significantly in watershed area as compared to those in non-treated villages. Though, the productivity level of crops varied from year to year in watershed villages vis-à-vis non watershed villages (Raju et al. 1991). National watershed Development Project in rainfed agriculture in Himachal Pradesh lacked proper infrastructural facilities i.e. adequate staff, proper storage facilities, contingency etc. which hinder its working (Sikka et al, 1991). Total area 77.12 ha was benefited by soil conservation measures like bund terracing, bunding operation and pasture development. The cultivated area increased by 0.50 ha/farm and irrigated area 1.42 per ha per farm (Shrivastava, et al. 1991) in Mandsour district of Madhya Pradesh. About 25 per cent of beneficiaries have benefitted by land development work by way of increased yield, irrigation potential and subsequent change in cropping pattern. The net irrigated area was increased by about 5 per cent. Almost all the farmers reported that supply of seed and fertilizer under the programme could reduce the cost during the year. The increase in total income per household worked out to be 5.5 per cent (Norman, et al. 1991). The greatest efficiency gains in water use can be made in agriculture where traditional irrigation by flooding or channelling water by gravity is inefficient (60% of the water is lost by evaporation or infiltration), new techniques of micro irrigation by drip systems allow an efficiency of 95 % (Postel,1992). Agriculture and allied activities were found to be the major source of income and this was 17 per cent higher on watershed beneficiary farms as compared to non-beneficiary farms (Nahatkar et al, 2003). Implementation of watershed development

project has resulted in area expansion and improvement in crop productivity (Babu et al, 2004). Sharma et al (2008) observed that the gross returns, farm business income, return to labour net returns, benefit cost ratio, cropping intensity and per cent area irrigated to total land holdings were higher on sprinkler irrigated farms than on surface irrigated farms in typical rain-fed area of Rajasthan. The watershed-based development proramme has resulted in increased crop production, productivity, employment generation, and farm income and groundwater status, leading to overall rural prosperity in the area (Thomas et al 2009).

Thus, integrated watershed development approach improves farm productivity and it is relevant to the Indian economy, considering its substantial benefits, impact on living standard and employment in the vast dry area.

1.3 Research Methodology

The sampling techniques, nature and types of data required for the investigation, tools and method of data collection and concept used while interpretation of the analyzed data for the study are included in the following sub heads:

1.3.1 Sampling Techniques

All the districts under the productivity components of IWMP in the State have been taken into consideration and were put under their respective agro-climatic zone (Table 1.1). One watershed in each district having maximum watershed command area was selected for the study (Table 1.2). All the villages covered under the selected watershed were selected for the study.

A list of all the beneficiaries of selected villages was prepared according to their size of holdings. A list of all the beneficiaries has been prepared and classified into marginal (<1 ha), small (1 to 2 ha), medium (2 to 5 ha) and large (>5 ha) categories according to their size of farms.

Table 1.1: Agro-Climatic Regions of Madhya Pradesh.

S. No.	Agro-Climatic Regions	Districts covered	Districts under IWMP
1	Vindhya Plateau	Bhopal, Sagar, Damoh, Vidisha, Guna :- Chanchoda, Raghogarh & Aron Tehsils.	Bhopal, Vidisha, Damoh*, Sagar*, Sagar and Guna
2	Central Narmada Valley	Narsinghpur, Hoshangabad, , Raisen (except Bareli Tehsil) Sehore :-Budni Tehsil, Raisen :-Bareli Tehsil	Narsinghpur,
3	Jhabua Hills	Jhabua District. (except Petlawad Tehsil), Alirajpur & Dhar :- Only Kukshi Tehsil.	Jhabua and Alirajpur
4	Kymore Plateau & Satpura Hills	Rewa, Satna, Panna, Jabalpur, Seoni, Katni & Sidhi (except Singroli Tehsil)	Rewa, Stana, Katni, Jabalpur, Seoni and Panna
5	Nimar Valley	Khandwa, Khargone, Burhanpur, Barwani, Dhar:-Manawar, Dharampuri & Gandhawani Tehsil. Harda & Dhar (Partly)	Khandwa, Khargone, Barwani
6	Northern Hill Region of Chhattisgarh	Shahdol, Mandla, Dindori, Anupnagar, Umaria Sidhi :- Singroli Tehsil (Bedhan)	Mandla
7	Satpura Plateau	Betul & Chhindwara	Betula and Chhindwara
8	Bundelkhand Region	Chhattarpur, Datia, Tikamgarh, & Shivpuri :-Karera, Pichhore, Narwar & Khaniadhana Tehsils.	Chhatarpur*, Datia, Tikamgarh , Shivpuri
9	Gird Region	Gwalior, Bhind, Shivpuri (excepted Pichore, Karera, Narwar, Khaniyadana Tehsil) Morena, Guna (except Aron, Raghogarh, Chachoda Tehsil) & Ashoknagar	Gwalior, Morena,
10	Malwa Plateau	Mandsaur, Neemuch, Ratlam, Ujjain, Indore, Shajapur Rajgarh & Dhar :-Dhar, Badnawar & Sardarpur Tehsils. Jhabua :- Petlawad Tehsil.	Mandsoure, Neemuch, Indore, Ratlam, Ujjain, Dhar,
11	Chhattisgarh Plain	Balaghat	---

*Under the Bundelkhand package

Further, 10 per cent or minimum 10 beneficiaries from each category were selected randomly for the study (Table 1.3). Thus, 431, 362, 309 and 183 beneficiaries have been selected from marginal, small, medium and large

categories respectively comprises a total sample size of 1285 beneficiaries, which covers 18.18 per cent of beneficiaries and more than 30 per cent of total Watershed Command Area of Madhya Pradesh.

Table 1.2: Selected watershed in different districts of Madhya Pradesh

S.No.	Districts	Selected watershed	Project Area covered (ha)
1	Chhatarpur*	IWMP-2	5920
2	Datia	IWMP-3	6229
3	Tikamgarh	IWMP-4	5300
4	Narsinghpur	IWMP-4	5272
5	Morena	IWMP-3	8000
6	Gwalior	IWMP-2	5973
7	Shivpuri	IWMP-3	7500
8	Alirajpur	IWMP-3	5664
9	Jhabua	IWMP-2	5394
10	Rewa	IWMP-1	5808
11	Satna	IWMP-1	4914
12	Katni	IWMP-3	9000
13	Jabalpur	IWMP-2	7380
14	Seoni	IWMP-2	9998
15	Panna	IWMP-2	7000
16	Barwani	IWMP-1	6496
17	Dhar	IWMP-2	7900
18	Ujjain	IWMP-1	6351
19	Ratlam	IWMP-2	9154
20	Indore	IWMP-1	8465
21	Mandsaur	IWMP-4	7000
22	Neemuch	IWMP-2	7075
23	Khandwa	IWMP-2	7300
24	Khargone	IWMP-1	7000
25	Mandla	IWMP-2	9300
26	Betul	IWMP-3	5579
27	Chhindwara	IWMP-2	9085
28	Vidisha	IWMP-3	5607
29	Damoh*	IWMP-2	5005
30	Bhopal	IWMP-3	5300
31	Sagar*	IWMP-5	6641
32	Sagar	IWMP-3	5500

33	Guna	IWMP-1	9578

* Under Bundelkhand Package

Table 1.3: Number of Selected Beneficiaries in different size of farms

S. No.	Selected Watershed	Total Beneficiaries					Selected Beneficiaries				
		Marginal	Small	Medium	Large	Total	Marginal	Small	Medium	Large	Total
1	Vidisha IWMP-3	222	107	24	8	361	22	10	10	8	50
2	Damoh* IWMP-2	16	3	1	1	21	10	3	1	1	15
3	Bhopal IWMP-3	232	43	14	1	290	23	10	10	1	44
4	Sagar IWMP-3	11	10	11	14	46	10	10	10	10	40
5	Sagar* IWMP-5	49	24	7	1	81	10	10	7	1	28
6	Guna IWMP-1	71	145	48	0	264	10	14	10	0	34
Vindhya Plateau		601	332	105	25	1063	85	57	48	21	211
7	Narsinghpur IWMP-4	28	47	50	9	134	10	10	10	9	39
Central Narmada Valley		28	47	50	9	134	10	10	10	9	39
8	Alirajpur IWMP-3	51	19	8	1	79	10	10	8	1	29
9	Jhabua IWMP-2	47	39	12	2	100	12	13	10	2	37
Jhabua Hills		98	58	20	3	179	22	23	18	3	66
10	Rewa IWMP-1	15	40	32	24	111	10	10	10	10	40
11	Satna IWMP-1	277	110	51	13	451	28	11	10	10	59
12	Katni IWMP-3	157	132	61	23	373	16	13	10	11	50
13	Jabalpur IWMP-2	161	46	33	20	260	16	10	10	10	46
14	Seoni IWMP-1	25	20	5	3	53	10	10	5	3	28
15	Panna IWMP-2	68	75	35	2	180	10	10	10	2	32
Kymore Plateau		703	423	217	85	1428	90	64	55	46	255
16	Khandwa IWMP-2	20	48	23	1	92	10	10	10	1	31
17	Khargone IWMP-1	107	79	96	0	282	10	10	10	0	30
Nimar Plains		127	127	119	1	374	20	20	20	1	61
18	Mandla IWMP-2	49	51	41	14	155	10	10	10	10	40
Northern Hill of Chhattisgarh		49	51	41	14	155	10	10	10	10	40
19	Betul IWMI-3	10	10	10	4	34	10	10	10	4	34
20	Chhindwara	108	106	41	13	268	10	10	10	10	40

	IWMP-2										
Satpura Hills		118	116	51	17	302	20	20	20	14	74

Cont. to Next Page

Table 1.4: Number of Selected Beneficiaries in different size of farms

S. No.	Selected Watershed	Total Beneficiaries					Selected Beneficiaries				
		Marginal	Small	Medium	Large	Total	Marginal	Small	Medium	Large	Total
21	Chhatarpur* IWMP-2	72	22	7	3	104	10	10	7	3	30
22	Datia IWMP-3	222	256	165	30	673	22	25	16	10	73
23	Tikamgarh IWMP-4	45	90	27	7	169	10	10	10	7	37
Bundelkhand region		339	368	199	40	946	42	45	33	20	140
24	Morena IWMP-3	283	129	4	0	416	28	13	4	0	45
25	Gwalior IWMP-2	5	88	64	23	180	5	10	10	10	35
26	Shivpuri IWMP-3	54	34	49	31	168	10	10	10	10	40
Gird Region		342	251	117	54	764	43	33	24	20	120
27	Badwani IWMP-1	159	89	43	11	302	15	10	10	10	45
28	Dhar IWMP-2	142	59	9	9	219	14	10	9	9	42
29	Ujjain IWMP-1	47	19	58	3	127	10	10	10	3	33
30	Ratlam IWMP-2	55	117	69	21	262	10	11	10	10	41
31	Indore IWMP-1	85	31	3	1	120	10	10	3	1	24
32	Mandsour IWMP-4	194	185	183	5	567	19	18	18	5	60
33	Neemuch IWMP-2	55	47	22	1	125	11	11	11	1	34
Malwa Plateau		737	547	387	51	1722	89	80	71	39	279
Total		3142	2320	1306	299	7067	431	362	309	183	1285

1.3.2 Nature and Sources of Data

The study is based on both primary and secondary data. The secondary data on number of watersheds in different districts and total number of beneficiaries in each watershed have been collected from the office of the Rajiv Gandhi Watershed Mission, Bhopal. The primary data were collected from the selected respondents of different locations of the study area.

1.3.3 Tools of Data Collection

A pre-tested interview schedule was used for collection of required data from the respondents. The interview schedule having all the information for analyzing the impact of the project viz. General information of the farmers, land utilization pattern, sources of irrigation, cropping pattern, number of farm machineries and animal and adoption of recommended technology by the beneficiaries in the current year. The primary data were collected from the individual respondents through survey method by personal contact. The required primary data have been collected in the agriculture year 2015-16. In the data collection process three visits were performed at various stages i.e. first at the time of pre testing of interview schedule, second at the time of data collection and third supervision of various watershed development activities.

Fig. 1.4: Orientation Training Programme

The process of primary data collection has been taken place in 4 stages. The first stage the orientation training programme was organised for the field investigators. During the training programme the concept of integrated

watershed development mission, impact evaluation technique and detail information regarding interview schedule were briefed to the trainees for better understanding and collection of précised and accurate data from the respondents.

Fig. 1.5: Collection of Primary Data by Field Investigators

At the second stage 4 interview schedules provided to each investigator for testing from the marginal, small, medium and large categories from their respective area of data collection. There after they have been called back for a meeting with filled interview schedule to solve the problems during the data collection. At the third stage field investigator collected primary data from their locations and sent back to the centre. At fourth and final stage the activities of data collection as well as various activities of watershed development programme of different locations of Madhya Pradesh has been supervised by competent authorities.

Fig. 1.6: Supervision by Principal Investigators

1.3.4 Classification of Data

The primary data have been classified into two i.e. before and after inception of productivity component in the watershed approach in the area under study. To analyze the impact of the study year 2009 -10 and 2014-15 were taken as the base and the current year respectively for the study. The collected data have been further classified into different agro-climatic regions existed in Madhya Pradesh. The collected primary data of various districts were classified into different size groups for interpretation and to drawn conclusion for the study.

1.3.5 Analysis of data

The collected data have been analyzed with suitable statistical methods. The impact of watershed development programme has been studied in terms of change in area under irrigation, land use pattern, cropping pattern, yield and production of different crops etc. The technology

adoption status of disseminated technology under each watershed and constraints prevails in the adoption of these technology were also analyzed in view of the stated objectives.

1.3.6 Concept used

The following concepts have been used to drawn conclusion for the study.

Marginal farmer: A farmer having less than 1 ha of land

Small farmer: A farmer having land between 1 – 2 ha

Medium farmer: A farmer having 2-5 ha of land

Large farmer: A farmer having more than 5 ha of land

Cropping intensity: (Gross Cropped Area/ Net area Sown) X 100

Adoption of technology: Percentage adoption of recommended technologies by a farmer.

Yield gap: Yield Gap of different crops have been analysed through following formulae.

1. Yield Gap I = Yp-Yh/Yp*100
2. Yield Gap II = Yh-Ya/Yh*100
3. Yield Gap III = Yp-Ya/Yp*100

Where,

Yp = Potential Yield (q/ha)

Yh = Highest Farm Yield (q/ha)

Ya = Average Farm Yield (q/ha)

Potential Yield of a particular crop is the yield which was harvested on farm in First/Front line Demonstration conducted by different Zonal Agriculture Research Station in the area under study.

Percentage Change: Percentage change has been calculated over the base year (2009-10) in the current year (2014-15).

% Change = (Current Year – Base Year) / Base year X 100

1.4 Limitation of the study

The finding of the study confined to the area under study and it can be generalised for the Madhya Pradesh. The primary data have been collected from the respondents' based on their recall memory as they do not keep any record.

As per the study report it has been mentioned that severe drought was observed in **46 districts (**Katni, Shahdol, Umaria, Anuppur, Tikamgarh, Rewa, Jabalpur, Sidhi, Sagar, Damoh, Seoni, Sigroli, Sheopur, Chhatarpur, Bhind, Panna, Satna, Dindori, Shivpuri, Mandsaur, Morena, Jhabua, Bhopal, Ujjain, Neemuch, Vidishia, Raisen, Rajgarh, Khandwa, Ratlam, Narsinghpur, Guna, Betul, Burhanpur, Agar Malwa, Sehore, Indore, Dhar, Shajapur, Harda, Chhindwara, Dewas,Ashoknagar,Khargone,Hoshangabad, Badwani) out of 51 affected by drought during 2015-16[*] (Study Year). Results could have been better if drought was not occurred in these districts of the study area.

1.5 Organization of the study

The study comprises five chapters, chapter I include introduction, objectives, review of literature and research methodology. In chapter II, impact of IWMP on irrigation potential in different agro-climatic region and various size of holding have been discussed in detail. Impact of IWMP on land use and cropping pattern, production and productivity of different crops in various agro-climatic regions and different size of holdings is the matter of chapter III. Chapter IV contains yield gap, adoption of technology and constraints thereof. Summary, conclusion and suggestions have been dealt in chapter V followed by chapter VI references and annexure.

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[*] Joint Need Assessment Report on Drought on Madhya Pradesh, May 2016

CHAPTER II

IMPACT OF IWMP ON IRRIGATION POTENTIAL

This chapter deals with the results of the study related to changes occurred in irrigation potential in different agro-climatic regions and various size of farms due to construction of different watershed body viz. tanks, stop dam, check dam, gabion structure, trench, plugging of gullies etc in the area under study. The irrigation potential was analyzed by irrigated area, depth of water table and number of irrigation in different agro-climatic regions as well as in various size of farms.

2.1 ACCORDING TO AGRO-CLIMATIC REGIONS

The irrigation potential was analyzed on sample farms for all the agro-climatic zones of the State i.e. Vindhya Plateau, Central Narmada Valley, Jhabua Hills, Kymore Plateau & Satpura Hills, Nimar Valley, Northern Hill of Chhattisgarh, Satpura Plateau, Bundelkhand region, Gird Region and Malwa Plateau except Chhattisgarh Plains.

2.1.1 Irrigated Area

The changes occurred in irrigated area through different sources of irrigation in different agro–climatic regions of Madhya Pradesh were observed and results of an average sample farmer are presented in these subheads.

2.1.1.1 Vindhya Plateau

The irrigated area was found to be increased by 18.42 per cent in the current year (1.80 ha) as compared to the base year (1.52 ha). The maximum increase in area under irrigation was from tube wells (84.62 per cent) followed by wells (15.31%) in the current year as compared to the base year. It was also found to be increased by 4.88 per cent through other sources of irrigation (Table 2.1).

Table 2.1: Changes occurred in irrigated area in Vindhya Plateau (ha)

Sources of Irrigation	The Base Year	The Current Year	% Change
Tube-wells	0.13	0.24	84.62
Wells	0.98	1.13	15.31
Others	0.41	0.43	4.88
Total	1.52	1.8	18.42

2.1.1.2 Central Narmada Valley

The percent change in area under irrigation was found to be increased by 2.48 per cent through all the sources of irrigation in the current year (2.07 ha) as compared to the base year (2.02 ha) in Central Narmada Valley. The maximum per cent increase in area under irrigation was from wells (4.55%) followed by tube-wells (2.30%). (Table 2.2)

Table 2.2: Changes occurred in irrigated area in Central Narmada Valley (ha)

Sources of Irrigation	The Base Year	The Current Year	% Change
Tube-wells	1.74	1.78	2.30
Wells	0.22	0.23	4.55
Others	0.06	0.06	0.00
Total	2.02	2.07	2.48

2.1.1.3 Jhabua Hills

The maximum increase in area under irrigation was found to be 23.94 per cent from wells and 1.69 per cent through other sources in Jhabua Hills. The area under irrigation through all the sources was found to be 2.40 and 2.01 ha in current and base year respectively, which shows 19.40 per cent increase during the period under study. Infinite change was observed in tube-wells as irrigated area in the base year was nil. (Table 2.3).

Table 2.3: Changes occurred in irrigated area in Jhabua Hills (ha)

Sources of Irrigation	The Base Year	The Current Year	% Change
Tube-wells	0.00	0.04	∞
Wells	1.42	1.76	23.94
Others	0.59	0.60	1.69
Total	2.01	2.4	19.4

2.1.1.4 Kymore Plateau & Satpura Hills

The irrigated area was found to be increased by 25.00 per cent in current year (1.05 ha) as compared to base year (0.84 ha) due to the implementation of IWMP in Kymore plateau (Table 2.4). Amongst different sources of irrigation, the maximum increase in irrigated area was by wells (57.69 %) and tube-wells (17.95 %), while the area under irrigation through other sources was also found to be increased by 5.55 per cent in the current year (0.18 ha) as compared to the base year (0.19 ha).

Table 2.4: Changes occurred in irrigated area in Kymore plateau (ha)

Sources of Irrigation	The Base Year	The Current Year	% Change
Tube-wells	0.39	0.46	17.95
Wells	0.26	0.41	57.69
Others	0.18	0.19	5.55
Total	0.84	1.05	25

2.1.1.5 Nimar Valley

The irrigated area was found to be increased by 8.65 per cent in current year (2.01 ha) as compared to base year (1.85 ha) in Nimar Valley (Table 2.5). Amongst different sources of irrigation, the maximum increase in irrigated area was observed by tube-wells (16.67 %) followed by wells (8.02 %). The area irrigated from the other sources was also found to be increased by 9.09 per cent in the current year (0.12 ha) as compared to the base year (0.11 ha).

Table 2.5: Changes occurred in irrigated area in Nimar Valley (ha)

Sources of Irrigation	The Base Year	The Current Year	% Change
Tube-wells	0.12	0.14	16.67
Wells	1.62	1.75	8.02
Others	0.11	0.12	9.09
Total	1.85	2.01	8.65

2.1.1.6 Northern Hills of Chhattisgarh

The area under irrigation through tube-wells was found to be nil in base and current year. The per cent increase in area under irrigation was found to be 13.16 and 31.94 in case of wells and other sources respectively.

Through all the sources area under irrigation was increased by 25.45 per cent in current year (1.38 ha) as compared to base year (1.10 ha) in Northern Hills of Chhattisgarh (Table 2.6).

Table 2.6: Changes occurred in irrigated area in Northern Hills of CG

(ha)

Sources of Irrigation	The Base Year	The Current Year	% Change
Tube-wells	0.00	0.00	0.00
Wells	0.38	0.43	13.16
Others	0.72	0.95	31.94
Total	1.1	1.38	25.45

2.1.1.7 Satpura Plateau

The area under irrigation was found to be increased by 12.16 per cent by all the sources in current year (0.83 ha) as compared to base year (0.74 ha) in Satpura Plateau (Table 2.7) during the period under study. The 16.36 per cent increase was observed in case of wells. The area irrigated by tube-wells was found to be nil and through other sources it was 0.19 ha in case of base and current year with no change.

Table 2.7: Changes occurred in irrigated area in Satpura plateau (ha)

Sources of Irrigation	The Base Year	The Current Year	% Change
Tube-wells	0.00	0.00	0.00
Wells	0.55	0.64	16.36
Others	0.19	0.19	0.00
Total	0.74	0.83	12.16

2.1.1.8 Bundelkhand Region

The irrigated area was found to be increased by 9.52 per cent in current year (1.84 ha) as compared to base year (1.68 ha) in Bundelkhand region (Table 2.8). Amongst different sources of irrigation the maximum area was found to be irrigated by tube-wells (10.38 %) followed by wells (8.16 %). The area irrigated by other sources was also found to be increased by 7.69 per cent during the period under study.

Table 2.8: Changes occurred in irrigated area in Bundelkhand Region (ha)

Sources of Irrigation	The Base Year	The Current Year	% Change
Tube-wells	1.06	1.17	10.38
Wells	0.49	0.53	8.16
Others	0.13	0.14	7.69
Total	1.68	1.84	9.52

2.1.1.9 Gird Region

The area under irrigation was found to be increased by 11.76 per cent in current year (2.28 ha) as compared to base year (2.04 ha) in Gird Region (Table 2.9). Amongst different sources of irrigation, the area irrigated by wells, tube-wells and other sources was found to be increased by 13.33, 12.78 and 8.93 per cent respectively.

Table 2.9: Changes occurred in irrigated area in Gird Region (ha)

Sources of Irrigation	The Base Year	The Current Year	% Change
Tube-wells	1.33	1.50	12.78
Wells	0.15	0.17	13.33
Others	0.56	0.61	8.93
Total	2.04	2.28	11.76

2.1.1.10 Malwa Plateau

The area under irrigation was found to be increased by 14.04 per cent in current year (1.30 ha) as compared to base year (1.14 ha) in Malwa Plateau (Table 2.10). Amongst different sources of irrigation the area irrigated by wells was increased slightly by 5.88 while the area irrigated by other sources was found to be increased by 70.37 per cent. The area under irrigation by tube-wells remained unchanged in the current year.

Table 2.10: Changes occurred in irrigated area in Malwa plateau (ha)

Sources of Irrigation	The Base Year	The Current Year	% Change
Tube-wells	0.33	0.33	0.00
Wells	0.51	0.54	5.88
Others	0.27	0.46	70.37
Total	1.14	1.3	14.04

2.1.2 Depth of Water Table

The depth of water table of different sources of irrigation was also recorded in base and current year along with percentage change over base year to understand the impact of watershed structures in a better way on an average farmer's field in the area under study across various agro-climatic regions of the State.

2.1.2.1 Vindhya Plateau

The remarkable change has been observed in depth of water table after implementation of IWMP in Vindhya Plateau. Amongst different sources of irrigation, depth of water table was found to be decreased by 18.18 and 16.67 per cent in case of tube-wells (11 to 9 meter) and wells (6 to 5 meter) respectively. (Table 2.11)

Table 2.11: Changes occurred Depth of Water Table in Vindhya Plateau.

(m)

Sources	The Base Year	The Current Year	% Change
Tube-wells	11	9	-18.18
Wells	6	5	-16.67

2.1.2.2 Central Narmada Valley

Amongst different sources of irrigation in Central Narmada Valley, the depth of water table was found to be decreased by 27.27 and 23.68 per cent in case of tube-wells (11 to 9 meter) and wells (38 to 29 meter) respectively. It is clear from the table that this change has been occurred due to implementation of IWMP (Table 2.12).

Table 2.12: Changes occurred Depth of Water Table in Central Narmada Valley

(m)

Sources	The Base Year	The Current Year	% Change
Tube-wells	11	8	-27.27
Wells	38	29	-23.68

2.1.2.3 Jhabua Hills

Amongst different sources of irrigation in Jhabua Hills the depth of water table was found to be decreased by 30.00 per cent in case of wells (10 to 7 meter) (Table 2.13), while infinite change was observed in case of tube-wells.

Table 2.13: Changes occurred Depth of Water Table in Jhabua Hills (m)

Sources	The Base Year	The Current Year	% Change
Tube-wells	0	8	∞
Wells	10	7	-30.00

2.1.2.4 Kymore Plateau

Amongst different sources of irrigation in Kymore Plateau the depth of water table was found to be decreased by 15.38 and 9.30 per cent in case of wells (13 to 11 meter) and tube-wells (43 to 39 meter) in current year as compared to the base year (Table 2.14).

Table 2.14: Changes occurred depth of water table in Kymore Plateau (m)

Sources	The Base Year	The Current Year	% Change
Tube-wells	43	39	-9.30
Wells	13	11	-15.38

2.1.2.5 Nimar Valley

In Nimar Valley depth of water table was found to be decreased by 18.18 per cent in case of tube-wells and wells i.e. from 11 to 9 meter (Table 2.15).

Table 2.15: Changes occurred Depth of Water Table in Nimar Valley (m)

Sources	The Base Year	The Current Year	% Change
Tube-wells	11	9	-18.18
Wells	11	9	-18.18

2.1.2.6 Northern Hills

Amongst different sources of irrigation in Northern Hills, the depth of water table in case of wells was found to be decreased by 23.08 per cent i.e. from 13 to 10 meter. (Table 2.16)

Table 2.16: Changes occurred Depth of Water Table in Northern Hills (m)

Sources	The Base Year	The Current Year	% Change
Tube-wells	0	0	0.00
Wells	13	10	-23.08

2.1.2.7 Satpura Plateau

Amongst different sources of irrigation in Satpura Plateau, the depth of water table in case of wells was found to be decreased by 16.67 per cent i.e. from 6 to 5 meter. while no change was observed in case of tube wells (Table 2.17).

Table 2.17: Changes occurred depth of water table in Satpura Plateau (m)

Sources	The Base Year	The Current Year	% Change
Tube-wells	0	0	0.00
Wells	6	5	-16.67

2.1.2.8 Bundelkhand Region

In Bundelkhand region the depth of water table was found to be decreased from 9 to 7 and 35 to 28 meter in absolute & 22.22 and 20.00 per cent in relative term in case of wells and tube-wells respectively during the period under study. (Table 2.18)

Table 2.18: Changes occurred Depth of Water Table in Bundelkhand Region (m)

Sources	The Base Year	The Current Year	% Change
Tube-wells	35	28	-20.00
Wells	9	7	-22.22

2.1.2.9 Gird Region

In Gird region the depth of water table was found to be decreased from 22 to 18 meter with 18.18 per cent decrease in case of tube-wells. In case of wells the changes in depth of water table was found unchanged during the period of the study (Table 2.19).

Table 2.19: Changes occurred Depth of Water Table in Gird Region (m)

Sources	The Base Year	The Current Year	% Change
Tube-wells	22	18	-18.18
Wells	3	3	0.00

2.1.2.10 Malwa Plateau

In Malwa Plateau the depth of water table was found to be decreased from 40 to 36 and 11 to 10 meter with 10.00 and 9.09 per cent in case of tube-wells and wells, respectively during the period under study. (Table 2.20)

Table 2.20: Changes occurred Depth of Water Table in Malwa Plateau (m)

Sources	The Base Year	The Current Year	% Change
Tube-wells	40	36	-10.00
Wells	11	10	-9.09

2.1.3 Number of Irrigations

The increase/decrease in number of irrigations across various agro-climatic regions is also considered to be a one of the important indicator, which shows the impact of watershed structure constructed in the area. Hence it was determined on an average farmer's field in the area under study.

2.1.3.1 Vindhya Plateau

The number of irrigations was found to be increased from 4 to 5 in case of tube-wells (25%) as compared to other sources of irrigation after inception of IWMP in Vindhya Plateau (Table 2.21). As regards to the wells no change has been observed in increase/decrease in number of irrigations in current year over the base year.

Table 2.21: Changes occurred in number of irrigations in Vindhya Plateau (No.)

Sources	The Base Year	The Current Year	% Change
Tube-wells	4	5	25.00
Wells	3	3	0.00

2.1.3.2 Central Narmada Valley

The number of irrigations was found to be increased by 50 per cent i.e. from 2 to 3 in case of wells and tube-wells in current year over the base year in central Narmada Valley (Table 2.22).

Table 2.22: Changes occurred in number of irrigations in Central Narmada Valley **(No.)**

Sources	The Base Year	The Current Year	% Change
Tube-wells	2	3	50.00
Wells	2	3	50.00

2.1.3.3 Jhabua Hills

The number of irrigations was found to be increased by 50 per cent in case of wells i.e. from 2 to 3, while through tube wells no irrigations was given during the period under study (Table 2.23).

Table 2.23: Changes occurred in number of irrigations in Jhabua Hills **(No.)**

Sources	The Base Year	The Current Year	% Change
Tube-wells	0	3	0.00
Wells	2	3	50.00

2.1.3.4 Kymore Plateau & Satpura Hills

In Kymore Plateau, the numbers of irrigations from wells have been increased by 33.33 per cent, while through tube wells it remained unchanged in the current year over the base year (Table 2.24).

Table 2.24: Changes occurred in number of irrigations in Kymore Plateau **(No.)**

Sources	The Base Year	The Current Year	% Change
Tube-wells	4	4	0.00
Wells	3	4	33.33

2.1.3.5 Nimar Valley

The percentage increase in number of irrigations was found to be 66.67 and 33.33 per cent in case of wells (3 to 5) and tube-wells (3 to 4) respectively. (Table 2.25)

Table 2.25: Changes occurred in number of irrigations in Nimar Valley **(No.)**

Sources	The Base Year	The Current Year	% Change
Tube-wells	3	4	33.33
Wells	3	5	66.67

2.1.3.6 Northern Hills

The number of irrigations through wells were found to be increased by 66.67 per cent with 3 to 5 irrigations, while through tube wells it remain unchanged in the current year over the base year in northern hills (Table 2.26).

Table 2.26: Changes occurred in number of irrigations in Northern Hills

(No.)

Sources	The Base Year	The Current Year	% Change
Tube-wells	0	0	0.00
Wells	3	5	66.67

2.1.3.7 Satpura Plateau

The numbers of irrigation remained unchanged amongst all the sources of irrigation after inception of IWMP in Satpura Plateau (Table 2.27).

Table 2.27: Changes occurred in number of irrigations in Satpura Plateau

(No.)

Sources	The Base Year	The Current Year	% Change
Tube-wells	0	0	0.00
Wells	2	2	0.00

2.1.3.8 Bundelkhand Region

The number of irrigations in Bundelkhand Region were found to be increased from 2 to 4 and 3 to 4 with 100 and 33.33 per cent in case of wells and tube-wells respectively (Table 2.28).

Table 2.28: Changes occurred in number of irrigations in Bundelkhand Region

(No.)

Sources	The Base Year	The Current Year	% Change
Tube-wells	3	4	33.33
Wells	2	4	100.00

2.1.3.9 Gird Region

The number of irrigations in Gird Region was found to be increased from 2 to 3 and 3 to 4 with 50.00 and 33.33 per cent in case of wells and tube-wells respectively in current year over base year (Table 2.29).

Table 2.29: Changes occurred in number of irrigations in Gird Region

(No.)

Sources	The Base Year	The Current Year	% Change
Tube-wells	3	4	33.33
Wells	2	3	50.00

2.1.3.10 Malwa Plateau

The number of irrigations in Malwa Plateau was found to be increased from 2 to 4, and 4 to 5 with 100.00 and 25.00 per cent in case of wells and tube-wells respectively in current year over base year (Table 2.30).

Table 2.30: Changes occurred in number of irrigations in Malwa Plateau

(No.)

Sources	The Base Year	The Current Year	% Change
Tube-wells	4	5	25.00
Wells	2	4	100.00

2.2 ACCORDING TO SIZE OF FARMS

The changes occurred in irrigated area, depth of water table and number of irrigations in different size of farms of an average farmer was observed and presented in following sub heads.

2.2.1 Irrigated Area

The area under irrigation by all the sources was found to be increased by 12.93 per cent in the current year (1.66 ha) as compared to base year (1.47 ha) with the implementation of IWMP in the State. The maximum increase in area under irrigation was from wells (17.78 per cent) followed by tube-wells (16.16 per cent) and it was also found increased in case of other sources by

2.94 per cent in the current year (0.34 ha) as compared to the base year (0.32 ha).

Table 2.31: Changes occurred in irrigated area in different size of farms

(ha)

Sources	Marginal			Small			Medium			Large			Overall		
	BY	CY	% change	BY	CY	% change	BY	CY	% change	BY	CY	% change	BY	CY	% change
Tube-wells	0.09	0.11	22.22	0.3	0.32	6.67	0.57	0.64	12.28	1.33	1.59	19.55	0.57	0.67	16.16
Wells	0.16	0.18	12.50	0.45	0.5	11.11	0.54	0.66	22.22	1.1	1.31	19.09	0.56	0.66	17.78
Others	0.13	0.13	0.00	0.2	0.2	0.00	0.4	0.44	10.00	0.56	0.57	1.79	0.32	0.34	2.94
Total	0.38	0.42	10.53	0.95	1.02	7.37	1.51	1.74	15.23	2.99	3.47	16.05	1.47	1.66	13.70

Amongst different size of farms the maximum change in area under irrigation was observed in large (16.05%) followed by medium (15.23%), marginal (10.53%) and small (7.37%) farms. But, remarkable difference was not found across various sizes of holdings. In case of tube well and well the change was found to be ranged between 6.67 to 22.22 per cent in small and 11.11 to 22.22 percent in small and medium respectively (Table 2.31).

2.2.2 Depth of Water Table

The depth of water table was found to be decreased remarkably in the State after implementation of IWMP. Amongst different sources of irrigation, the maximum decrease of depth of water table was found in case of wells (21.29%) from 11.98 to 9.43 meter and tube-wells (7.32%) from 30.73 to 28.48 meter in current year as compared to base year (Table 2.32).

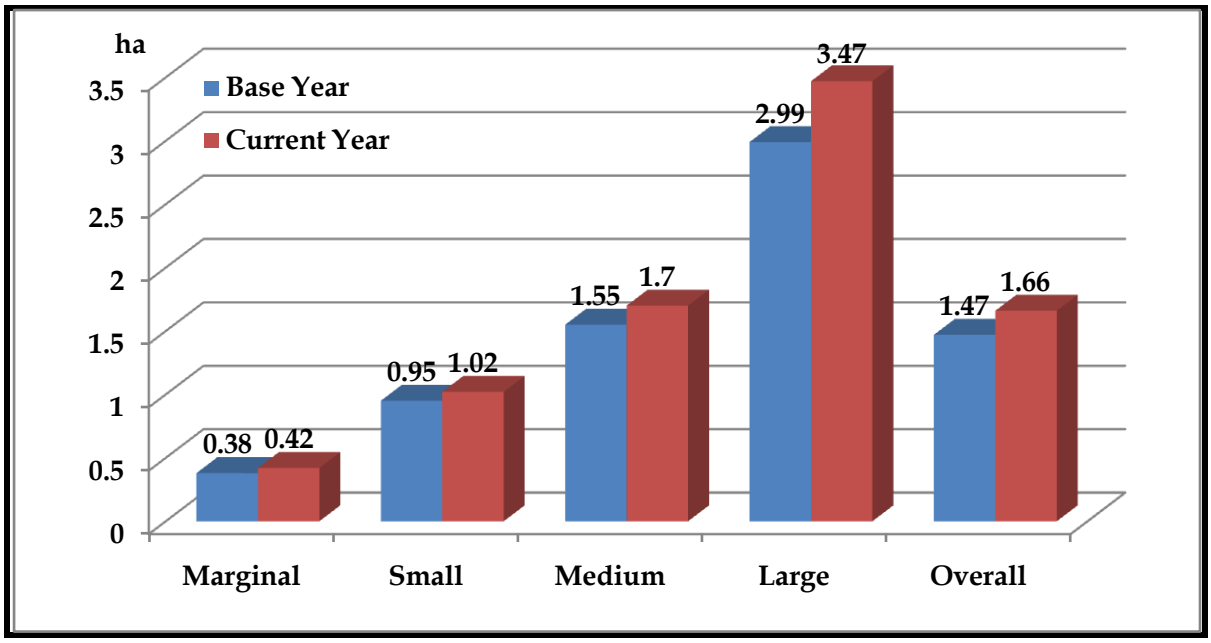

Fig. 2.1: Changes occurred in irrigated area in different size of farm (ha)

In case of wells the maximum decrease in depth of water table was observed in marginal farms (26.36%) followed by medium (21.18%), large (19.69%) and small farms (18.12%), while in case of tube-wells, the maximum decrease was found in marginal farms (12.43%) followed by large (7.79%), medium (4.42%) and small (3.81%) farms.

Table 2.32: Changes occurred in status of depth of water table in different size of farms (m)

Sources	Marginal			Small			Medium			Large			Overall		
	Base Year	Current Year	% change	Base Year	Current Year	% change	Base Year	Current Year	% change	Base Year	Current Year	% change	Base Year	Current Year	% change
Tube-wells	33.8	29.6	-12.43	28.9	27.8	-3.81	29.4	28.1	-4.42	30.8	28.4	-7.79	30.73	28.48	-7.32
Wells	12.9	9.5	-26.36	13.8	11.3	-18.12	8.5	6.7	-21.18	12.7	10.2	-19.69	11.98	9.43	-21.29

The decrease in depth of water table was also noticed in case of wells with 12.43, 7.9, 4.42 and 3.81 per cent in marginal, large, medium and small farms respectively. It is clear from the above finding that the depth of water

table amongst all the sources of irrigation was found to be decreased remarkably in the area under study due to implementation of IWMP.

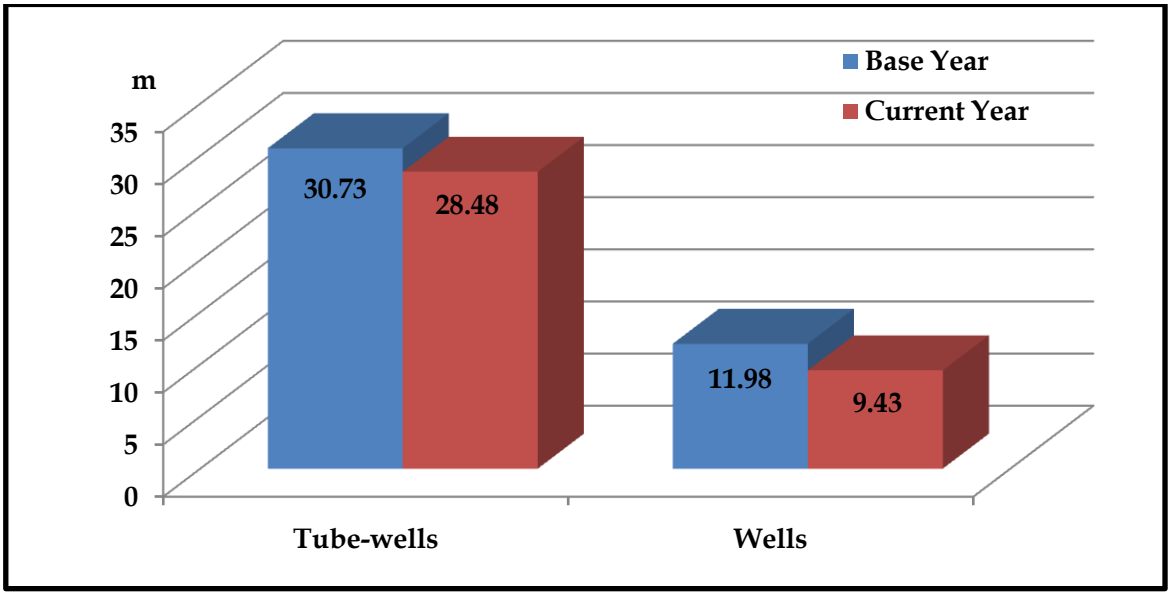

Fig. 2.2: Changes occurred in depth of water table in different sources of irrigation

2.2.3 Number of Irrigations

The maximum increase in number of irrigations were found in case of tube wells (41.30%) from 2.3 to 3.3 followed by wells (35.14%) from 2.8 to 3.8 in current year as compared to the base year.

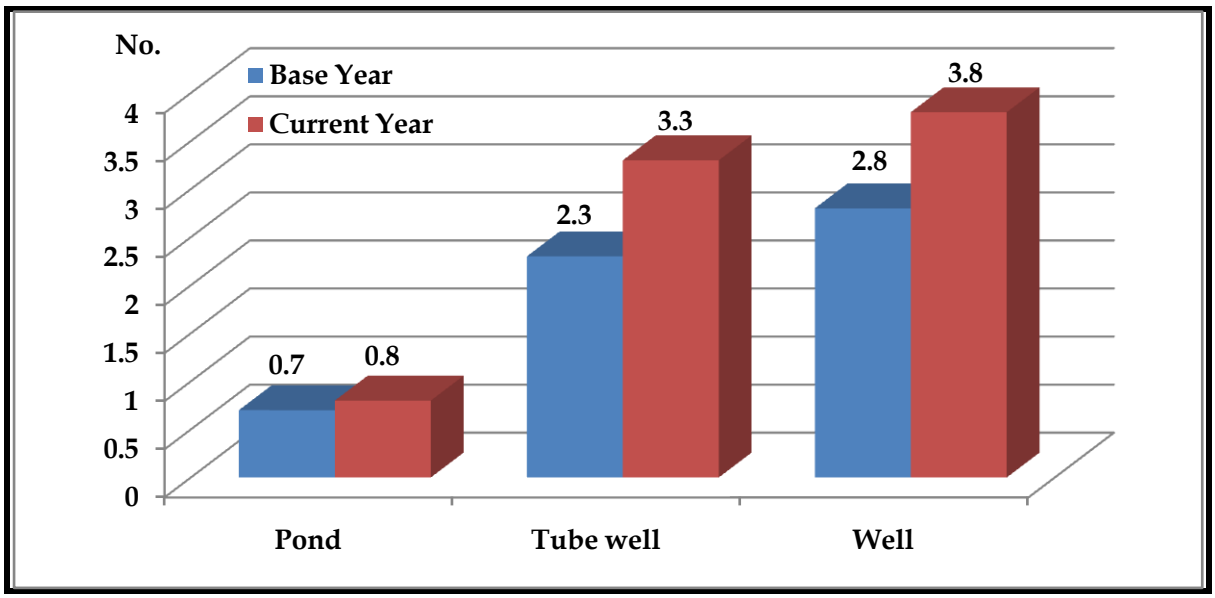

Fig. 2.3 : Changes occurred in number of irrigation in different sources of irrigation

Amongst all the sources of irrigation, the increase in number of irrigation through tube-wells and wells ranged between 25.00 (marginal) to 64.00 (small) and 31.03 (small) to 39.29 (large) per cent respectively in current year over the base year across different size of holdings (Table 2.33).

Table 2.33 : Changes occurred in number of irrigation in different size of farms **(No.)**

Sources	Marginal			Small			Medium			Large			Overall		
	Base Year	Current Year	% change	Base Year	Current Year	% change	Base Year	Current Year	% change	Base Year	Current Year	% change	Base Year	Current Year	% change
Tube-wells	2.4	3	25.00	2.5	4.1	64.00	2.5	3.6	44.00	1.8	2.3	27.78	2.3	3.3	41.30
Wells	2.7	3.7	37.04	2.9	3.8	31.03	2.7	3.6	33.33	2.8	3.9	39.29	2.8	3.8	35.14

It is clear from the above findings that not only area under irrigation through all the sources of irrigation was found to be increased due to remarkable decrease in depth of water table almost in all the sources, but the number of irrigations by all the resources was also increased across different size of holdings.

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CHAPTER III

IMPACT OF IWMP ON LAND UTILIZATION PATTERN, CROPPING PATTERN, PRODUCTION AND PRODUCTIVITY

This chapter deals with the impact of IWMP on land utilization as well as cropping pattern in different agro-climatic regions and across various size of holding in the area under study. The results obtained are presented in two sub heads viz., according to agro-climatic regions, farm size and focused on an average farmer of the study area.

3.1 ACCORDING TO AGRO-CLIMATIC REGIONS

The changes in different parameters of land use pattern, cropping pattern, production and productivity have been observed on sample farms for various agro-climatic regions viz. Vindhya Plateau, Central Narmada Valley, Jhabua Hills, Kymore Plateau & Satpura Hills, Nimar Valley, Northern Hill of Chhattisgarh, Satpura Plateau, Bundelkhand Region, Gird Region and Malwa Plateau except Chhattisgarh Plains of Madhya Pradesh

3.1.1. Land Utilization Pattern

The different parameters of land utilization pattern i.e. size of holding area under net cultivated land, non-agricultural and grazing land, other uncultivated land, current fallow and old fallow have been considered for all the agro – climatic regions of Madhya Pradesh and different size of holdings.

3.1.1.1 Vindhya Plateau

The massive change in land utilization pattern of an average farmer's field has been observed in Vindhya Plateau. The maximum decrease in area under old fallow (-100%) from 0.03 to 0.00 ha was recorded followed by other cultivable land (-50%), area under non-agricultural and grazing land (-25.00%) and current fallow (-26.32%) in the current year as compared to the base year. With the result of these the area under net cultivated land and size of holding was found to be increased by 13.48 and 1.72 per cent with 1.78 to

2.02 ha and 2.32 to 2.36 ha in the current year as compared to the base year respectively (Table 3.1). The increase in size of holding might be due to extra land could have been purchased by the farmers or inclusion of leased in land in the current year of the study.

Table 3.1: Changes occurred in land utilization pattern in Vindhya Plateau

(ha)

Particulars	The Base Year	The Current Year	% Change
Size of holding	2.32	2.36	1.72
Cultivated land	1.78	2.02	13.48
Non-agril and grazing land	0.24	0.18	-25.00
Other Uncultivated Land	0.08	0.04	-50.00
Current fallow	0.19	0.14	-26.32
Old fallow	0.03	0.00	-100

3.1.1.2 Central Narmada Valley

The area under old fallow was found to be decreased by -3.36 per cent i.e. 1.19 to 1.15 ha resulting into increase in cultivated land by 1.76 per cent i.e. from 2.27 to ha 2.31 in the current year over the base year. The change in size of holding was found to be nil in Central Narmada Valley Agro-Climatic Region (Table 3.2)

Table 3.2: Changes occurred in land utilization pattern in Central Narmada Valley

(ha)

Particulars	The Base Year	The Current Year	% Change
Size of holding	3.56	3.56	0.00
Cultivated land	2.27	2.31	1.76
Non-agri and grazing land	0.04	0.04	0.00
Other Uncultivated Land	0.06	0.06	0.00
Current fallow	0	0	0.00
Old fallow	1.19	1.15	-3.36

3.1.1.3 Jhabua Hills

In Jhabua Hills cultivated land and size of holding was found to be increased by 7.69 and 0.31 per cent with the increase in area from 2.47 (base year) to 2.66 (current year) and 3.21 (base year) to 3.22 ha (current year) respectively. This change was recorded only because of 60.71 and 2.63 per cent decrease in uncultivated waste land and non-agricultural grazing land

respectively. The other parameters of land utilization pattern remain unchanged.

Table 3.3: Changes occurred in land utilization pattern in Jhabua Hills

(ha)

Particulars	The Base Year	The Current Year	% Change
Size of holding	3.21	3.22	0.31
Cultivated land	2.47	2.66	7.69
Non-agri and grazing land	0.38	0.37	-2.63
Other Uncultivated Land	0.28	0.11	-60.71
Current fallow	0.00	0.00	0.00
Old fallow	0.08	0.08	0.00

3.1.1.4 Kymore Plateau & Satpura Hills

The area under old fallow was found to be decreased by 16.67 per cent from 0.12 to 0.10 ha. The area under non-agricultural grazing land was also found to be decreased by 12.50 per cent respectively. With the result of this cultivated land was found to be increased by 1.39 per cent. The uncultivated waste land and size of holding remained unchanged in the current year over the base year

Table 3.4: Changes occurred in land utilization pattern in Kymore Plateau & Satpura Hills

(ha)

Particulars	The Base Year	The Current Year	% Change
Size of holding	2.58	2.58	0.00
Cultivated land	2.16	2.19	1.39
Non-agri and grazing land	0.08	0.07	-12.50
Other Uncultivated Land	0.07	0.07	0.00
Current fallow	0.15	0.15	0.00
Old fallow	0.12	0.10	-16.67

3.1.1.5 Nimar Valley

The area under cultivated land was found to be increased by 3.50 per cent from 2.57 (base year) to 2.66 (current year) ha in Nimar valley. The area under non-agriculture and grazing land, other uncultivated land, current fallow and size of holding remain unchanged. The area under old fallow land was found to be decreased by 87.50 per cent due to implementation of the project in Nimar valley of Madhya Pradesh. (Table 3.5)

Table 3.5: Changes occurred in land utilization pattern in Nimar Valley

(ha)

Particulars	The Base Year	The Current Year	% Change
Size of holding	2.70	2.70	0.00
Cultivated land	2.57	2.66	3.50
Non-agri and grazing land	0.02	0.02	0.00
Other Uncultivated Land	0.01	0.01	0.00
Current fallow	0.02	0.02	0.00
Old fallow	0.08	0.01	-87.50

3.1.1.6 Northern Hills of Chhattisgarh

In Northern Hills of Chhattisgarh area under size of holding and cultivated land was found to be increased by 3.83 and 4.92 per cent respectively. The area under current fallow was decreased by 4.17 per cent in the current year as compared to the base year (Table 3.6).

Table 3.6: Changes occurred in land utilization pattern in Northern Hills of CG

(ha)

Particulars	The Base Year	The Current Year	% Change
Size of holding	2.09	2.17	3.83
Cultivated land	1.83	1.92	4.92
Non-agri and grazing land	0.01	0.01	0.00
Other Uncultivated Land	0.01	0.01	0.00
Current fallow	0.24	0.23	-4.17
Old fallow	0.00	0.00	0.00

3.1.1.7 Satpura Plateau

In satpura plateau area under old fallow was found to be decreased by 70.00 per cent, while other parameters like non-agriculture and grazing land, other uncultivated land and size of holding remain unchanged and the area under cultivated land was found to be increased by 2.49 per cent from 2.51 to 2.57 ha in current year over the base year. (Table 3.7)

Table 3.7: Changes occurred in land utilization pattern in Satpura Plateau

(ha)

Particulars	The Base Year	The Current Year	% Change
Size of holding	2.77	2.77	0.00
Cultivated land	2.51	2.57	2.49
Non-agri and grazing land	0.00	0.00	0.00
Other Uncultivated Land	0.10	0.10	0.00
Current fallow	0.07	0.07	0.00
Old fallow	0.10	0.03	-70.00

3.1.1.8 Bundelkhand Region

The area under non-agricultural and grazing land was found to be decreased by 33.33 per cent i.e. from 0.03 to 0.02 ha, while it was found to be increased by 9.17 per cent in case of size of holding. Resulting into the increase in area under cultivated land by 9.28 per cent i.e. 2.37 to 2.59 ha in current year over the base year (Table 3.8).

Table 3.8: Changes occurred in land utilization pattern in Bundelkhand Region

(ha)

Particulars	The Base Year	The Current Year	% Change
Size of holding	2.40	2.62	9.17
Cultivated land	2.37	2.59	9.28
Non-agri and grazing land	0.03	0.02	-33.33
Other Uncultivated Land	0.00	0.00	0.00
Current fallow	0.01	0.01	0.00
Old fallow	0.00	0.00	0.00

3.1.1.9 Gird Region

Amongst all the parameters of land utilization pattern the area under old fallow and non-agricultural grazing land was found to be decreased by 100.00 per cent, while uncultivated waste land and current fallow remain unchanged. The area of size of holding was found to be increased by 7.00 per cent from 2.57 to 2.75 ha resulting into increase in cultivated land by 7.42 per cent (Table 3.9).

Table 3.9: Changes occurred in land utilization pattern in Gird Region

(ha)

Particulars	The Base Year	The Current Year	% Change
Size of holding	2.57	2.75	7.00
Cultivated land	2.56	2.75	7.42
Non-agri and grazing land	0.01	0.00	-100
Other Uncultivated Land	0.00	0.00	0.00
Current fallow	0.00	0.00	0.00
Old fallow	0.01	0.00	-100.00

3.1.1.10 Malwa Plateau

In Malwa Plateau, slight change in size of holding (1.51%) resulting into increase in cultivated land by 1.17 per cent i.e. from 2.57 to 2.60 ha was noticed, while other parameters like non-agriculture & grazing land, other uncultivated land, current fallow and old fallow remain unchanged (Table 3.10)

Table 3.10: Changes occurred in land utilization pattern in Malwa Plateau

(ha)

Particulars	The Base Year	The Current Year	% Change
Size of holding	2.65	2.69	1.51
Cultivated land	2.57	2.60	1.17
Non-agri and grazing land	0.02	0.02	0.00
Other Uncultivated Land	0.04	0.04	0.00
Current fallow	0.02	0.02	0.00
Old fallow	0.01	0.01	0.00

3.1.2 Cropping Pattern

Cropping pattern is the proportion of area under various crops at a point of time as it changes over space and time. The cropping patterns of a region are closely influenced by the geo-climatic, socio-economic, historical and political factors (Hussain, M. 1996) patterns of crop land use of a region are manifestation of combined influence of physical and human environment. Differences in attitude towards the rural land in the level of prosperity and technology have produced changes in emphasis. Their effects on both landscape and land use studies are likely to be far reaching (Coppock, 1968). Weather plays a decisive role in determining the existing cropping pattern. Cropping pattern is also depending on terrain,

topography, slope, soils and availability of water for irrigation use of pesticides, fertilizers and mechanization. It is dynamic concept because no cropping pattern can be said to be ideal for all times to a particular region. It changes in space and time with a view to meet requirements and is governed largely by the physical as well as cultural and technological factors. The change in cropping pattern in particular span of time clearly indicates the changes that have taken place in the agricultural development. These changes are brought about by socio-economic influence. "In most of the situations the physical environment reduces the choice of certain crops altogether or by reducing their level (Morgan, W.B. and Munton R.J.C. 1971). The changes in cropping pattern of an average farmer have been observed in light of IWMP in the current year over the base year in different agro-climatic region.

3.1.2.1 Vindhya Plateau

The net operated area of an average farmer in Vindhya Plateau was found to be increased by 13.48 per cent from 1.78 to 2.02 ha in current year over the base year. His gross cropped area and cropping intensity was also found to be increased by 16.97 and 8.00 per cent in current year as compared to the base year. (Table 3.11) Out of gross cropped area (3.24 ha), he was found to be covered 55.54 and 44.44 per cent area in kharif and rabi season in the current year with soybean (36%) and wheat (33%) as major crops, respectively. (Fig. 3.1)

Table 3.11: Changes occurred in cropping pattern in Vindhya Plateau (ha)

Particulars	Base Year	Current Year	% Change
Soybean	1.09	1.16	6.42
Paddy	0.3	0.45	50.00
Urd	0.1	0.19	90.00
Total Kharif	**1.49**	**1.8**	**20.81**
Wheat	0.79	1.07	35.44
Gram	0.38	0.2	-47.37
Pea	0.11	0.17	54.55
Total Rabi	**1.28**	**1.44**	**12.50**
Gross Cropped Area	**2.77**	**3.24**	**16.97**
Cropping Intensity (%)	**156**	**164**	**8.00**
Net Operated area	**1.78**	**2.02**	**13.48**

The area under total kharif crops (20.81%) was found to be increased more as compared to total rabi crops (12.50%). In case of Kharif the maximum area was found to be increased in Urd crop (90.00%) followed by Paddy (50.00%) and Soybean (6.42%), while in Rabi the area under pea and wheat was found to be increased by 54.55 and 35.44%, the area under Gram was decreased by 47.37 per cent in current year over the base year.

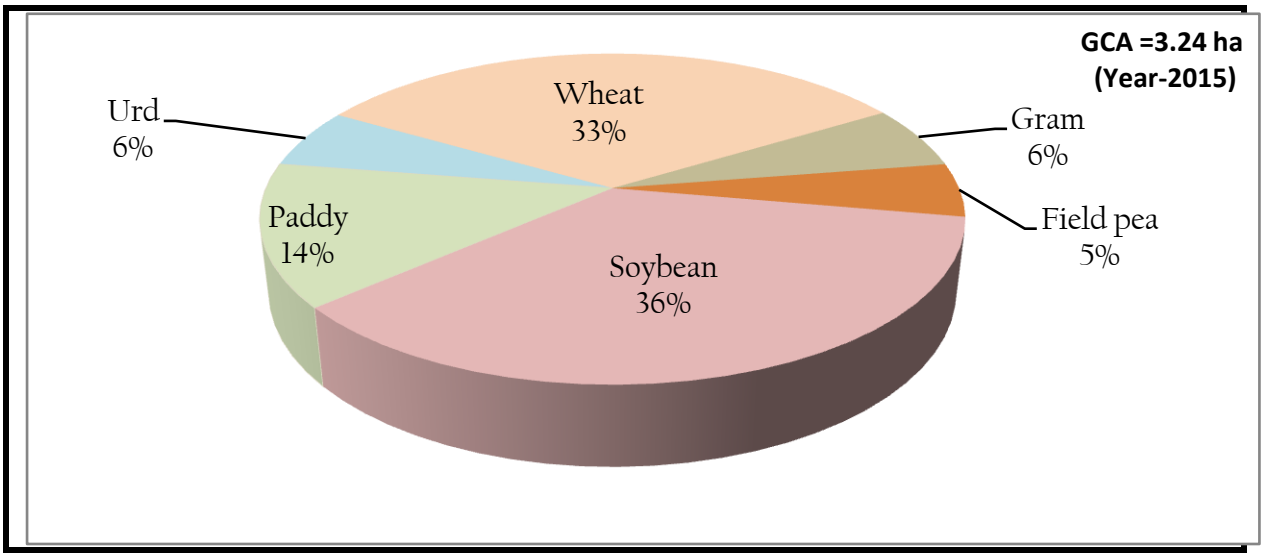

Fig 3.1: Cropping pattern of an average farmer in Vindhyan Plateau

3.1.2.2 Central Narmada Valley

Net operated area of an average farmer in Central Narmada Valley was found to be increased by 1.76 per cent from 2.27 to 2.31 ha in current year over the base year.

Table 3.12: Changes occurred in cropping pattern in Central Narmada Valley (ha)

Particulars	Base Year	Current Year	% Change
Soybean	0.61	0.55	-9.84
Paddy	0.7	0.76	8.57
Moong	0.13	0.13	0.00
Tur	0.12	0.12	0.00
Total Kharif	**1.56**	**1.56**	**0.00**
Wheat	1.12	1.2	7.14
Gram	0.51	0.4	-21.57
Sugarcan	0.28	0.43	53.57
Total Rabi	**1.91**	**2.03**	**6.28**
Gross Cropped Area	**3.47**	**3.59**	3.46
Cropping Intensity (%)	**153**	**155**	2.00
Net Operated area	**2.27**	**2.31**	1.76

His gross cropped area and cropping intensity was also found to be increased by 3.46 and 2 per cent in current year as compared to the base year. Out of gross cropped area (3.59 ha), he was found to be covered 43.45 and 56.55 per cent area in kharif and rabi season with Paddy (21%) and wheat (34%) as major crops, respectively in the current year. (Fig. 3.2) The area under total rabi crops was found to be increased by 6.28 per cent, while the area under kharif crops remain unchanged in current year over the base year (Table 3.12).

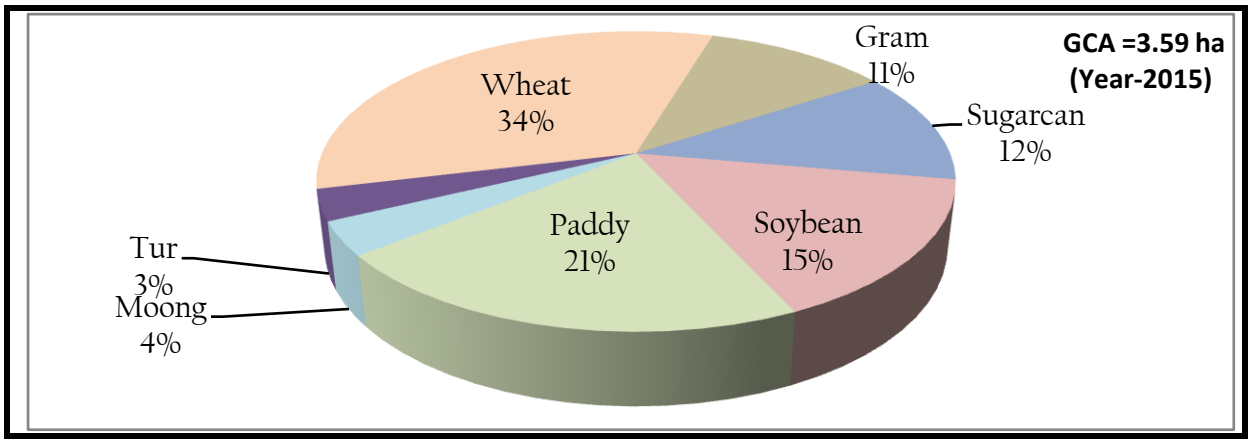

Fig 3.2: Cropping pattern of an average farmer in Central Narmada Valley

3.1.2.3 Jhabua Hills

The net operated area of an average farmer in Jhabua Hills was found to be increased by 7.69 per cent from 2.47 to 2.66 ha in current year over the base year

Table 3.13: Changes occurred in cropping pattern in Jhabua Hills (ha)

Particulars	Base Year	Current Year	% Change
Soybean	1.1	1.2	9.09
Maize	0.26	0.34	30.77
Jowar	0.05	0.03	-40.00
Bajara	0.6	0.44	-26.67
Cotton	0	0.04	∞
Total Kharif	**2**	**2.06**	**3.00**
Wheat	1.32	1.75	32.58
Gram	0.4	0.37	-7.50
Total Rabi	**1.72**	**2.11**	**22.67**
Gross Cropped Area	**3.71**	**4.17**	**12.40**
Cropping Intensity (%)	**150**	**157**	**7.00**
Net Operated area	**2.47**	**2.66**	**7.69**

His gross cropped area and cropping intensity was also found to be increased by 12.40 and 7.00 per cent in the current year as compared to the base year. Out of gross cropped area (4.17 ha), he was found to be covered 50.60 and 49.40 per cent area in rabi and kharif season with wheat (42%) and soybean (29%) as major crops, respectively in the current year. (Fig. 3.3) The area under total Rabi crops (22.67%) was found to be increased more as compared to total kharif crops (3.00%). (Table 3.13)

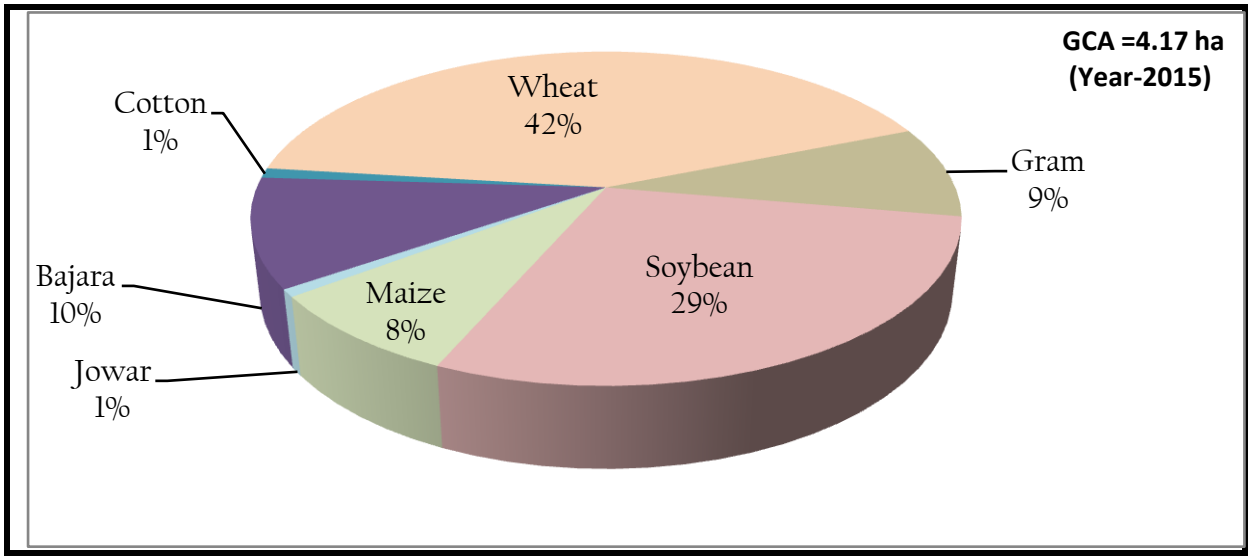

Fig 3.3: Cropping pattern of an average farmer in Jhabua Hills

The area of soybean and maize was found to be increased by 9.09 and 30.77 per cent in kharif season. The cotton was the only crop which was found to be introduced during the period of the study and its area increased by 0.00 to 0.04 ha (∞ %) in the current year over the base year, while in Rabi the area under wheat was found to be increased by 32.58%, the area under Gram was decreased by 7.50 per cent in current year over the base year.

3.1.2.4 Kymore Plateau & Satpura Hills

The net operated area of an average farmer in Kymore Plateau & Satpura Hills was found to be increased by 1.39 per cent from 2.16 to 2.19 ha in current year over the base year. His gross cropped area and cropping intensity was also found to be increased by 9.75 and 14.00 per cent in the current year as compared to the base year. Out of gross cropped area (3.94 ha), he was found to be covered 55.08 and 44.92 per cent area in kharif and

rabi season with paddy (19%) and wheat (33%) as major crops, respectively. The area under total kharif crops (15.69%) was found to be increased more as compared to total rabi crops (5.34%). The increase in area of maize was found to be maximum (83.33%) followed by paddy (19.67%) and sesame (9.09%) in kharif season, whereas the area of kodo and tur was found to be decreased by 21.43 and 9.09 per cent in this season. The area of soybean, urd, and kutki was found unchanged during the period of study (Table 3.14).

Table 3.14: Changes occurred in cropping pattern in Kymore Plateau & Satpura Hills (ha)

Particulars	Base Year	Current Year	% Change
Soybean	0.11	0.11	0.00
Paddy	0.61	0.73	19.67
Maize	0.18	0.33	83.33
Urd	0.06	0.06	0.00
Sesame	0.11	0.12	9.09
Bajara	0	0.01	∞
Kodo	0.14	0.11	-21.43
Tur	0.22	0.2	-9.09
Kutki	0.1	0.1	0.00
Total Kharif	**1.53**	**1.77**	**15.69**
Wheat	1.13	1.30	15.04
Gram	0.6	0.55	-8.33
Lentil	0.1	0.11	10.00
Pea	0.13	0.1	-23.08
Mustard	0.1	0.11	10.00
Total Rabi	**2.06**	**2.17**	**5.34**
Gross Cropped Area	**3.59**	**3.94**	**9.75**
Cropping Intensity (%)	**166**	**180**	**14**
Net Operated area	**2.16**	**2.19**	**1.39**

In case of rabi season the increase in area was found maximum in wheat (15.04%) followed by lentil (10.00%) and mustard (10.00%), and the area of gram and pea was found to be decreased by 8.33 and 23.08 per cent in the current year over the base year. Bajra was the crop which was introduced during the period under study showing infinite change.

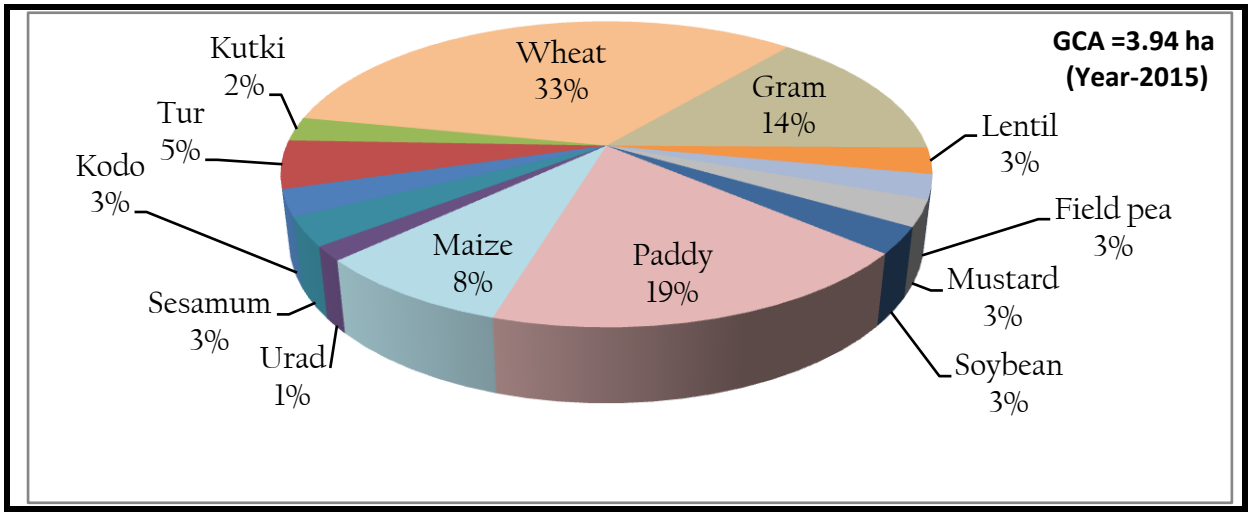

Fig 3.4: Cropping pattern of an average farmer in Kymore Plateau & Satpura Hills

3.1.2.5 Nimar Valley

The net operated area of an average farmer in Nimar Valley was found to be increased by 3.50 per cent from 2.57 to 2.66 ha in current year over the base year. His gross cropped area and cropping intensity was also found to be increased by 6.74 and 4.00 per cent in the current year as compared to the base year (Table 3.15).

Table 3.15: Changes occurred in cropping pattern in Nimar Valley (ha)

Particulars	Base Year	Current Year	% Change
Paddy	1.01	1.04	2.97
Maize	0.49	0.6	22.45
Jowar	0.07	0.08	14.29
Cotton	0.2	0.26	30
Total Kharif	**1.77**	**1.98**	**11.86**
Wheat	1.8	2.01	11.67
Gram	0.29	0.13	-55.17
Total Rabi	**2.09**	**2.14**	**2.39**
Gross Cropped Area	**3.86**	**4.12**	**6.74**
Cropping Intensity (%)	**150**	**154**	**4.00**
Net Operated area	**2.57**	**2.66**	**3.5**

Out of gross cropped area (4.12 ha), was found to be covered 51.94 and 48.05 per cent area he in kharif and rabi season with paddy (25%) and wheat (49%) as major crops, respectively. (Fig. 3.5) The area under total kharif crops (11.86%) was found to be increased more as compared to total rabi crops (2.39%) in the current year as compared to the base year.

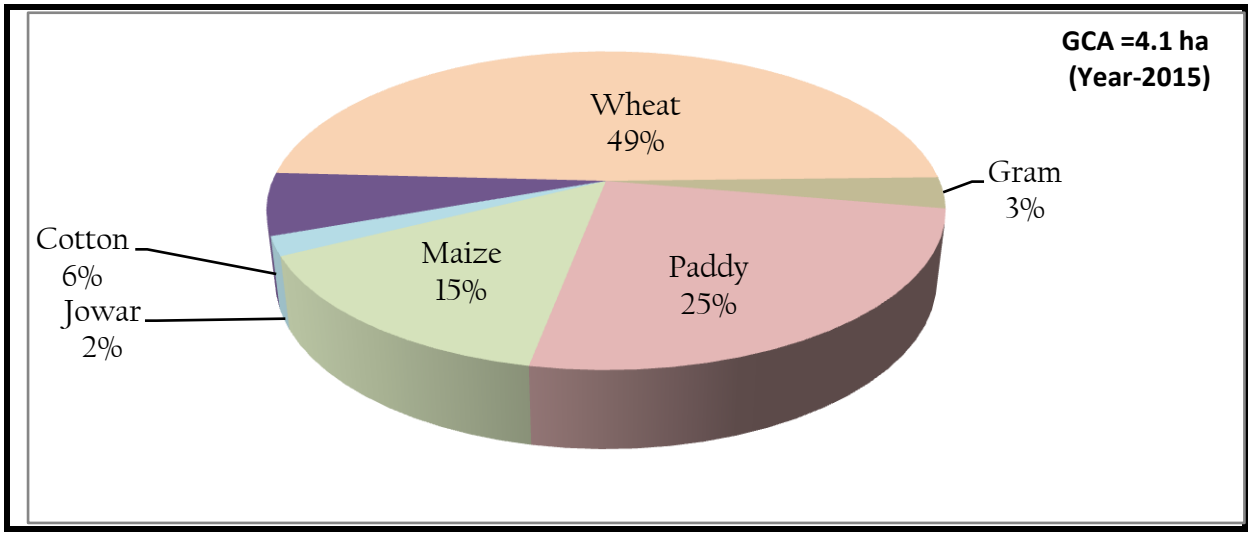

Fig 3.5: Cropping pattern of an average farmer in Nimar Valley

In case of kharif season the increase in area of cotton was found to be maximum (30.00%) followed by maize (22.45%), jowar (14.29%) and paddy (2.97%), while in case of rabi season the area of wheat (11.67%) was found to be increased and the area of gram was found to be decreased by 55.17 per cent in the current year over the base year (Table 3.15).

3.1.2.6 Northern Hills of Chhattisgarh

The net operated area of an average farmer in Northern Hills of Chhattisgarh was found to be increased by 4.92 per cent from 1.83 to 1.92 ha in current year over the base year. His gross cropped area and cropping intensity was also found to be increased by 6.92 and **3**.00 per cent in the period under study. Out of gross cropped area (3.09 ha), he was found to be covered 54.37 and 45.63 per cent area in kharif and rabi season with paddy (27%) and wheat (32%) as major crops, respectively. (Fig. 3.6) The area under total rabi crops (12.80%) was found to be increased more as compared to total kharif crops (2.44%). The area of lentil, mustard, pea and wheat was found to be increased by 150.00, 100.00, 14.29 and 11.11 per cent respectively; while in gram the area was found to be unchanged in current year over the base year (Table 3.16).

Table 3.16: Changes occurred in cropping pattern in Northern Hills of CG (ha)

Particulars	Base Year	Current Year	% Change
Paddy	0.8	0.84	5.00
Maize	0.28	0.33	17.86
Sesame	0.1	0.07	-30.00
Kodo	0.2	0.15	-25.00
Kutki	0.12	0.1	-16.67
Tur	0.07	0.1	42.86
Urd	0.07	0.09	28.57
Total Kharif	**1.64**	**1.68**	**2.44**
Wheat	0.9	1.00	11.11
Gram	0.24	0.24	0.00
Mustered	0.02	0.04	100
Lentil	0.02	0.05	150
Pea	0.07	0.08	14.29
Total Rabi	**1.25**	**1.41**	**12.8**
Gross Cropped Area	**2.89**	**3.09**	**6.92**
Cropping Intensity (%)	**157**	**160**	**3.00**
Net Opperated area	1.83	1.92	**4.92**

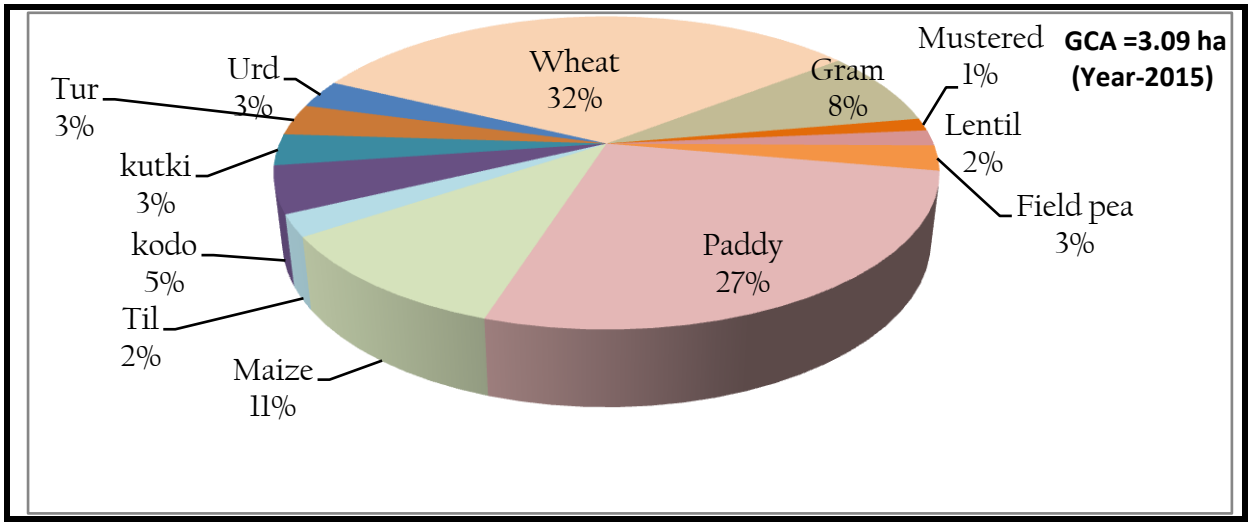

Fig 3.6: Cropping pattern of an average farmer in Northern Hills

In case of kharif season the maximum change in area was found in tur (42.86%) followed by urd (28.57%), maize (17.86%) and paddy (5.00%), and the area of sesame, kodo and kutki was found to be decreased by 30.00, 25.00 and 16.67 per cent respectively in the current year over the base year.

3.1.2.7 Satpura Plateau

The net operated area of an average farmer in Northern Hills of Chhattisgarh was found to be increased by 2.39 per cent from 2.51 to 2.57 ha in current year over the base year (Table 3.17). His gross cropped area and cropping intensity was also found to be increased by 4.56 and 4.00 per cent during the period under study. Out of gross cropped area (4.13 ha), he was found to be covered 50.12 and 51.33 per cent area in kharif and rabi season with soybean (31%) and wheat (36%) as major crops, respectively. (Fig. 3.7) The area under total rabi crops (12.17%) was found to be increased more as compared to total kharif crops (0.49%).

Table 3.17: Changes occurred in cropping pattern in Satpura Plateau (ha)

Particulars	Base Year	Current Year	% Change
Soybean	1.21	1.31	8.26
Paddy	0.19	0.11	-42.11
Maize	0.12	0.18	50.00
Jowar	0.11	0.09	-18.18
Sesame	0.1	0.09	-10.00
Urd	0.03	0.03	0.00
Tur	0.07	0.07	0.00
Kutki	0.23	0.19	-17.39
Total Kharif	**2.06**	**2.07**	**0.49**
Wheat	1.43	1.53	6.99
Gram	0.41	0.54	31.71
Pea	0.05	0.05	0.00
Total Rabi	**1.89**	**2.12**	**12.17**
Gross Cropped Area	**3.95**	**4.13**	**4.56**
Cropping Intensity (%)	**157**	**161**	**4.00**
Net Operated area	**2.51**	**2.57**	**2.39**

In case of Kharif season the maximum area was found to be increased in maize (50.00%) followed by soybean (8.26%), whereas the area of Paddy, jowar, Kutki and sesame was found to be decreased by 42.11, 18.18, 17.39 and 10.00 per cent respectively and the area of urd and tur remain unchanged in current year over the base year. The area of gram and wheat in rabi season was found to be increased by 31.71 and 6.99 per cent, while area of pea remain unchanged in current year over the base year. (Table 3.17)

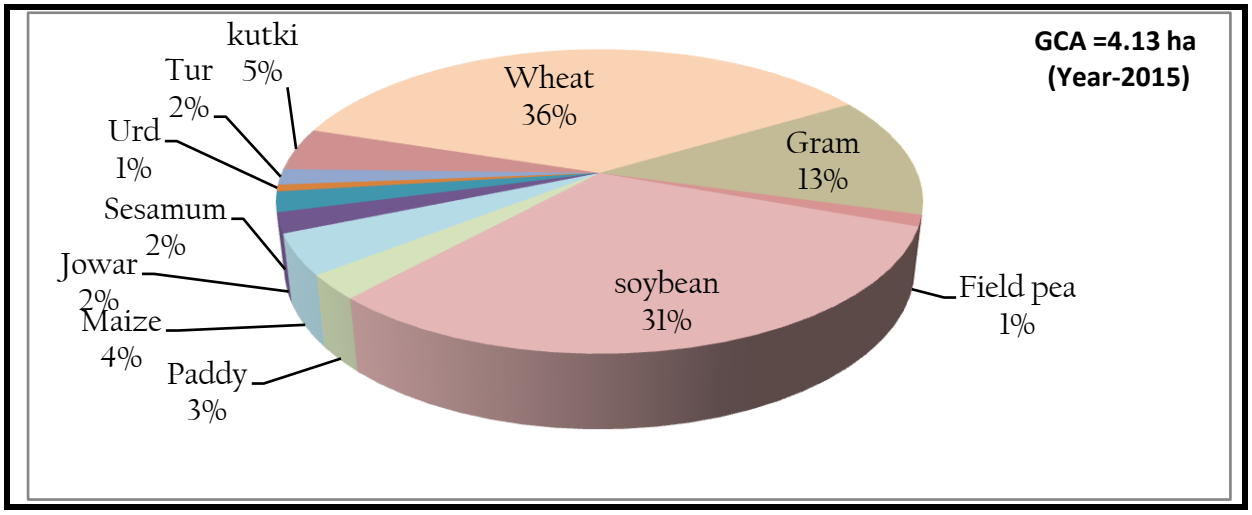

Fig 3.7: Cropping pattern of an average farmer in Satpura Plateau

3.1.2.8 Bundelkhand Region

Net operated area of an average farmer in Bundelkhand Region was found to be increased by 9.28 per cent from 2.37 to 2.59 ha in current year over the base year. His gross cropped area and cropping intensity was also found to be increased by 14.56 and 7.00 per cent during the period under study (Table 3.18).

Table 3.18: Changes occurred in cropping pattern in Bundelkhand Region

(ha)

Particulars	Base Year	Current Year	% Change
Soybean	0.87	1.13	29.89
Paddy	0	0.03	∞
Sesame	0.21	0.19	-9.52
Jowar	0.23	0.28	21.74
Bajara	0.28	0.29	3.57
Tur	0.02	0	-100.00
Urd	0.15	0.1	-33.33
Groundnut	0.06	0.09	50.00
Total Kharif	**1.82**	**2.11**	**15.93**
Wheat	1.37	1.48	8.03
Gram	0.26	0.31	19.23
Pea	0.04	0.04	0.00
Masoor	0.03	0.03	0.00
Mustered	0.19	0.28	47.37
Total Rabi	**1.89**	**2.14**	**13.23**
Gross Cropped Area	**3.71**	**4.25**	**14.56**
Cropping Intensity (%)	**157**	**164**	**7.00**
Net Operated area	**2.37**	**2.59**	**9.28**

Out of gross cropped area (4.25 ha), he was found to be covered 49.65 and 50.35 per cent area in kharif and rabi season with soybean (26%) and wheat (35%) as major crops, respectively. (Fig. 3.18) The area under total kharif crops (15.93%) was found to be increased more as compared to rabi crops (13.23%) in current year over the base year. The area under kharif season was found to be increase more in case of groundnut (50.00%) followed by soybean (29.89%), jowar (21.74%) and bajra (3.57 %), while in case of tur, sesame and urd it was found to be decreased by 100.00, 33.33 and 9.52 per cent. Paddy was introduced during the period under study showing infinite change. The area of mustard, gram and wheat in rabi season was found to be increased by 47.37, 19.23 and 8.03 per cent, the area under pea and lentil remain unchanged in current year as compared to the base year.

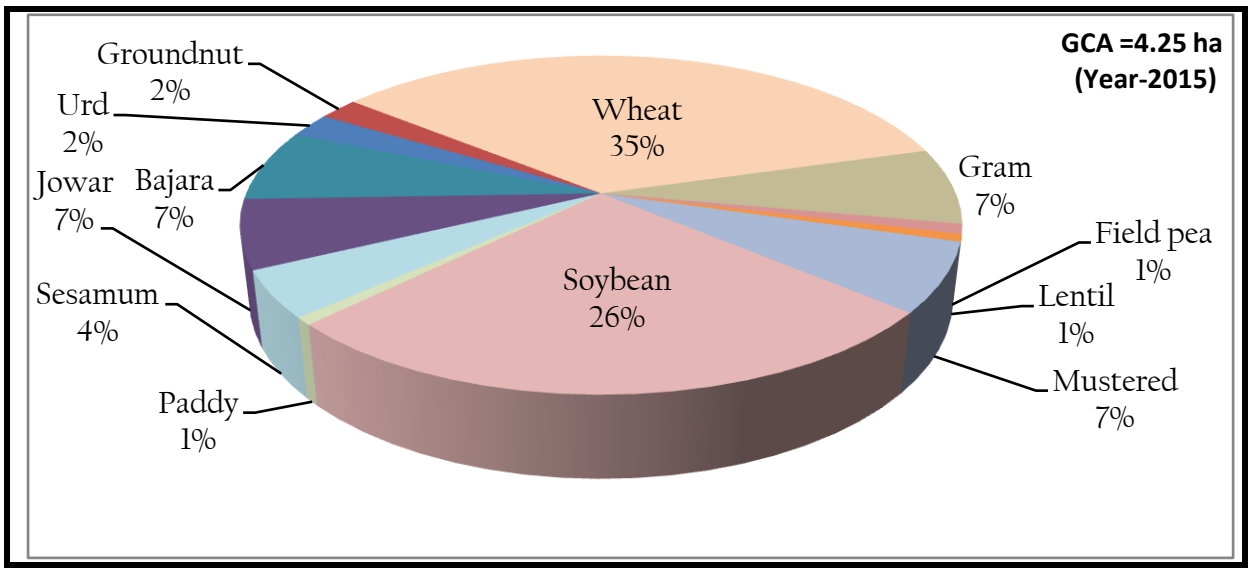

Fig 3.8: Cropping pattern of an average farmer in Bundelkhand Region

3.1.2.9 Gird Region

Net operated area of an average farmer in Gird Region was found to be increased by 7.42 per cent from 2.56 to 2.75 ha in current year over the base year (Table 3.19). His gross cropped area and cropping intensity was also found to be increased by 10.20 and 5.00 per cent. Out of gross cropped area (4.43 ha), he was found to be covered 50.11 and 49.89 per cent area in kharif and rabi season with soybean (20.32%) and wheat (30.47%) as major crops, respectively. (Fig. 3.9)

Table 3.19: Changes occurred in cropping pattern in Gird Region (ha)

Gird	Base Year	Current Year	% Change
Soybean	1.19	0.9	-24.37
Paddy	0.46	0.81	76.09
Moong	0.22	0.32	45.45
Tur	0.13	0.2	53.85
Total Kharif	**1.99**	**2.22**	**11.56**
Wheat	1.22	1.35	10.66
Gram	0.38	0.29	-23.68
Sugarcan	0.44	0.57	29.55
Total Rabi	**2.03**	**2.21**	**8.87**
Gross Cropped Area	**4.02**	**4.43**	**10.20**
Cropping Intensity (%)	**157**	**162**	**5.00**
Net Operated area	**2.56**	**2.75**	**7.42**

The area under total kharif crops (11.56%) was found to be increased more as compared to rabi crops (8.87%) in current year over the base year. The area under total kharif crops was found to be increased more in case of paddy (76.09%) followed by tur (53.85%) and moong (45.45%), while in case of soybean it was found to be decreased by 24.37 per cent (Table 3.19)

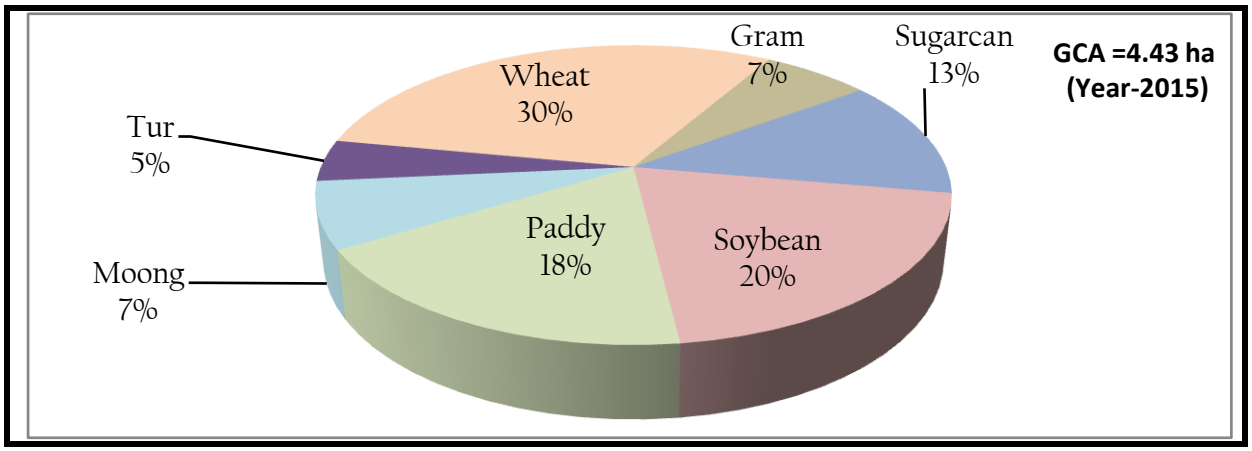

Fig 3.9: Cropping pattern of an average farmer in Gird Region

The area of wheat and sugarcane in rabi season was found to be increased by 10.66 and 29.55 per cent respectively, the area under gram was decreased by 23.68 per cent in current year as compared to the base year.

3.1.2.10 Malwa Plateau

The net operated area of an average farmer in Malwa Plateau was found to be increased by 1.17 per cent from 2.57 to 2.60 ha in current year over the base year. His gross cropped area and cropping intensity was also

found to be increased by 10.38 and 14.00 per cent in the current year as compared to the base year Out of gross cropped area (4.36 ha), he was found to be covered 58.26 and 41.74 per cent area in kharif and rabi season with soybean (27%) and wheat (30%) as major crops, respectively (Fig. 3.10).

Table 3.20: Changes occurred in cropping pattern in Malwa Plateau (ha)

Particular	Base Year	Current Year	% Change
Soybean	0.97	1.16	19.59
Paddy	0.49	0.36	-26.53
Tur	0.36	0.4	11.11
Total Kharif	**2.30**	**2.54**	**10.43**
Wheat	1.03	1.3	26.21
Gram	0.62	0.52	-16.13
Total Rabi	**1.65**	**1.82**	**10.30**
Summer Moong	**0.48**	**0.62**	**29.17**
Gross Cropped Area	**3.95**	**4.36**	**10.38**
Cropping Intensity (%)	**154**	**168**	**14.00**
Net Operated area	**2.57**	**2.60**	**1.17**

The area under total kharif crops (10.43%) was found to be increased more as compared to total rabi crops (10.30%). In case of Kharif the maximum area was found to be increased in summer moong (29.17%) followed by soybean (19.59%) and tur (11.11%) and the area of paddy was found to be decreased by 26.53 per cent in current year over the base year. The area under rabi season was found to be increased in case of wheat (26.21%), whereas it was decreased by 16.13 per cent in case of gram in current year over the base year (Table 3.20).

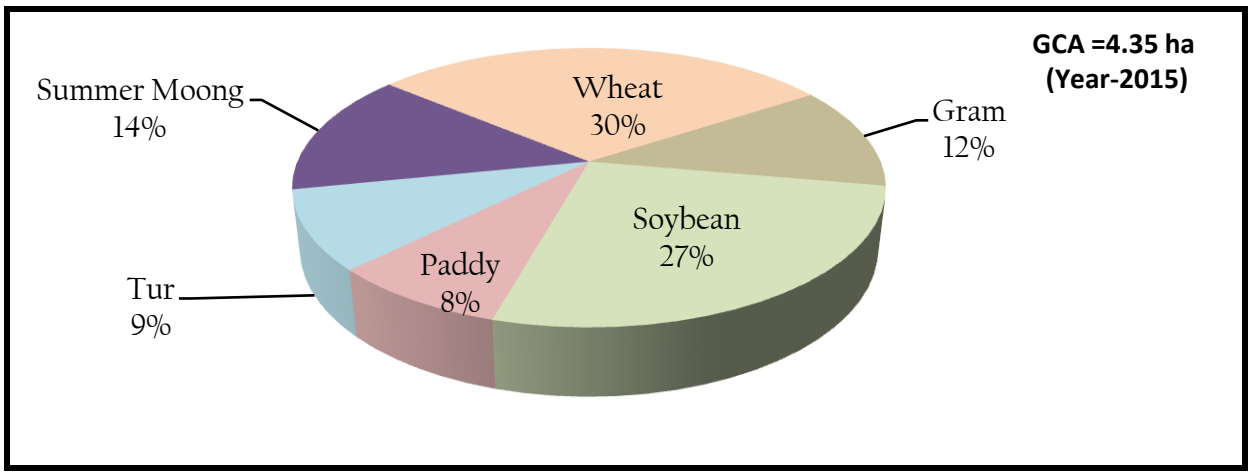

Fig 3.10: Cropping pattern of an average farmer in Malwa Plateau

3.1.3 Production

The production of various crops in kharif and rabi season have been recorded for an average farmer and analyzed across the agro-climatic regions to understand the impact of IWMP on the production of crops in the State and the same has been presented in the following sub heads.

3.1.3.1 Vindhya Plateau

The increase in production was found to be maximum in case of urd **(**114.96%**)** from 0.34 to 0.73 q followed by paddy (62.94%) from 7.68 to 12.52q, pea (62.51%) from 0.47 to 0.76q, wheat (42.00%) from 16.80 to 23.85q and soybean (8.83%) from 8.19 to 8.91q, while production of gram decreased by 44.97 per cent i.e. from 3.50 to 1.92q in the current year over the base year (Table 3.21).

Table 3.21: Changes occurred in Production in Vindhya Plateau (q/farm)

Crops	Base Year	Current Year	% Change
Soybean	8.19	8.91	8.83
Paddy	7.68	12.52	62.94
Urd	0.34	0.73	114.96
Wheat	16.80	23.85	42.00
Gram	3.50	1.92	-44.97
Pea	0.47	0.76	62.51

The decrease in production of gram was due to decrease in area under gram as mentioned in table which shows that the production was more due to horizontal expansion alarming towards the very much needed technological breakthrough thereby increase in yield by vertical expansion as average size of holding is decreasing day by day.

3.1.3.2 Central Narmada Valley

The maximum and minimum percentage increase in production was found to be 65.03 (9.04 to 14.92q) and 3.11 (1.35 to 1.39q) per cent in case of sugarcane and tur, in remaining crops of the region the production was found to be increased by 16.43, 15.63 and 12.62 per cent in case of wheat, paddy and moong respectively, while area under gram and soybean was found to be decreased by 14.14 and 4.26 per cent in the current year over the

base year. The decrease in the production was due to decrease in area under the crops during the period of study (Table 3.22).

Table 3.22: Changes occurred in Production in Central Narmada Valley

(q/farm)

Crops	Base Year	Current Year	% Change
Soybean	5.43	5.20	-4.26
Paddy	17.44	20.16	15.63
Tur	1.35	1.39	3.11
Moong	0.28	0.31	12.62
Wheat	32.44	37.76	16.43
Gram	4.57	3.93	-14.14
Sugarcan	9.04	14.92	65.03

3.1.3.3 Jhabua Hills

The production of maize, wheat and soybean was found to be increased by 56.90, 45.05 and 15.68 per cent, while decreased in jowar, bajra and gram by 39.49, 19.41 and 0.37 per cent respectively. The cotton was the only crop which was found to be introduced during the period of the study and its production increased by 0.00 to 0.60q (∞ %) in the current year over the base year (Table 3.23).

Table 3.23: Changes occurred in Production in Jhabua Hills (q/farm)

Crops	Base Year	Current Year	% Change
Soybean	6.01	6.95	15.68
Maize	3.23	5.06	56.90
Bajara	6.31	5.08	-19.41
Jowar	0.59	0.36	-39.49
Cotton	0.00	0.60	∞
Wheat	28.34	41.11	45.05
Gram	3.32	3.31	-0.37

3.1.3.4 Kymore Plateau & Satpura Hills

The increase in production of maize was found to be maximum (95.69%) followed by wheat (51.39%), paddy (29.91%), sesame (26.44%), lentil (22.42%), soybean (12.87%), urd (5.62%), kutki (5.33%) and gram (1.16%) with 19.23, 13.86 and 3.04 per cent decrease in pea, kodo and tur respectively in the current year over the base year. Bajra was the crop which was introduced during the period under study showing infinite change (Table 3.24).

Table 3.24: Changes occurred in Production in Kymore Plateau & Satpura Hills

(q/farm)

Crops	Base Year	Current Year	% Change
Soybean	0.56	0.64	12.87
Paddy	15.18	19.72	29.91
Maize	2.38	4.65	95.69
Urd	0.15	0.16	5.62
Sesame	0.60	0.76	26.44
Bajara	0.00	0.07	∞
Kodo	0.61	0.53	-13.86
Tur	1.69	1.63	-3.04
Kutki	0.51	0.53	5.33
Wheat	21.44	32.45	51.39
Gram	5.91	5.98	1.16
Lentil	0.55	0.67	22.42
Pea	0.99	0.80	-19.23
Mustard	0.78	0.91	16.89

3.1.3.5 Nimar Valley

The maximum and minimum change in production of cotton and gram was found to be 37.56 and - 49.21 per cent, while in cotton, maize, wheat and paddy the production was found to be increased by 28.37, 22.17, 16.75 and 11.57 per cent respectively. The production of gram was found to be decreased due to decrease in area under the crop in the region (Table 3.25).

Table 3.25: Changes occurred in Production in Nimar Valley (q/farm)

Crops	Base Year	Current Year	% Change
Paddy	9.07	10.12	11.57
Maize	8.21	10.54	28.37
Jowar	1.23	1.44	16.75
Cotton	2.24	3.08	37.56
Wheat	38.65	47.21	22.17
Gram	2.68	1.36	-49.21

3.1.3.6 Northern Hills of Chhattisgarh

The production of lentil and mustard was found to be increased by 170.87 and 123.04 per cent, while in other crops it ranges between 0.88 (gram) to 51.30 (Tur) per cent. The production of kodo, sesame and kutki was found

to be decreased by 23.13, 18.51 and 12.09 per cent respectively in the current year over the base year (Table 3.26).

Table 3.26: Changes occurred in Production in Northern Hills of CG (q/farm)

Crops	Base Year	Current Year	% Change
Paddy	17.40	20.17	15.91
Maize	3.44	4.57	32.71
Sesame	0.59	0.48	-18.51
Urd	0.17	0.23	35.45
Tur	0.27	0.41	51.30
kodo	1.04	0.80	-23.13
kutki	0.72	0.63	-12.09
Wheat	15.77	19.16	21.51
Gram	1.36	1.37	0.88
Lentil	0.11	0.30	170.87
Pea	0.42	0.54	29.79
Mustered	0.09	0.21	123.04

3.1.3.7 Satpura Plateau

In most of the crops the production was found to be increased which ranges between 2.06 (Sesame) to 57.12 (Maize) per cent, and decrease in production ranged between – 7.93 (Kutki) to – 33.50 (Paddy) per cent in the current year over the base year (Table 3.27).

Table 3.27: Changes occurred in Production in Northern Hills of CG (q/farm)

Crops	Base Year	Current Year	% Change
Soybean	8.39	9.68	15.45
Paddy	4.46	2.97	-33.50
Maize	1.87	2.94	57.12
Jowar	1.42	1.20	-15.58
Sesame	0.60	0.61	2.06
Urd	0.04	0.05	25.40
Tur	0.61	0.71	16.80
Kutki	0.88	0.81	-7.93
Wheat	31.39	34.67	10.45
Gram	5.28	7.21	36.62
Pea	0.29	0.31	8.76

3.1.3.8 Bundelkhand Region

The change in production of mustard was found to be maximum (61.93%) followed by groundnut (58.22 %), jowar (34.50%), gram (31.99%), wheat (22.43%), lentil (6.53%), bajra (6.07%) and pea (4.98%) and the

production of arahr, urd and sesame was found to be decreased by 100.00, 26.77 and 1.72 per cent respectively in the current year over the base year (Table 3.28).

Table 3.28: Changes occurred in Production in Bundelkhand Region

(q/farm)

Crops	Base Year	Current Year	% Change
Soybean	5.11	6.93	35.64
Paddy	0.00	0.45	∞
Sesame	0.97	0.96	-1.72
Jowar	2.19	2.95	34.50
Bajara	3.13	3.32	6.07
Tur	0.10	0.00	-100.00
Urd	0.56	0.41	-26.77
Groundnut	0.67	1.06	58.22
Wheat	33.81	41.40	22.43
Gram	1.55	2.05	31.99
Masoor	0.17	0.18	6.53
Pea	0.23	0.24	4.98
Mustered	0.81	1.31	61.93

3.1.3.9 Gird Region

The 91.74, 83.42, 78.27, 31.80 and 13.77 per cent increase in production was recorded in case of paddy, moong, tur, sugarcane and wheat, while the production of gram and soybean was found to be decreased by 17.37 and 5.91 per cent respectively in the current year over the base year (Table 3.29).

Table 3.29: Changes occurred in Production in Gird Region (q/farm)

Crops	Base Year	Current Year	% Change
Soybean	8.53	8.03	-5.91
Paddy	12.47	23.91	91.74
Tur	0.71	1.27	78.27
Moong	1.15	2.10	83.42
Wheat	41.15	46.82	13.77
Gram	4.73	3.91	-17.37
Sugarcan	4.55	5.99	31.80

3.1.3.10 Malwa Plateau

The percentage increase in production of crops ranged between 15.60 (Soybean) to 37.61 (wheat) per cent and it was found to be decreased by 14.75

and 7.65 per cent in paddy and gram respectively in the current year over the base year (Table 3.30).

Table 3.30: Changes occurred in Production in Malwa Plateau (q/farm)

Crops	Base Year	Current Year	% Change
Soybean	11.93	13.79	15.60
Paddy	4.52	3.86	-14.75
Tur	2.12	2.51	18.48
Wheat	27.50	37.84	37.61
Gram	5.64	5.21	-7.65
Summer Moong	1.91	2.59	35.67

3.1.4 Productivity

Productivity of an average farmer of major crop has also been observed across the agro-climatic regions to analyse the impact of IWMP and the same has been presented in the following sub heads.

3.1.4.1 Vindhyan Plateau

The percentage increase in productivity was found to be maximum in urd (13.14%), followed by paddy (8.63%), pea (5.15%), wheat (4.84%), gram (4.47%) and soybean (2.26%) in current year over the base year, which clearly shows the impact of IWMP on productivity/vertical expansion of various crops grown in the region (Table 3.31).

Table 3.31: Changes occurred in Productivity Vindhyan Plateau (q/ha)

Crops	Base Year	Current Year	% Change
Soybean	7.51	7.68	2.26
Paddy	25.61	27.82	8.63
Urd	3.39	3.83	13.14
Wheat	21.26	22.29	4.84
Gram	9.2	9.62	4.57
Pea	4.27	4.49	5.15

3.1.4.2 Central Narmada Valley

The productivity of crops in this region was also found to be increased and ranged between 3.11 (Tur) to 12.62 (Moong) per cent, the productivity of other crops was found to be increased by 9.48, 8.67, 7.46, 6.50 and 6.18 in case of gram, wheat, sugarcane, paddy and soybean, respectively (Table 3.32).

Table 3.32: Changes occurred in Productivity Central Narmada Valley

(q/ha)

Crops	Base Year	Current Year	% Change
Soybean	8.9	9.45	6.18
Paddy	24.91	26.53	6.50
Tur	11.25	11.6	3.11
Moong	2.14	2.41	12.62
Wheat	28.96	31.47	8.67
Gram	8.97	9.82	9.48
Sugarcan	32.29	34.7	7.46

3.1.4.3 Jhabua Hills

The maximum and minimum increase in productivity was found to be 19.98 and 0.85 per cent in maize and jowar with 9.90, 9.41, 7.71, 6.04 per cent increase in case of bajra, wheat, gram and soybean respectively while, infinite change in productivity was recorded in cotton during the period under study in current year over the base year (Table 3.33).

Table 3.33: Changes occurred in Productivity Jhabua Hills (q/ha)

Crops	Base Year	Current Year	% Change
Soybean	5.46	5.79	6.04
Maize	12.41	14.89	19.98
Bajara	10.51	11.55	9.90
Jowar	11.81	11.91	0.85
Cotton	0	14.96	∞
Wheat	21.47	23.49	9.41
Gram	8.3	8.94	7.71

3.1.4.4 Kymore Plateau & Satpura Hills

The percentage increase in productivity was found to be maximum in Sesame (15.90%) followed by wheat (14.81%), soybean (12.87%), lentil (11.29%) and gram (10.36%), while increase in productivity of remaining crops grown in the region ranged between 5.00 (Pea) to 9.63 (Kodo) per cent in current year over the base year (Table 3.34).

Table 3.34: Changes occurred in Productivity in Kymore Plateau & Satpura Hills

(q/ha)

Crops	Base Year	Current Year	% Change
Soybean	5.13	5.79	12.87
Paddy	24.89	27.02	8.56
Maize	13.2	14.09	6.74
Urd	2.49	2.63	5.62
Sesame	5.47	6.34	15.90
Bajara	0	6.96	∞
Kodo	4.36	4.78	9.63
Tur	7.66	8.17	6.66
Kutki	5.07	5.34	5.33
Wheat	18.97	21.78	14.81
Gram	9.85	10.87	10.36
Lentil	5.49	6.11	11.29
Pea	7.6	7.98	5.00
Mustard	7.82	8.31	6.27

3.1.4.5 Nimar Valley

The change in productivity was found to be maximum in gram (13.30%) and minimum in jowar (2.15%) and in remaining crops productivity ranged between 4.84 (Maize) to 9.41 (Wheat) per cent in current year over the base year (Table 3.35).

Table 3.35: Changes occurred in Productivity in Nimar Valley (q/ha)

Crops	Base Year	Current Year	% Change
Paddy	8.98	9.73	8.35
Maize	16.75	17.56	4.84
Jowar	17.64	18.02	2.15
Cotton	11.18	11.83	5.81
Wheat	21.47	23.49	9.41
Gram	9.25	10.48	13.30

3.1.4.6 Northern Hills

The percentage increase in productivity was found to be maximum in Sesame (16.41%) followed by pea (13.57%), maize (12.60%), mustard (11.52%), paddy (10.39%). The change in productivity in remaining crops ranged between 2.50 (Kodo) to 8.35 (Lentil) per cent, while minimum change was recorded to be 0.88 per cent in case of gram in current year over the base year (Table 3.36).

Table 3.36: Changes occurred in Productivity in Northern Hills of CG (q/ha)

Crops	Base Year	Current Year	% Change
Paddy	21.75	24.01	10.39
Maize	12.3	13.85	12.60
Sesame	5.91	6.88	16.41
Urd	2.43	2.56	5.35
Tur	3.89	4.12	5.91
Kodo	5.21	5.34	2.50
Kutki	6.01	6.34	5.49
Wheat	17.52	19.16	9.36
Gram	5.66	5.71	0.88
Lentil	5.51	5.97	8.35
Pea	5.97	6.78	13.57
Mustered	4.6	5.13	11.52

3.1.4.7 Satpura Plateau

The maximum increase in productivity was found to be 25.40 percent in case of urd followed by tur (16.80%), paddy (14.86%), Sesame (13.40%), kutki (11.46%). Amongst remaining crops grown in the region, the increase in productivity ranged between 3.23 (Gram) to 8.76 (Pea) per cent in current year over the base year (Table 3.37).

Table 3.37: Changes occurred in Productivity in Satpura Plateau (q/ha)

Crops	Base Year	Current Year	% Change
Soybean	6.93	7.39	6.64
Paddy	23.48	26.97	14.86
Maize	15.6	16.34	4.74
Jowar	12.89	13.3	3.18
Sesame	5.97	6.77	13.40
Urd	1.26	1.58	25.40
Tur	8.69	10.15	16.80
Kutki	3.84	4.28	11.46
Wheat	21.95	22.66	3.23
Gram	12.88	13.36	3.73
Pea	5.71	6.21	8.76

3.1.4.8 Bundelkhand Region

The productivity of major crops grown in the region by an average farmer was found to be increased by 13.33, 10.70 and 10.48 percent in case of wheat, gram and jowar respectively and ranged between 2.41 (Bajra) to 9.88 (Mustard) per cent amongst the remaining crops grown in the region in current year over the base year (Table 3.38).

Table 3.38: Changes occurred in Productivity in Bundelkhand Region

(q/ha)

Crops	Base Year	Current Year	% Change
Soybean	5.87	6.13	4.43
Paddy	0	15.15	∞
Sesame	4.64	5.04	8.62
Jowar	9.54	10.54	10.48
Bajara	11.19	11.46	2.41
Tur	4.94	0	-100.00
Urd	3.76	4.13	9.84
Groundnut	11.13	11.74	5.48
Wheat	24.68	27.97	13.33
Gram	5.98	6.62	10.70
Masoor	5.51	5.87	6.53
Pea	5.82	6.11	4.98
Mustered	4.25	4.67	9.88

3.1.4.9 Gird Region

The productivity of moong, soybean and tur was found to be increased with 26.10, 24.41 and 15.88 per cent respectively and amongst the remaining crops the increases in productivity ranged between 1.74 (Sugarcane) to 8.89 (Paddy) per cent in current year over the base year (Table 3.39).

Table 3.39: Changes occurred in Productivity in Gird Region (q/ha)

Crops	Base Year	Current Year	% Change
Soybean	7.17	8.92	24.41
Paddy	27.11	29.52	8.89
Tur	5.48	6.35	15.88
Moong	5.21	6.57	26.10
Wheat	33.73	34.68	2.82
Gram	12.45	13.48	8.27
Sugarcan	10.33	10.51	1.74

3.1.4.10 Malwa Plateau

The increase in productivity of paddy and gram was found to be 15.03 and 10.11 per cent with 5.04 (Summer Moong) to 9.03 (Wheat) per cent increase amongst the remaining crops grown in the region during the period under study, while the productivity of soybean had been decreased by 3.33 per cent in current year over the base year (Table 3.40).

Table 3.40: Changes occurred in Productivity in Malwa Plateau (q/ha)

Crops	Base Year	Current Year	% Change
Soybean	12.3	11.89	-3.33
Paddy	9.23	10.71	16.03
Tur	5.88	6.27	6.63
Wheat	26.7	29.11	9.03
Gram	9.1	10.02	10.11
Summer Moong	3.97	4.17	5.04

3.2 ACCORDING TO SIZE OF FARMS

The changes occurred in land use pattern, cropping pattern, production and productivity in different size of farms are presented in this sub head.

3.2.1 Land Use Pattern

At overall level, size of holding of an average farmer was found to be increased by 2.14 per cent in the current year as compared to the base year. The increase in size of holding might be due to extra land could have been purchased by the farmers or inclusion of leased in land in the current year (Table 3.41). The cultivated area was also found to be increased by 4.88 per cent i.e. from 2.31 (Base year) to 2.42 ha (current year). The area under uncultivated waste land, non-agriculture and grazing land, current fallow and old fallow was found to be decreased by 28.57, 14.71, 14.29 and 14.06 per cent respectively due to implementation of the IWMP in the State.

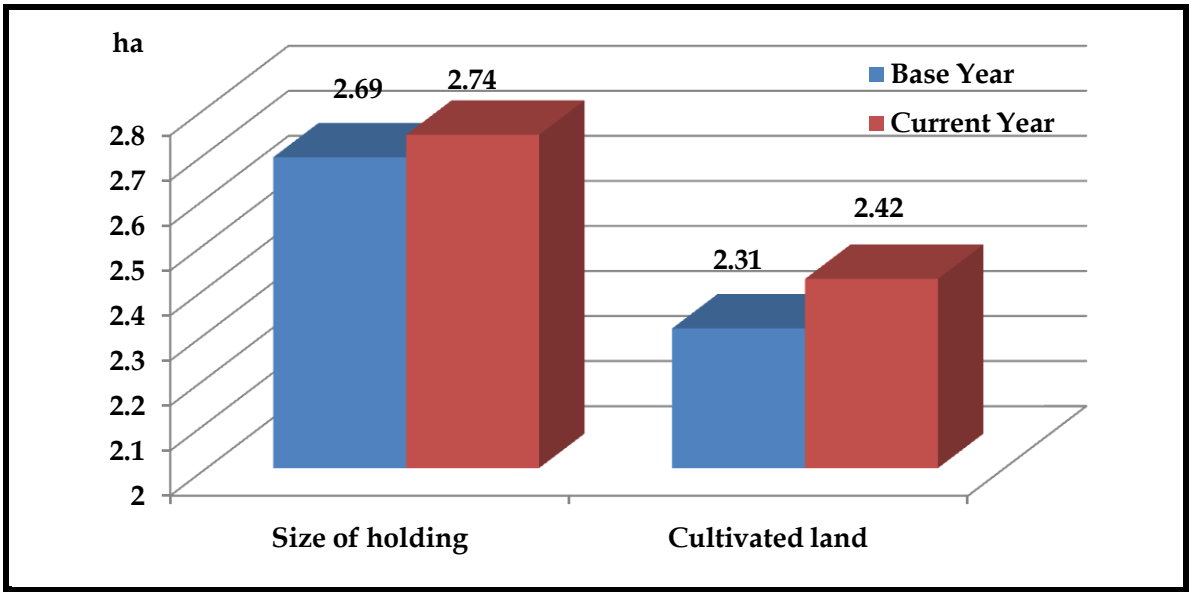

Fig. 3.11 Changes occurred in size of holding and cultivated land

The size of holding of an average medium and large size farms were found to increase by 1.89 and 3.11 per cent with no change in marginal and slight change in small (-0.71%) was recorded. The area under cultivated land was found to be increased from 0.58 to 0.59 ha, 1.34 to 1.35 ha, 2.4 to 2.51 ha and 4.86 to 5.23 ha showing 1.72, 0.75, 2.45 and 7.61 per cent increase in the current year as compared to base year on an average marginal, small, medium and large size of farms respectively.

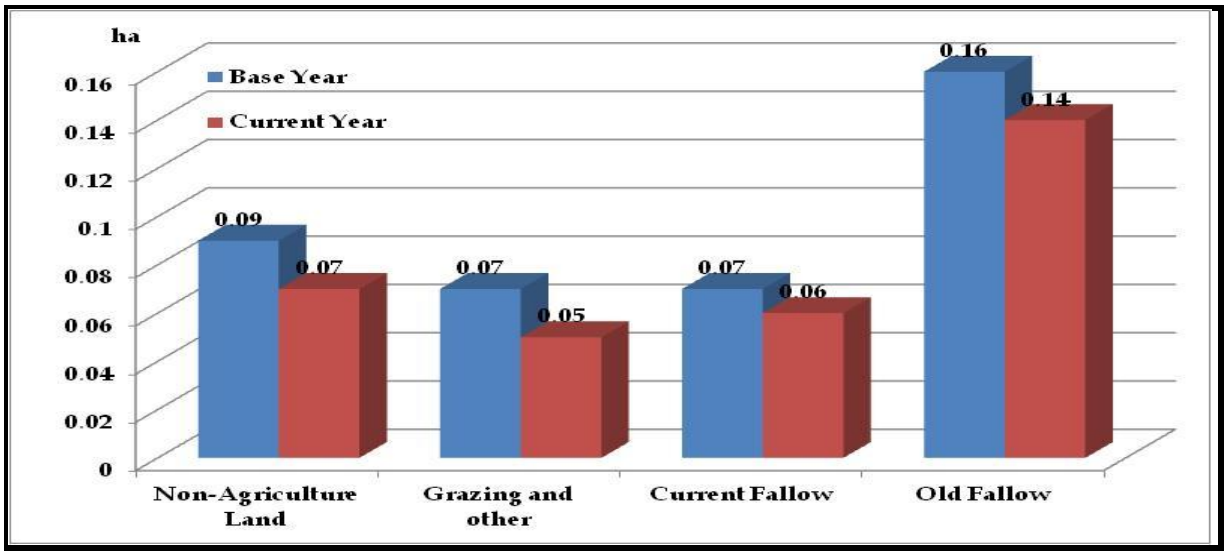

Fig. 3.12 Changes occurred in non- agricultural and fallow land

The area under non-agricultural land was found to be decreased by 66.67, 20.00 and 7.69 per cent in an average small, medium and large size of

farm respectively in the current year as compared to base year. The area under other cultivated land was remain unchanged in all size of holdings except large, which was found to be decreased by 30.77 per cent. The area under current fallow was remain unchanged across all size of holdings except in marginal and large size of farms. In case of area under old fallow, it has been decreased by 100, 12.50 and 12.73 per cent in small, medium and large size of farms respectively in the current year as compared to base year.

Table 3.41: Changes occurred in land utilization pattern in different size of farms (ha)

Particular	Marginal			Small			Medium			Large			Overall		
	Base Year	Current Year	%change	Base Year	Current Year	%change	Base Year	Current Year	%change	Base Year	Current Year	%change	Base Year	Current Year	%change
Size of holding	0.59	0.59	0.00	1.40	1.39	-0.71	2.64	2.69	1.89	6.11	6.30	3.11	2.69	2.74	2.14
Cultivated land	0.58	0.59	1.72	1.34	1.35	0.75	2.45	2.51	2.45	4.86	5.23	7.61	2.31	2.42	4.88
Non-agri and grazing land	0.00	0.00	0.00	0.03	0.01	-66.67	0.05	0.04	-20.00	0.26	0.24	-7.69	0.09	0.07	-14.71
Graging and other	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.26	0.18	-30.77	0.07	0.05	-28.57
Current fallow	0.01	0.00	-100.00	0.01	0.01	0.00	0.06	0.06	0.00	0.20	0.17	-15.00	0.07	0.06	-14.29
Old fallow	0.00	0.00	0.00	0.01	0.00	-100.00	0.08	0.07	-12.50	0.55	0.48	-12.73	0.16	0.14	-14.06

3.2.2 Cropping Pattern

The changes occurred in cropping pattern as well as cropping intensity has also been observed for various size of farms and presented in the table 3.42. It is observed from the data that cropping intensity of an average farm was found to be increased by 11 per cent from 151 (Base year) to 162 per cent (Current year) during the period under study. The net and gross cropped area was also found to be increased by 4.88 and 11.15 per cent respectively.

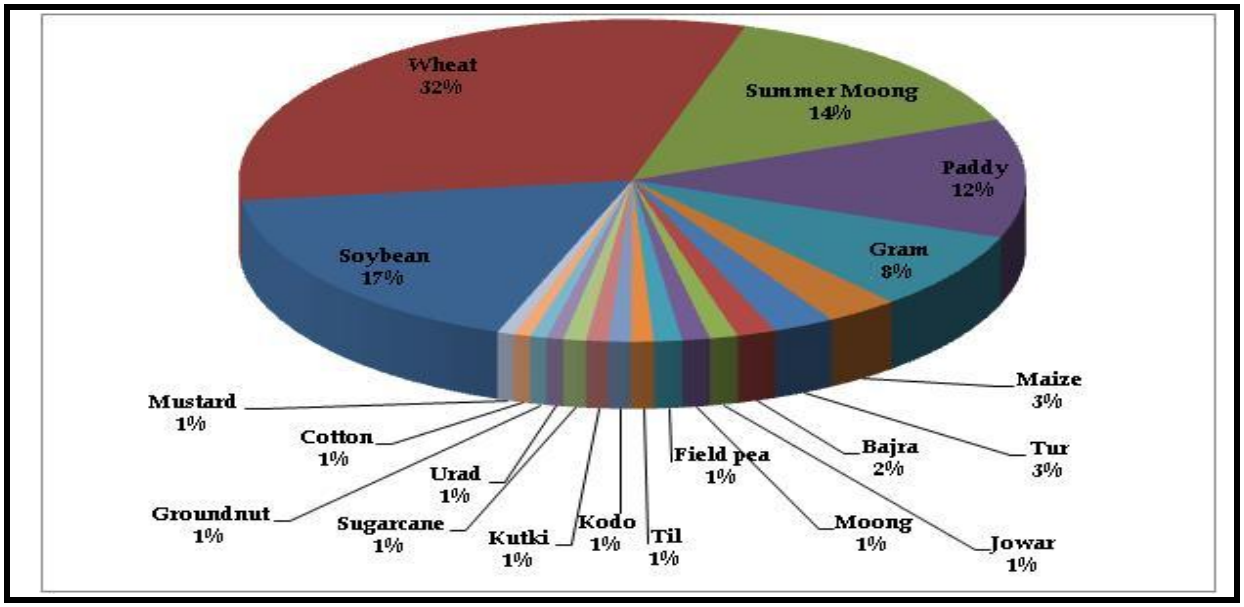

Fig. 3.13: Cropping Pattern of an average farmer.

The area under rabi crop (7.51%) showed more percentage change as compared to kharif krops (7.34%). Amongst different kharif crops the area of all the crops found to be increased except Sesame (-20.00%), bajra (-22.22%) and kutki (-20.00%). Amongst rabi crops the area of all the crops found to be increased from 14.05 per cent (Wheat) to 100 per cent (Lentil) except gram (-17.07%). The area of summer moong was also found to be increased by 67.67 per cent in the current year as compared to the base year. Amongst different size of farms the cropping intensity of medium (16.00%)farmers showed maximum change in cropping intensity as compared to small (10.00%) marginal (12.00%) and large (5.00%) size of farms. All the crops which were found to be grown by marginal farmers, the area of all the crops was found to be increased except tur (-33.33%), jowar (50.00%) and gram (41.67%). In case of small farms the area of all the crops was found to be increased except urd, tur, kodo, moong, cotton, gram and musterd while in case of medium farms the area of all the crop was increased from 8.03 per cent (Wheat) to 100 per cent (Lentil) except sesame, urd, tur, bajra,kodo, and gram. In case of large farms the maximum area was found to be increased in cotton (200%) as compared to other crops. In this particular category the area of soybean , paddy, maize ,tur , kodo, jowar, groundnut , moong, wheat, suger cane and summer moong was found to be increased while the area of sesame, bajra, kutki, gram and lentil was found to be decreased during the period under study.

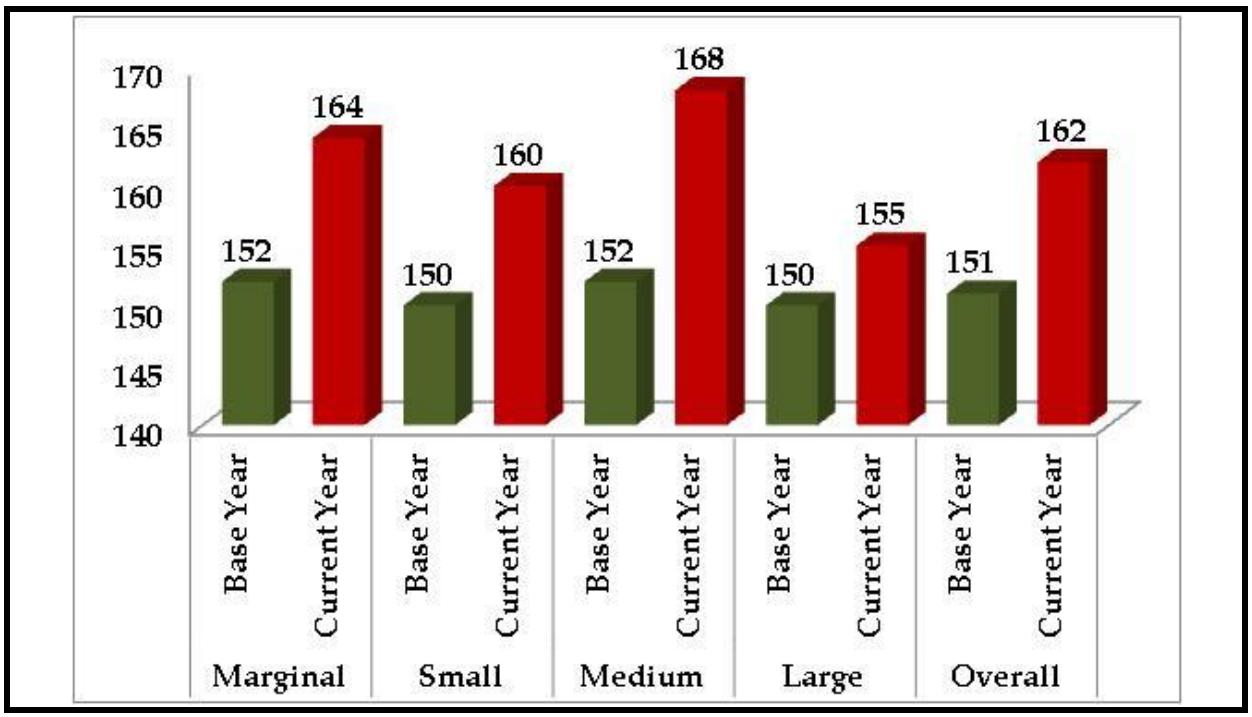

Fig. 3.14: Changes occurred in Cropping Intensity (%)

Table 3.42 Changes occurred in cropping pattern in different size of farms. **(ha)**

Crops	Marginal			Small			Medium			Large			Overall		
	BY	CY	% Change	BY	CY	% Change	BY	CY	% Change	BY	CY	% Change	BY	CY	% Change
Soybean	0.14	0.15	7.14	0.47	0.51	8.51	0.79	0.88	11.39	1.46	1.52	4.11	0.71	0.76	7.04
Paddy	0.16	0.18	12.50	0.33	0.34	3.03	0.44	0.44	0.00	1.01	1.13	11.88	0.48	0.52	8.33
Maize	0.04	0.04	0.00	0.04	0.05	25.00	0.12	0.16	33.33	0.23	0.26	13.04	0.11	0.13	18.18
Sesame	0.01	0.01	0.00	0.02	0.03	50.00	0.05	0.04	-20.00	0.12	0.09	-25.00	0.05	0.04	-20.00
Urd	0.01	0.01	0.00	0.03	0.01	-66.67	0.04	0.03	-25.00	0.05	0.05	0.00	0.03	0.03	0.00
Tur	0.03	0.02	-33.33	0.06	0.05	-16.67	0.11	0.10	-9.09	0.20	0.27	35.00	0.10	0.11	10.00
Bajra	0.01	0.02	100.00	0.03	0.04	33.33	0.12	0.09	-25.00	0.19	0.15	-21.05	0.09	0.07	-22.22
Kodo	0.00	0.00	0.00	0.03	0.02	-33.33	0.06	0.05	-16.67	0.05	0.08	60.00	0.03	0.04	33.33
Kutki	0.00	0.00	0.00	0.01	0.01	0.00	0.04	0.05	25.00	0.13	0.09	-30.77	0.05	0.04	-20.00
Jowar	0.02	0.01	-50.00	0.03	0.03	0.00	0.04	0.04	0.00	0.09	0.11	22.22	0.05	0.05	0.00
Groundnut	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.10	66.67	0.02	0.03	50.00
Moong	0.01	0.02	100.00	0.03	0.01	-66.67	0.04	0.07	75.00	0.06	0.09	50.00	0.03	0.05	66.67
Cotton	0.00	0.01	∞	0.02	0.01	-50.00	0.04	0.07	75.00	0.01	0.03	200.00	0.02	0.03	50.00
Total Kharif	**0.43**	**0.47**	**9.30**	**1.10**	**1.11**	**0.91**	**1.89**	**2.02**	**6.88**	**3.66**	**3.97**	**8.47**	**1.77**	**1.90**	**7.34**
Wheat	0.29	0.36	24.14	0.69	0.76	10.14	1.37	1.48	8.03	2.55	2.91	14.12	1.21	1.38	14.05
Gram	0.12	0.07	-41.67	0.20	0.15	-25.00	0.34	0.28	-17.65	0.97	0.84	-13.40	0.41	0.34	-17.07
Lentil	0.00	0.00	0.00	0.02	0.02	0.00	0.01	0.02	100.00	0.06	0.04	-33.33	0.01	0.02	100.00
Pea	0.01	0.02	100.00	0.02	0.03	50.00	0.03	0.04	33.33	0.11	0.11	0.00	0.04	0.05	25.00
Mustard	0.02	0.02	0.00	0.04	0.02	-50.00	0.04	0.06	50.00	0.07	0.07	0.00	0.03	0.03	0.00
Sugarcane	0.00	0.00	0.00	0.00	0.01	∞	0.03	0.05	66.67	0.08	0.11	37.50	0.03	0.04	33.33
Total Rabi	**0.44**	**0.47**	**6.82**	**0.97**	**0.99**	**2.06**	**1.82**	**1.93**	**6.04**	**3.84**	**4.08**	**6.25**	**1.73**	**1.86**	**7.51**
Summer Moong	**0.14**	**0.14**	0.00	**0.35**	**0.41**	17.14	**0.53**	**0.8**	50.94	**0.9**	**1.12**	24.44	0.37	0.62	67.57
Gross Cropped Area	0.88	0.97	10.23	2.01	2.16	7.46	3.72	4.21	13.17	7.29	8.11	11.25	3.48	3.86	11.15
Net Operated Area	0.58	0.59	1.72	1.34	1.35	0.75	2.45	2.51	2.45	4.86	5.23	7.61	2.31	2.42	4.88
Cropping Intensity (%)	152	164	12.00	150	160	10.00	152	168	16.00	150	155	5.00	151	162	11.00

3.2.3 Productivity

The productivity in major kharif crops like soybean, paddy, maize and tur was found to be ranged between 7.65 (Large) to 8.40 (Medium), 21.74 (Large) to 22.38 (Medium), 15.26 (Large) to 15.94 (Medium) and 7.58 (Large) to 8.26 (Medium) quintal per ha respectively in the current year of the study.

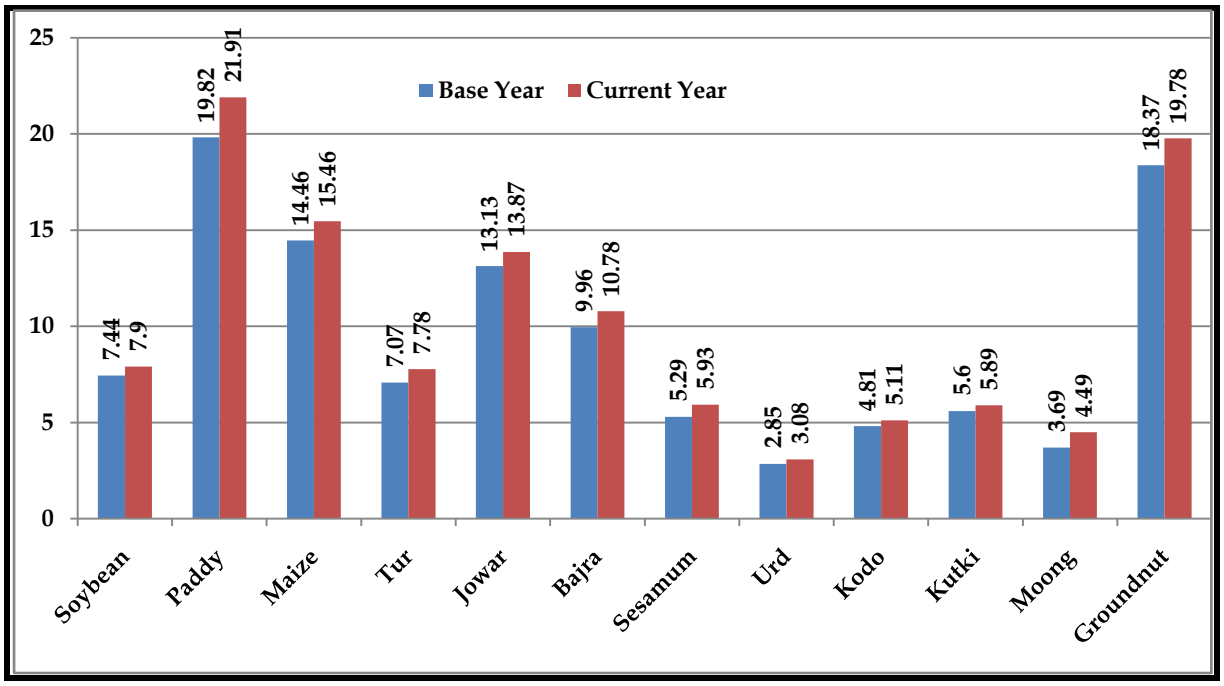

Fig. 3.15: Changes occurred in Productivity of Kharif Crops (q/ha)

The maximum increase in productivity of moong, Sesame, paddy and tur was found to be 21.60, 12.06, 10.56 and 10.01 per cent respectively while, amongst the remaining crops grown in the region the change in productivity ranged between 3.10 (Pea) to 9.57 (Lentil) per cent at overall level of different size of holding (Table 3.43).

The change in productivity across different size of holdings ranged between 19.61 (Medium) to 23.10 (Large) per cent in moong, 9.21 (Small) to 14.94 (Marginal) per cent in Sesame, 8.33 (Medium) to 14.00 (marginal) per cent in tur and 10.25 (Medium) to 10.79 (Large) per cent in paddy.

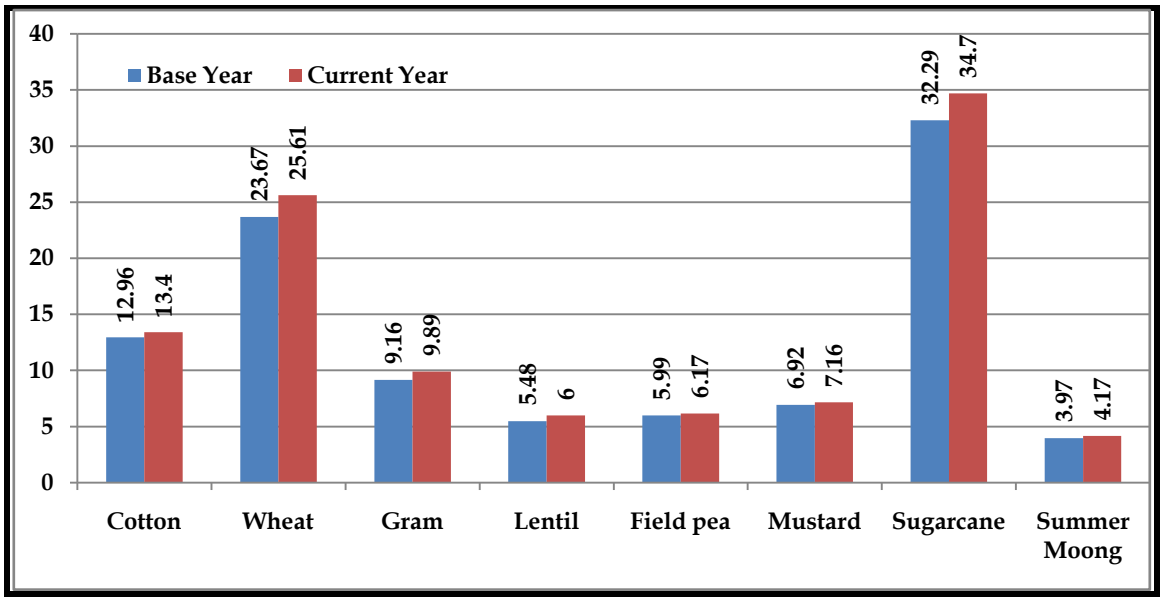

Fig. 3.16: Changes occurred in Productivity of Rabi Crops (q/ha)

The productivity in major kharif crops like soybean, paddy, maize and tur was found to be ranged between 7.65 (Large) to 8.40 (Medium), 21.74 (Large) to 22.38 (Medium), 15.26 (Large) to 15.94 (Medium) and 7.58 (Large) to 8.26 (Medium) quintal per ha respectively in the current year of the study.

The productivity of major rabi crops viz. wheat, gram, lentil and pea was found to be ranged between 25.40 (Marginal) to 26.04 (Medium), 9.57 (Marginal) to 10.41 (Medium), 5.95 (Marginal) to 6.55 (Medium) and 5.63 (Marginal) to 6.58 (Medium) quintal per ha respectively in the current year of the study.

Table 3.43 Changes occurred in Productivity in different size of farms. (q/ha)

Crops	Marginal		% Change	Small		% Change	Medium		% Change	Large		% Change	Overall		% Change
	BY	CY		BY	CY		BY	CY		BY	CY		BY	CY	
Soybean	7.31	7.76	6.22	7.29	7.80	6.97	7.89	8.40	6.44	7.29	7.65	4.91	7.44	7.90	6.14
Paddy	19.65	21.74	10.64	19.70	21.78	10.56	20.30	22.38	10.25	19.63	21.74	10.78	19.82	21.91	10.56
Maize	14.29	15.30	7.05	14.34	15.34	6.95	14.94	15.94	6.68	14.27	15.26	6.92	14.46	15.46	6.90
Tur	6.68	7.62	14.00	7.02	7.66	9.04	7.62	8.26	8.33	6.95	7.58	8.99	7.07	7.78	10.01
Jowar	12.81	13.37	4.40	12.86	14.21	10.53	13.46	13.76	2.23	13.40	14.13	5.45	13.13	13.87	5.61
Bajra	10.68	9.89	-7.40	10.73	11.39	6.10	11.33	11.99	5.78	7.11	9.85	38.60	9.96	10.78	8.19
Sesame	4.89	5.62	14.94	5.25	5.73	9.21	5.53	6.17	11.57	5.51	6.21	12.70	5.29	5.93	12.06
Urd	2.96	3.24	9.64	2.75	2.97	7.99	3.35	3.54	5.47	2.33	2.57	10.31	2.85	3.08	8.15
Kodo	0.00	0.00	0.00	4.64	4.94	6.58	5.24	5.54	5.83	4.57	4.86	6.46	4.81	5.11	6.27
Kutki	0.00	0.00	0.00	5.42	5.72	5.54	6.02	6.32	4.98	5.35	5.64	5.42	5.60	5.89	5.30
Moong	3.58	4.33	21.12	3.56	4.37	22.93	4.16	4.97	19.61	3.49	4.29	23.10	3.69	4.49	21.60
Groundnut	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.28	19.68	7.69	18.37	19.78	7.68
Cotton	0.00	13.23	∞	11.06	13.22	19.48	11.66	13.84	18.70	10.99	11.63	5.82	12.96	13.40	3.36
Wheat	23.46	25.40	8.30	23.57	25.48	8.12	24.13	26.04	7.92	23.52	25.51	8.43	23.67	25.61	8.19
Gram	8.99	9.57	6.35	9.04	9.81	8.48	9.64	10.41	7.98	8.97	9.78	8.96	9.16	9.89	7.94
Lentil	0.00	0.00	0.00	5.32	5.60	5.20	5.89	6.55	11.09	5.22	5.87	12.32	5.48	6.00	9.57
Pea	5.65	5.63	-0.41	5.82	6.30	8.32	6.74	6.58	-2.34	5.75	6.19	7.66	5.99	6.17	3.10
Mustard	6.57	7.00	6.47	7.35	7.04	-4.24	7.22	7.64	5.75	6.55	6.96	6.18	6.92	7.16	3.37
Sugarcane	0.00	0.00	0.00	0.00	34.53	∞	32.62	35.13	7.69	31.95	34.45	7.82	32.29	34.70	7.49
Summer Moong	3.80	4.01	5.53	3.85	4.05	5.19	4.45	4.65	4.49	3.78	3.97	5.03	3.97	4.17	5.04

3.2.4 Production

As a result of increase in area and productivity of the crops the production was also found to be increased from 3.47 (Mustard) to 118.98 (Lentil) per cent in the current year as compared to the base year. At overall level the change in production of lentil was found to be maximum (118.98%) followed by moong (102.80%), cotton (61.51%), Zaid Moong (57.56%), cotton (55.09%), sugarcane (43.28%), kodo (41.65%), pea (28.76%), maize (26.35%), wheat (23.40%), tur (21.05%), paddy (19.76%), soybean (13.666%), urd (8.07%), jowar (5.64%) and mustard (3.47%), while the production of kutki, bajra, gram, and sesame was found to be decreased by 15.86, 15.82, 10,46 and 10.32 per cent respectively in the current year over the base year (Table 3.44). The change in production of soybean in terms of percentage ranged between 9.25 (large) to 18.59 (Medium), paddy 10.25 (medium) to 24.47 (marginal), maize 7.07 (Marginal) to 42.26 (Medium), tur -1.46 (medium) to 47.24 (Large), jowar -47.81 (Marginal) to 28.88 (large), bajra -20.63 (medium) to 85.21 (marginal), sesame -10.74 (medium) to 63.71 (small), urd -64.00 (small) to 10.30 (large), kodo -29.02 (small) to 70.15 (large), kutki -27.02 (large) to 31.23 (medium), moong -59.08 (small) to 141.90 (marginal), groundnut , cotton -40.24 (small) to infinite (marginal), wheat 16.58 (medium) to 34.40 (marginal), gram -37.90 (marginal) to -5.58 (large), lentil -25.03 (large) to 122.41 (medium), pea 7.65 (large) to 99.29 (marginal), mustard -52.11 (small) to 58.73 (medium), sugarcane 0.00 (marginal) to infinite (small) and zaid moong 5.53 (marginal) to 110.39 (small).

Table 3.44 Changes occurred in Production in different size of farms. (ha)

Crops	Marginal		% Change	Small		% Change	Medium		% Change	Large		% Change	Overall		% Change
	BY	CY		BY	CY		BY	CY		BY	CY		BY	CY	
Soybean	1.02	1.16	13.74	3.43	3.98	16.10	6.23	7.39	18.59	10.64	11.63	9.25	5.28	6.00	13.66
Paddy	3.14	3.91	24.47	6.50	7.41	13.91	8.93	9.85	10.25	19.83	24.57	23.91	9.51	11.39	19.76
Maize	0.57	0.61	7.07	0.57	0.77	33.72	1.79	2.55	42.26	3.28	3.97	20.89	1.59	2.01	26.35
Tur	0.20	0.15	-23.95	0.42	0.38	-9.07	0.84	0.83	-1.46	1.39	2.05	47.24	0.71	0.86	21.05
Jowar	0.26	0.13	-47.81	0.39	0.43	10.50	0.54	0.55	2.23	1.21	1.55	28.88	0.66	0.69	5.64
Bajra	0.11	0.20	85.21	0.32	0.46	41.53	1.36	1.08	-20.63	1.35	1.48	9.37	0.90	0.75	-15.82
Sesame	0.05	0.06	14.93	0.11	0.17	63.71	0.28	0.25	-10.74	0.66	0.56	-15.47	0.26	0.24	-10.32
Urd	0.03	0.03	9.46	0.08	0.03	-64.00	0.13	0.11	-20.75	0.12	0.13	10.30	0.09	0.09	8.07
Kodo	0.00	0.00	0.00	0.14	0.10	-29.02	0.31	0.28	-11.90	0.23	0.39	70.15	0.14	0.20	41.65
Kutki	0.00	0.00	0.00	0.05	0.06	5.54	0.24	0.32	31.23	0.70	0.51	-27.02	0.28	0.24	-15.86
Moong	0.04	0.09	141.90	0.11	0.04	-59.08	0.17	0.35	109.07	0.21	0.39	84.38	0.11	0.22	102.80
Groundnut	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	1.97	79.43	0.37	0.59	61.51
Cotton	0.00	0.13	∞	0.22	0.13	-40.24	0.47	0.97	107.72	0.11	0.35	217.47	0.26	0.40	55.09
Wheat	6.80	9.14	34.40	16.26	19.36	19.07	33.06	38.54	16.58	59.98	74.23	23.77	28.64	35.34	23.40
Gram	1.08	0.67	-37.90	1.81	1.47	-18.61	3.28	2.91	-11.07	8.70	8.22	-5.58	3.76	3.36	-10.46
Lentil	0.00	0.00	0.00	0.11	0.11	5.26	0.06	0.13	122.41	0.31	0.23	-25.03	0.05	0.12	118.98
Pea	0.06	0.11	99.29	0.12	0.19	62.37	0.20	0.26	30.17	0.63	0.68	7.65	0.24	0.31	28.76
Mustard	0.13	0.14	6.54	0.29	0.14	-52.11	0.29	0.46	58.73	0.46	0.49	6.26	0.21	0.21	3.47
Sugarcane	0.00	0.00	0.00	0.00	0.35	∞	0.98	1.76	79.49	2.56	3.79	48.26	0.97	1.39	43.28
Summer Moong	0.04	0.04	5.53	0.08	0.16	110.39	0.22	0.37	67.19	0.26	0.44	65.04	0.16	0.25	57.56

CHAPTER IV

YIELD GAP, ADOPTION OF TECHNOLOGIES AND CONSTRAINTS IN CROP CULTIVATION

This chapter deals with the yield gap analysis and adoption of different technologies of crop cultivation across various size of holdings. An attempt has also been made to find out the constraints in cultivation of crops as reported by various categories of farmers.

4.1 Yield Gap Analysis

The yield gap analysis was done for all the kharif (Soybean, Paddy & Maize) and Rabi (Wheat & Gram) crops grown by the majority of farmers in area under study. The yield gap analysis was carried out for an average size of farm across various agro-climatic regions and state as a whole. The results obtained did not show any remarkable change in yield gap on sample farms amongst various agro-climatic regions. Hence, results of yield gap of various crops for the State are being presented in this section.

4.1.1 Soybean

The soybean was found to be major Kharif crop of the study area grown in almost all the agro-climatic regions of Madhya Pradesh (Vindhyan Plateau, Satpura Plateau, Nimar Valley, Central Narmda, Malwa Plateau, Kymore Plateau, Jhabua Hills, Gird Region, Bundelkhand region) except Northern Hills of Chhattisgarh.

Table 4.1: Yield gap analysis of Soybean in Madhya Pradesh (%)

Particulars	Marginal	Small	Medium	Large	Average
Potential Yield (q/ha)	15	15	15	15	15
Highest Farm Yield (q/ha)	11.73	11.77	12.37	11.69	11.89
Average Farm Yield (q/ha)	7.76	7.8	8.4	7.65	7.9
Yield Gap-I	21.8	21.5	17.5	22.1	20.7
Yield Gap-II	33.84	33.73	32.09	34.56	33.56
Yield Gap-III	48.27	48.00	44.00	49.00	47.33

On an average soybean grower's farms a considerable yield gap (III) of 47.33 per cent was found between potential (15 q/ha) and average farmer yield (7.9 q/ha). Out of this total yield gap (yield gap-III), a gap of 20.7 (yield gap-I), and 33.56 per cent (yield gap-II), was found between potential (15

q/ha) & highest farm yield (11.89 q/ha), and highest & average farm yield (7.9 q/ha), respectively. The yield gap-I denotes that the recommended packages of practices (RPP) of soybean yet not been found to be transferred fully to an average soybean grower's farmer due to difference in soil and climatic conditions in experimental field and farmer's field, while yield gap II was found due to various socio-economic constraints present in the study area. Amongst different size of farms yield gap I, II and III were found less in medium size of farm as compared to other size of farms (Table 4.1).

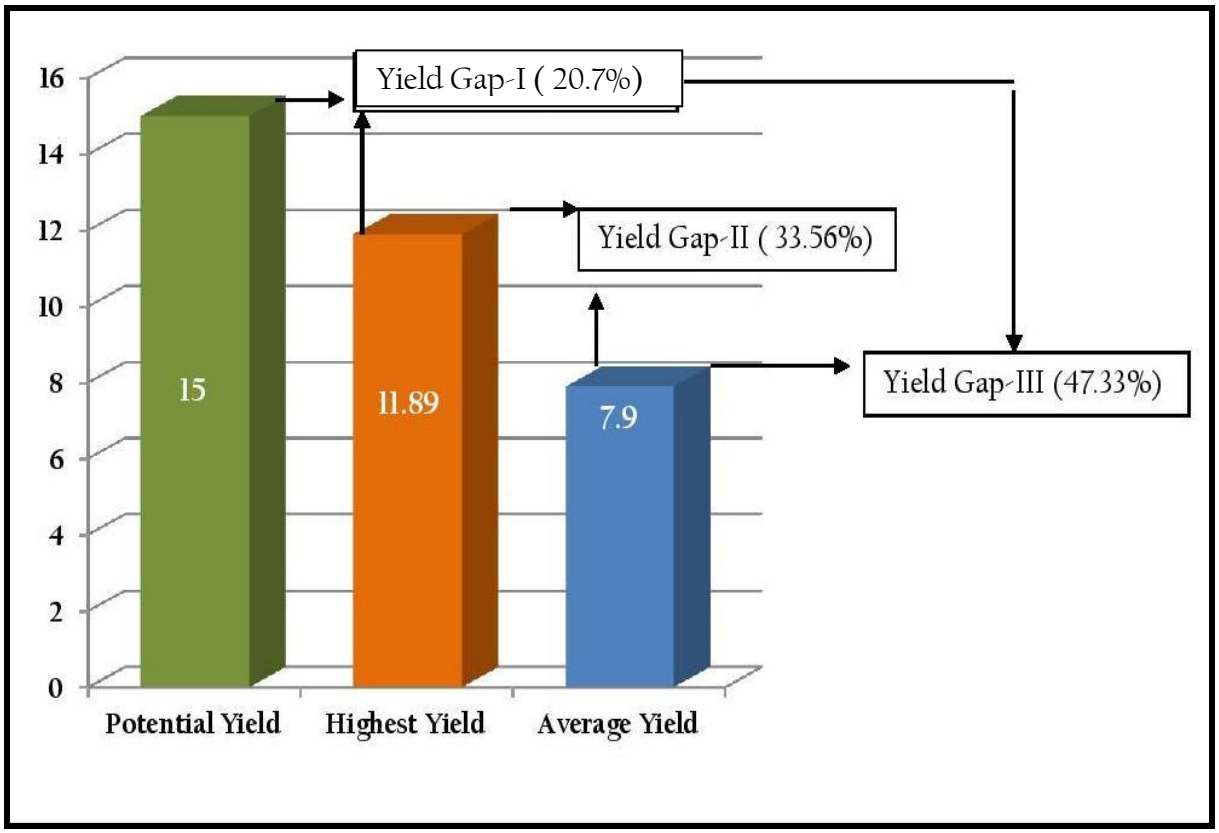

Fig 4.1 : Yield gap in Soybean

4.1.2 Paddy

The Paddy was found to be another major Kharif crop of the State which is grown in all the agro-climatic regions of Madhya Pradesh viz. Vindhyan Plateau, Satpura Plateau, Nimar Valley, Central Narmda, Malwa Plateau, Kymore Plateau, Jhabua Hills, Gird Region, Bundelkhand region and Northern Hills of Chhattisgarh. The yield gap analysis of paddy across various size of holding was carried out and results obtained are presented in table 4.2.

Table 4.2: Yield gap analysis of Paddy in Madhya Pradesh (%)

Particulars	Marginal	Small	Medium	Large	Average
Potential Yield (q/ha)	30	30	30	30	30
Highest Farm Yield (q/ha)	29.36	29.4	30	29.32	29.52
Average Farm Yield (q/ha)	21.05	21.78	21.69	21.74	21.24
Yield Gap-I	2.1	2.0	0.0	2.3	1.6
Yield Gap-II	28.30	25.92	27.70	25.85	28.05
Yield Gap-III	29.83	27.40	27.70	27.53	29.20

On an average paddy grower's farms the yield gap (III) was found to be 29.20 per cent between potential (30 q/ha) and average farmer yield (21.24 q/ha). Out of this total yield gap (yield gap-III), a gap of only 1.6 (yield gap-I) and 28.05 per cent (yield gap-II), was found between potential (30 q/ha) & highest farm yield (29.52 q/ha), and highest & average farm yield (21.24 q/ha), respectively. The yield gap-I denotes that the paddy production recommended packages of practices (RPP) yet not been found to transfer fully to an average paddy grower's farm due to soil and climatic difference in experimental field and farmer's field, while yield gap II was found due various socio-economic constraints present in the study area. Amongst different size of farms the yield gaps were found to be more in marginal as compared to other size of farms.

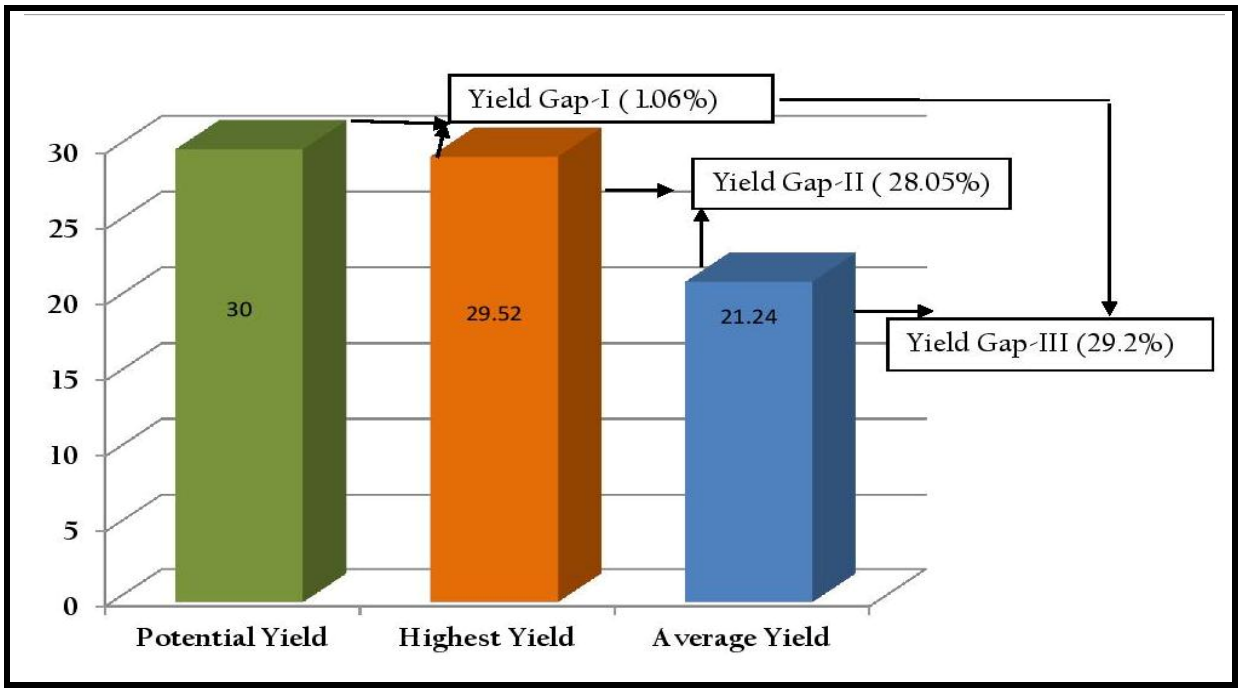

Fig 4.2 : Yield gap in Paddy

4.1.3 Maize

The maize is also considered as a major Kharif crop of the study area and found to be grown in Northern Hills, Kymore Plateau, Satpura Plateau and Nimar Valley by farmers. The yield gap analysis of maize was performed and results obtained are presented in table 4.3.

Table 4.3: Yield gap analysis of Maize in Madhya Pradesh (%)

Particulars	Marginal	Small	Medium	Large	Average
Potential Yield (q/ha)	20	20	20	20	20
Highest Farm Yield (q/ha)	17.4	17.44	18.04	17.36	17.56
Average Farm Yield (q/ha)	15.3	15.34	15.94	15.26	15.46
Yield Gap-I	13.0	12.8	9.8	13.2	12.2
Yield Gap-II	12.07	12.04	11.64	12.10	11.96
Yield Gap-III	23.50	23.30	20.30	23.70	22.70

On an average maize grower's farms a considerable yield gap (III) of 22.70 per cent between potential (20 q/ha) and average farm yield (15.46 q/ha) was recorded. Out of this total yield gap (yield gap-III), a gap of 12.2 (yield gap-I), and 11.96 per cent (yield gap-II) was found between potential (20 q/ha) & highest farm yield (17.56 q/ha), and highest & average farm yield (15.46 q/ha), respectively.

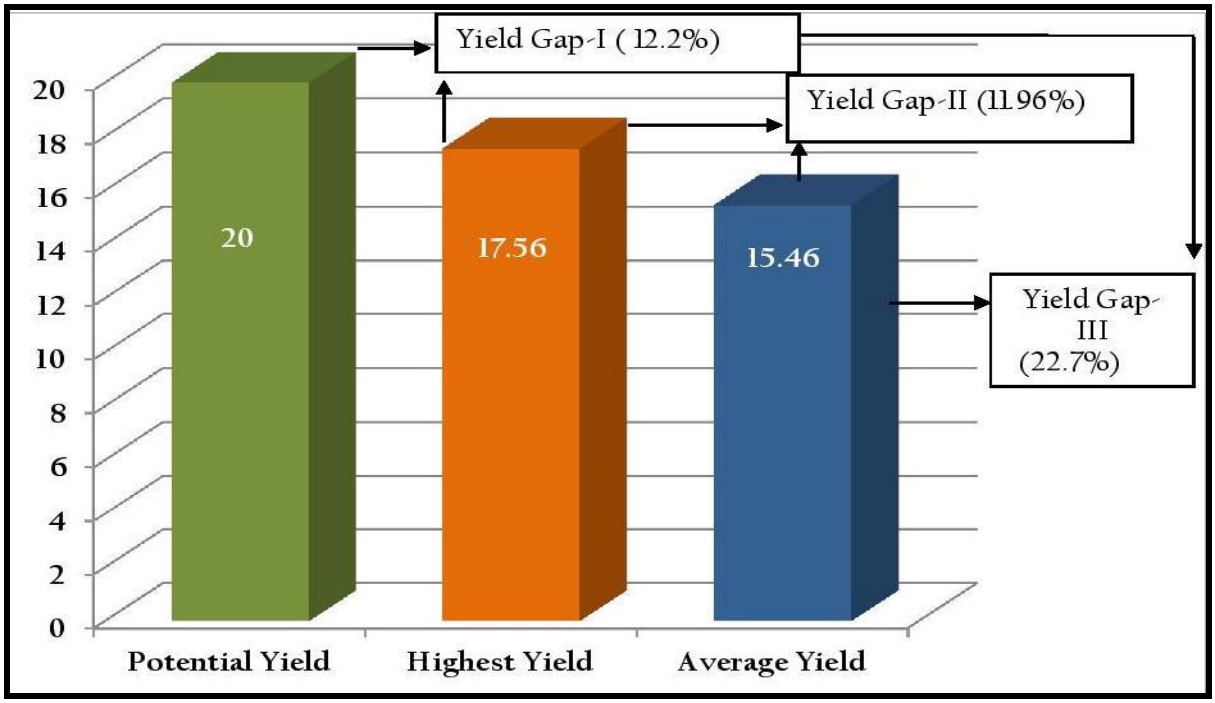

Fig 4.3 : Yield gap in Maize

The yield gap-I denotes that the maize production recommended packages and practices (RPP) yet not been found to be transferred fully to an average maize grower's farm due to difference in soil and climatic condition in experimental field and farmer's field, while yield gap II was found due to various socio-economic constraints present in the study area. Amongst different size of farms there yield gap were found to be less in medium size of farm as compared to others.

4.1.4 Wheat

The wheat was found to be major Rabi crop of the study area which is grown in all the agro-climatic region of Madhya Pradesh viz. Vindhyan Plateau, Satpura Valley, Nimar Valley, Central Narmda, Malwa Plateau, Kymore Plateau, Jhabua Hills, Gird Region, Bundelkhand region and Northern Hills by farmers. The yield gap analysis of wheat for the State was carried out and results are presented in table 4.4.

Table 4.4: Yield gap analysis of Wheat in Madhya Pradesh (%)

Particulars	Marginal	Small	Medium	Large	Average
Potential Yield (q/ha)	35	35	35	35	35
Highest Farm Yield (q/ha)	34.52	34.56	34.88	34.48	34.61
Average Farm Yield (q/ha)	25.4	25.48	26.04	25.51	25.61
Yield Gap-I	1.4	1.3	0.3	1.5	1.1
Yield Gap-II	26.42	26.27	25.34	26.02	26.00
Yield Gap-III	27.43	27.20	25.60	27.11	26.83

A considerable yield gap (III) of 26.83 per cent between potential (35 q/ha) and average farmer yield (25.61 q/ha) was found on an average wheat grower's farms. Out of this total yield gap (yield gap-III), a gap of 1.1 (yield gap-I), and 26.00 per cent (yield gap-II) was found between potential (35 q/ha) & highest farmers yield (34.61 q/ha), and between highest & average farm yield (25.61 q/ha), respectively. The yield gap-I denotes that recommended packages and practices (RPP) for wheat production yet not been found to be transferred fully to an average wheat grower's farm due to

soil and climatic difference in experimental field and farmer's field, while yield gap II was found due to various socio-economic constraints present in the study area. The yield gaps were found to be less in medium size of farms as compared to other size of farms.

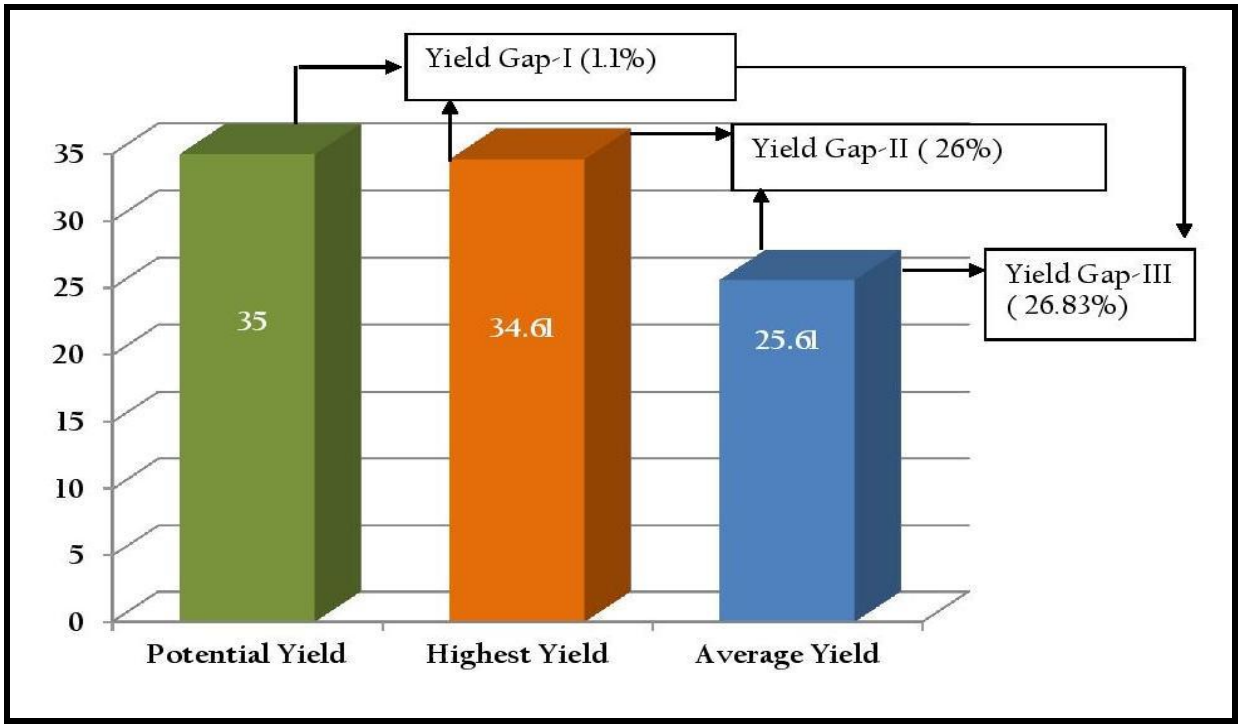

Fig 4.4 : Yield gap in Wheat

4.1.5 Gram

Gram was found to be second major crop of rabi season in the State and is grown in all the agro-climatic regions of Madhya Pradesh viz. Vindhyan Plateau, Satpura Valley, Nimar Valley, Central Narmda, Malwa Plateau, Kymore Plateau, Jhabua Hills, Gird Region, Bundelkhand region and Northern Hills of Chhattisgarh. The yield gap analysis of gram was performed across the various sizes of holdings and results are presented in table 4.5.

A considerable yield gap (III) of 34.07 per cent between potential (15 q/ha) and average farmer yield (9.89 q/ha) was found on an average farmer's field. Out of this total yield gap (yield gap-III), a gap of 10.1 (yield gap-I), and 26.63 per cent (yield gap-II), was found between potential (15 q/ha) & highest farmers yield (13.48 q/ha), and between highest & average farmer yield (9.89 q/ha), respectively.

Table 4.5: Yield gap analysis of Gram in Madhya Pradesh (%)

Particulars	Marginal	Small	Medium	Large	Average
Potential Yield (q/ha)	15	15	15	15	15
Highest Farm Yield (q/ha)	13.32	13.36	13.96	13.28	13.48
Average Farm Yield (q/ha)	9.57	9.81	10.41	9.78	9.89
Yield Gap-I	11.2	10.9	6.9	11.5	10.1
Yield Gap-II	28.15	26.57	25.43	26.36	26.63
Yield Gap-III	36.20	34.60	30.60	34.80	34.07

The yield gap-I denotes that the recommended packages of practices (RPP) of gram yet not been found to be transferred fully to an average farmer's field due to soil and climatic difference in experimental and farmer's field, while yield gap II was found due to various socio-economic constraints present in the study area. The yield gaps were found to be more in case of small farm as compared to other size of farms.

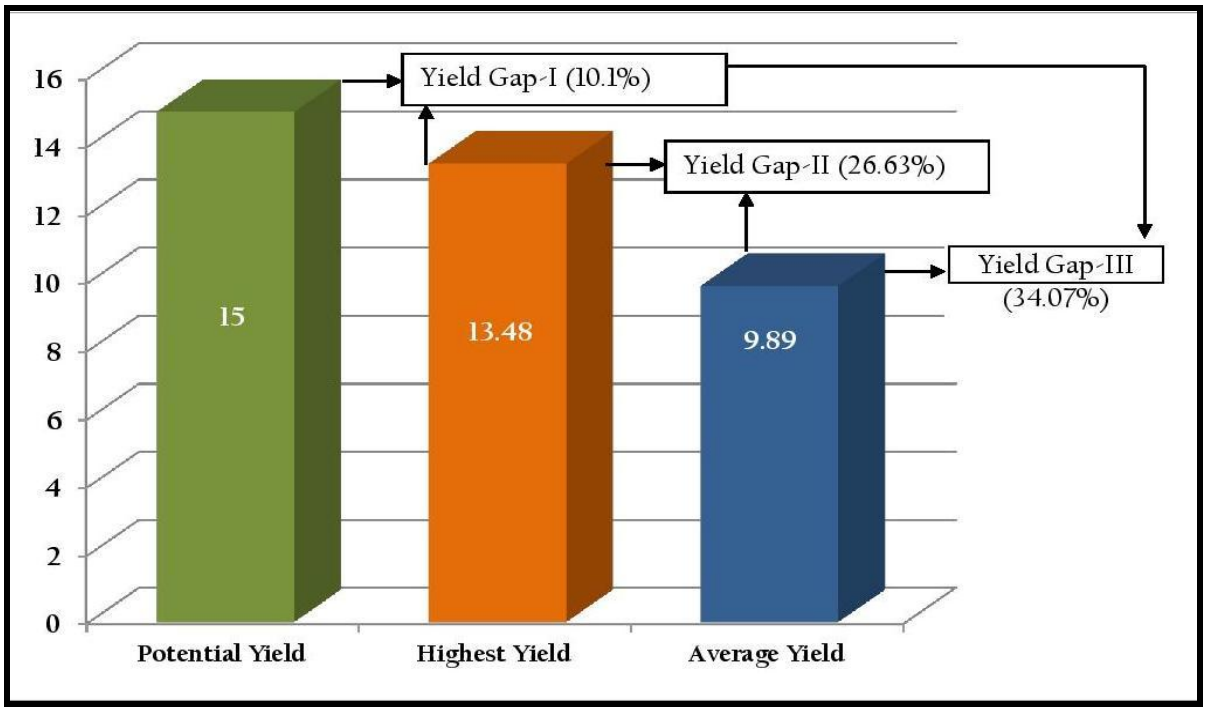

Fig 4.5 : Yield gap in Gram

4.2 Adoption of Different Crop Production Technologies

Adoption of different crop production technologies has been analysed for all the major crops viz. Soybean, Paddy, Maize, Wheat and Gram, grown by various categories of farmers in the area under study.

4.2.1 Soybean

It was observed that all the respondents of the study area were found to adopt HYVs of Soybean but only 12.68, 6.38, 7.0 per cent farmers treated their seed with the rhizobium culture, PSB culture and fungicide respectively. The method of sowing followed by the respondents for cultivation of soybean were found to be ridge & furrow (11.4%), line sowing (59.5%) and broadcasting (29.1%). As regards to application of fertilizers the majority of farmers were found to adopt recommended dose of Di-Ammonium Phosphate (45.99%) followed by Urea (24.12%), Murate of Potash (9.57%) and Single Super Phosphate (7.00%).

Table 4.6: Adoption of different inputs/technologies in Soybean by Farmers (%)

Technologies		Marginal	Small	Medium	Large	Average
Seed		100	100	100	100	100
Seed Treatment	Rhizobium	10.90	12.15	15.21	13.66	12.68
	PSB	6.50	7.46	4.85	6.56	6.38
	Fungi	5.57	7.18	9.71	5.46	7.00
Method of sowing	Ridge & Furrow	8.11	13.5	12.3	11.5	11.4
	Line Sowing	53.6	55.1	62.17	67.32	59.5
	Broad cast	39.3	26.07	29.05	21.93	29.1
Fertilizers	Urea	22.97	24.59	26.54	21.86	24.12
	DAP	45.48	47.24	48.22	40.98	45.99
	MOP	8.58	11.33	10.68	6.56	9.57
	SSP	7.42	6.08	7.12	7.65	7.00
Micro Nutrients	Gypsum	3.25	3.59	3.88	5.46	3.81
	Zinc	3.02	3.31	4.85	7.10	4.12
	Sulphur	3.71	3.87	4.85	3.83	4.05
Plant Protection	Insecticide	35.03	38.40	46.28	35.52	38.75
	Fungicide	1.62	2.21	4.21	2.73	2.57
	Weedicide	32.02	33.43	39.16	36.61	34.79

The micro nutrients i.e. Gypsum, Zinc and Sulphur were found to be adopted by only 3.81, 4.12 and 4.05 per cent of total respondents, respectively. As regards to the adoption of plant protection chemicals the majority of them were found to apply insecticide (38.75%) followed by weedicide (34.79%) and fungicide (2.57%). The remarkable difference in adoption of technologies was not observed amongst different size of farm

but the adoption of these recommended packages of practice was found to be more in medium size of farm as compared to other farms (Table 4.6).

4.2.2 Paddy

It was observed that all the respondents of the study area were found to adopt HYVs of paddy but only 1.32, 1.01, 0.08 per cent farmers treated their seed with the PSB culture, fungicide and azotobactor culture, respectively. The majority of paddy growers adopted System of Rice Intensification (61.0%) followed by broadcasting (29.1%) and line sowing (9.9%) respectively. The majority of farmers were found to adopt recommended doses of Urea (19.84%) followed by Di-Ammonium Phosphate (12.62%), Murate of Potash (3.19%) and Single Super Phosphate (2.88%).

Table 4.7: Adoption of different inputs/technologies in Paddy by Farmers

(%)

Technologies		Marginal	Small	Medium	Large	Average
Seed		100	100	100	100	100
Seed Treatment	PSB	1.86	1.66	0.97	0.00	1.32
	Azotobactor	0.00	0.00	0.00	0.55	0.08
	Fungicide	0.70	0.83	0.32	3.28	1.01
Method of sowing	SRI	61.66	58.98	55.68	67.54	61.0
	Line Sowing	10.08	6.21	9.89	13.45	9.9
	Broad cast	42.78	29.73	26	18.01	29.1
Fertilizers	Urea	15.31	17.68	22.33	30.60	19.84
	DAP	9.05	11.60	14.56	19.67	12.61
	MOP	3.48	3.59	3.56	1.09	3.19
	SSP	3.02	3.31	3.56	0.55	2.88
Micro Nutrients	Gypsum	0.46	0.00	0.00	0.55	0.23
	Zinc	1.39	2.21	1.62	6.01	2.33
	Sulphur	0.46	0.28	0.00	0.55	0.31
Plant Protection	Insecticide	3.25	4.42	3.24	7.10	4.12
	Fungicide	0.46	0.00	0.00	0.55	0.23
	Weedicide	2.32	2.21	1.62	6.56	2.72

The micro nutrients i.e. Zinc, Sulphur and Gypsum were found to be adopted by only 2.33, 0.31 and 0.23 per cent of total respondents, respectively. As regards to adoption of plant protection chemicals the majority of them used to apply insecticide (4.12%) followed by weedicide

(2.72%) and fungicide (0.23%). Amongst different categories of farmers the adoption of RPP was found more in large size of farm as compared to other size of farms in most of the cases (Table 4.7).

4.2.3 Maize

It was observed that all the respondents of the study area were found to adopt HYVs of maize but only 0.93, 0.08, per cent farmers treated their seed with the PSB culture, fungicide. None of the farmer was found to treat their seed with azotobactor. The majority of farmers were found to adopt line sowing (69.01%) while still 31.02 per cent of maize grower used to broadcast seed in their field. As regards to application of fertilizers the majority of farmers found to adopt recommended dose of Urea (10.74%) followed by Di-Ammonium Phosphate (7.63%), Murate of Potash (3.50%) and Single Super Phosphate (2.33%).

Table 4.8: Adoption of different inputs/technologies in Maize by Farmers (%)

Technologies		Marginal	Small	Medium	Large	Average
Seed		100	100	100	100	100
Seed Treatment	PSB	0.70	0.28	1.29	2.19	0.93
	Azotobactor	0.00	0.00	0.00	0.00	0.00
	Fungi	0.23	0.00	0.00	0.00	0.08
Method of sowing	Ridge & Furrow	0.00	0.00	0.00	0.00	0.00
	Line Sowing	72.38	68.57	60.77	74.32	69.01
	Broad cast	40.71	31.28	24.00	28.07	31.02
Fertilizers	Urea	8.35	10.50	12.94	13.11	10.74
	DAP	6.26	8.29	8.41	8.20	7.63
	MOP	2.78	3.87	5.50	1.09	3.50
	SSP	2.55	2.49	3.24	0.00	2.33
Micro Nutrients	Gypsum	0.46	0.00	0.00	0.00	0.16
	Zinc	1.16	0.28	0.00	1.64	0.70
	Sulphur	0.46	0.00	0.00	0.00	0.16
Plant Protection	Insecticide	0.46	1.93	2.59	1.64	1.56
	Fungicide	0.00	0.00	0.00	0.00	0.00
	Weedicide	0.00	0.28	0.00	0.00	0.08

The application of micro nutrients i.e. Zinc, Gypsum and Sulphur were found to be adopted by only 0.70, 0.16 and 0.16 per cent of total respondents respectively. As regards to adoption of plant protection chemicals, the majority of them were found to apply insecticide (1.56%) followed by weedicide (0.08%). None of the farmer was found to apply fungicide to protect their crop from diseases (Table 4.8).

4.2.4 Wheat

It was observed that all the respondents of the study area were found to adopt HYVs of wheat but only 5.68, 3.19, 3.19 per cent farmers were found to treat their seeds with fungicide, rhizobium culture and PSB culture respectively. The majority of farmers were found to adopt line sowing (67.44%) but 32.61 per cent still adopted broadcasting method of sowing. The majority of farmers found to adopt recommended dose of Urea (68.64%) followed by Di-Ammonium Phosphate (64.12%), Single Super Phosphate (7.47%) and Murate of Potash (7.24%).

Table 4.9: Adoption of different inputs/technologies in Wheat by Farmers

(%)

Technologies		Marginal	Small	Medium	Large	Average
Seed		100	100	100	100	100
Seed Treatment	Azotobactor	2.55	4.14	2.91	3.28	3.19
	PSB	2.78	3.87	2.91	3.28	3.19
	Fungi	3.94	5.52	6.47	8.74	5.68
Method of sowing	SRI	0.00	0.00	0.00	0.00	0.00
	Ridge & Furrow	0.00	0.00	0.00	0.00	0.00
	Line Sowing	73.33	67.5	59.03	69.88	67.44
	Broad cast	56.37	22.7	23.9	27.45	32.61
Fertilizers	Urea	62.65	74.31	69.58	69.95	68.64
	DAP	60.32	67.40	66.99	61.75	64.12
	MOP	6.26	7.46	8.74	6.56	7.24
	SSP	6.73	7.18	8.09	8.74	7.47
Micro Nutrients	Gypsum	3.71	2.76	3.24	5.46	3.58
	Zinc	5.34	5.80	5.50	6.56	5.68
	Sulphur	0.93	0.28	0.00	1.09	0.54
Plant Protection	Insecticide	2.55	1.66	3.88	4.37	2.88
	Fungicide	0.70	0.28	0.97	1.64	0.78
	Weedicide	12.99	13.81	20.06	20.77	16.03

The application of micro nutrients i.e. Zinc, Gypsum and Sulphur were found to be adopted by only 5.68, 3.58 and 0.54 per cent of total respondent respectively. In case of plant protection chemicals majority of them were found to apply weedicide (16.03%) followed by insecticide (2.88%) and fungicide (0.78%) in the study area (Table 4.9).

4.2.5 Gram

It was observed that all the respondents of the study area were found to adopt HYV's of gram but only 2.80, 2.65, 0.54 per cent farmers treated their seed with the rhizobium culture, fungicide and PSB culture, respectively. The majority of gram growers adopted line sowing (67.24%) and broadcasting method of sowing (32.74%). The majority of farmers found to adopt recommended dose of Di-Ammonium Phosphate (19.69%) followed by Urea (14.01%), Single Super Phosphate (1.87%) and Murate of Potash (0.39%).

Table 4.10: Adoption of different inputs/technologies in Gram by Farmers (%)

Technologies		Marginal	Small	Medium	Large	Average
Seed		100	100	100	100	100
Seed Treatment	Rizobium	1.86	1.66	3.56	6.01	2.80
	PSB	0.46	0.83	0.32	0.55	0.54
	Fungi	1.86	2.49	2.27	5.46	2.65
Method of sowing	SRI	0.00	0.00	0.00	0.00	0.00
	Ridge & Furrow	0.00	0.00	0.00	0.00	0.00
	Line Sowing	65.11	59.76	73.64	70.44	67.24
	Broad cast	30.02	36.25	33.51	31.18	32.74
Fertilizers	Urea	11.14	14.92	14.56	18.03	14.01
	DAP	16.24	19.06	22.98	23.50	19.69
	MOP	0.46	0.28	0.32	0.55	0.39
	SSP	1.86	2.21	1.94	1.09	1.87
Micro Nutrients	Gypsum	3.25	2.76	2.91	4.92	3.27
	Zinc	0.23	0.55	0.00	1.09	0.39
	Sulphur	0.00	0.00	0.00	0.00	0.00
Plant Protection	Insecticide	10.90	5.80	12.94	10.38	9.88
	Fungicide	1.16	0.55	0.65	2.19	1.01
	Weedicide	1.62	1.38	0.32	0.55	1.09

The application of micro nutrients i.e. Gypsum, Zinc and Sulphur were found to be adopted by only 3.27, 0.39 and 0.00 per cent of total respondent, respectively. As regards to adoption of plant protection chemicals the majority of them used to apply insecticide (9.88%) followed by weedicide (1.09%) and fungicide (1.01%) in the study area (Table 4.10).

4.3 Constraints in Adoption of Recommended Package of Practices of Crops

The constraints in various crop production technologies have been observed during the course of investigation and found that these constraints are almost same for all the crops. The constraints prevailed in the area under study are classified according to crop production technologies i.e. seed and sowing, seed treatment, manures and fertilizer, micro nutrients and plant protection chemicals.

4.3.1 Seed and Sowing

The farmers are not able to adopt HYVs seeds due to lack of information, non-availability of desire variety of seeds, low germination as reported by 18.29, 74.32 and 2.18 per cent respondents, respectively. The majority of farmers still adopting broadcasting method of sowing due to unavailability of seed drill and machinery on hired basis when required (Table 4.11).

Table 4.11: Constraints related to adoption of Seed and Sowing Technologies. **(%)**

Constraints	Marginal	Small	Medium	Large	Overall
Lack of Information of HYV	18.33	19.06	16.83	19.13	18.29
Low Germination of Seed	2.55	1.93	1.94	2.73	2.18
Unavailability of Desired variety of seed	74.01	74.31	73.14	76.5	74.32
Lack of Seed drill & machinery	22.56	21.73	21.94	22.87	22.28

4.3.2 Seed Treatment

The constraints related to adoption of seed technologies by the respondents presented in the Table 4.12. It is observed that majority of

farmers were not able to treat seeds with rhizobium culture, PSB culture and fungicides due to unavailability at the time of sowing (39.93%), non availability of good quality of culture (41.24%) and lack of knowledge about method of seed treatment (12.62%) in the study area (Table 4.12).

Table 4.12: Constraints related to adoption of Seed Treatment Technologies

(%)

Constraints	Marginal	Small	Medium	Large	Overall
Unavailability at the time of sowing	44.58	35.11	38.65	38.71	39.93
lack of knowledge about method of seed treatment	13.31	13.36	11.59	11.29	12.62
non availability of good quality of culture	37.77	46.18	39.61	43.55	41.24
Other	1.55	0.76	1.45	2.42	1.41

4.3.3 Manure & fertilizers

Majority of farmers reported that they were not applied recommended doses of manures in their field due to unavailability of FYM & compost (88.57%). The farmers were not able to apply recommended dose of fertilizers in crop cultivation due to high cost of fertilizer, lack of knowledge about recommended doses of fertilizers and lack of capital as reported by 22.36, 11.8 and 11.8 per cent of respondents, respectively. Only 37.89 per cent respondents were reported that fertilizers are not required for cultivation of crops as they were using manures in their fields (Table 4.13).

Table 4.13: Constraints related to adoption of Manures and Fertilizers Technologies

(%)

Constraints	Marginal	Small	Medium	Large	Overall
Unavailability of FYM and Compost	81.82	93.1	94.67	88.46	88.57
High cost of fertilizers	20.31	31.43	24.39	9.52	22.36
Unavailability at the time of sowing	15.63	8.57	12.2	33.33	16.15
Lack of knowledge about Proper dose of fertilizers	12.5	0	12.2	28.57	11.8
Lack of capital	18.75	17.14	2.44	0	11.8
No Requirement as they were using manures	32.81	42.86	48.78	28.57	37.89

4.3.4 Micro Nutrients

The farmers were not able to apply micro nutrients in cultivation of crops due to lack of knowledge (31.59%), unavailability at time (7.57%), high cost of micro nutrients (25.66%) and lack of capital (4.09%). The majority of farmers (51.09%) also reported that micro nutrients are not required for cultivation of crops as they did not test their soil (Table 4.14).

Table 4.14: Constraints related to adoption of Micro nutrients Technologies. (%)

Constraints	Marginal	Small	Medium	Large	Overall
High cost of micro nutrients	26.84	25.85	27.38	21.27	25.66
Unavailability at the time of sowing	8.35	7.38	5.54	9.49	7.57
Lack of knowledge about Proper dose of micro nutrients	30.13	33.23	29.89	35.44	31.59
Lack of capital	4.05	3.38	5.17	2.53	4.09
No Requirement	50.63	50.15	52.03	51.27	51.09

4.3.5 Plant Protection Chemicals

The majority of farmers were not found to apply plant protection chemicals i.e. insecticides, pesticides, fungicides and weedicides in cultivation of crops due to no severe problem of insect, pest, diseases and weeds was observed in the last year (69.29%), lack of information (19.42%) and chemicals are harmful to human health (1.46%). These finding are similar for all size of farm and no remarkable observation was found across different size of farms (Table 4.15).

Table 4.15: Constraints related to adoption of Plant Protection Chemicals (%)

Constraints	Marginal	Small	Medium	Large	Overall
No severe pest problems in last year	71.43	68.82	71.53	55.81	69.26
Harmful to human	1.73	2.94	2.19	0	1.46
Lack of information	16.45	16.47	21.17	32.56	19.42
Other	10.39	11.76	5.11	11.63	9.87

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CHAPTER V

SUMMARY, CONCLUSIONS AND SUGGESTIONS

Integrated Watershed Management Programme (IWMP) is brought about scientific utilization of land, water, plant and human resources in a geological area that drains at a common point in the natural drainage lines (Anonymous, 1993). Watershed is a natural drainage area of a river, tank, lake or a nala. In the watershed approach a watershed is used as a unit for efficient planning and management of natural and manmade resources and all interrelated factors such as physical, biological, technological, economic, social cultural and managerial considered together in a system of frame work (Singh, 1991). The watershed accomplishes both arable and the non-arable land managing for its development irrespective of the administrative or ownership boundaries. There must be a comprehensive plan for use of land within integrated approach in both arable and non-arable land based on their capability, to result in higher productivity. The watershed programme endeavour to improve, optimize and sustain production and productivity of all categories of land. The specific object of the programme include, promotion of in situ soil and water conservation, optimum use of land to minimize risk in rainfed farming, increase productivity of land and provide higher returns to the farmers on a sustainable basis through adoption of better technology, cropping pattern and diversification of sources of income, proper management to non-arable land, improvement of ground water recharge and production on food, fodder, fuel, fiber, fruits and timber to maintain the ecological balance (Ramana, 1991). Most of the watershed projects in India are implemented with the twin objectives of soil and water conservation and enhancing the livelihood of rural poor (Sharma and Scott, 2005).

The Madhya Pradesh State Government also gave too much emphasis on watershed development programme and taken it in mission mode. Rajiv Gandhi Watershed Management Mission is registered as a society under the Madhya Pradesh Societies Registration Act, 1973. As a registered society, it is mandated to coordinate the watershed development efforts of various line departments in the State; pool resources and expertise readily available to create synergy and lend focus to interventions; and work towards building an appropriate environment for sustainable people-centred interventions.

In IWMP the several location specific activities have been taken under consideration in the watershed area. The irrigation potential in these area has been increased up to 10 -15 percent due to these activities in the State. A productivity component combined with introduction of suitable varieties of crops suited to respective Agro-climatic Regions of the State, promotion of new varieties of crops and seed production in farmers' fields, encouragement local cultivars, introduction of best suited cropping system for watershed areas according to water availability, land use according to their land capabilities, enhancement of seed replacement rate, encouragement to seed treatment technology, soil testing and integrated nutrient management programme, integrated plant protection management, efficient irrigated water management etc have been introduced in the year 2010-11 in these watersheds with the objective to enhance agriculture production at their optimum level.

How far these activities have been implemented in these watersheds and what are their levels of adoption of these to enhance production of crops in the different locations of the State, the present study has been formulated to

evaluate the Impact of IWMP[1] on land use and cropping pattern in Madhya Pradesh with following specific objectives:

5.2 Specific Objectives

1. To analyze change in irrigation potential in different categories of farms
2. To determine the impact of watershed mission on land use and cropping pattern in different categories of farms
3. To analyze adoption gap between technology disseminated and adopted by the farmers
4. To identify constraints in adoption of technology and suggest ways and means for improvement of watershed area.

5.3 Research Methodology

All the districts under the productivity components of IWMP in the State have been taken into consideration and were put under their respective agro-climatic region One watershed in each district having maximum watershed command area was selected for the study All the villages covered under the selected watershed were selected for the study. A list of all the beneficiaries of selected villages was prepared according to their size of holdings. A list of all the beneficiaries has been prepared and classified into various categories viz. marginal (<1 ha), small (1 to 2 ha), medium (2 to 5 ha) and large (>5 ha) according to their size of farms. Further, 10 per cent or minimum 10 beneficiaries from each category were selected randomly for the study. Thus, 431, 362, 309 and 183 beneficiaries have been selected from marginal, small, medium and large categories respectively comprises a total sample size of 1285 beneficiaries, which covers 18.18 per cent of beneficiaries and more than 30 per cent of total Watershed Command Area of Madhya Pradesh.

[1] Presently known as Pradhan Mantri Krishi Sinchai Yojna (Watershed Development)

The study based on both primary and secondary data. The secondary data on number of watersheds in different districts and total number of beneficiaries in each watershed have been collected from the office of the Rajiv Gandhi Watershed Mission, Bhopal. The primary data were collected from the selected respondents of different locations of the study area.A pre-tested interview schedule was used for collection of required data from the respondents. The primary data were collected from the individual respondents through survey method by personal contact. The required primary data have been collected in the agriculture year 2015-16.

The primary data have been classified into two i.e. before and after inception of productivity component in the watershed approach in the area under study. To analyze the impact of the study year 2009 -10 and 2014-15 were taken as the base and the current year respectively for the study. The collected data have been further classified into different agro-climatic regions existed in Madhya Pradesh. The collected primary data of various districts were classified into different size groups for interpretation and to drawn conclusion for the study.

5.4 Conclusions

The conclusions which were brought from the findings of primary data as well as during supervision are given below:

5.4.1 Conclusions drawn from Primary Data

The conclusions which were arrived from the findings of primary data are as follows:

The area under irrigation by all the sources was found to be increased by 12.93 per cent in the current year (1.66 ha) as compared to base year (1.47 ha) with the implementation of IWMP in the State. The maximum increase in area under irrigation was from wells (17.78 per cent) followed by tube-wells (16.16

per cent) and it was also found increased in case of other sources by 2.94 per cent in the current year (0.34 ha) as compared to the base year (0.32 ha). Amongst different size of farms the maximum change in area under irrigation was observed in large (16.05%) followed by medium (15.23%), marginal (10.53%) and small (7.37%) farms. But, remarkable difference was not found across various sizes of holdings. In case of tube well and well the change was found to be ranged between 6.67 to 22.22 per cent in small and 11.11 to 22.22 percent in small and medium respectively.

The depth of water table was found to be decreased remarkably after implementation of IWMP. Amongst different sources of irrigation, the maximum decrease of depth of water table was found in case of wells (21.29%) from 11.98 to 9.43 meter and tube-wells (7.32%) from 30.73 to 28.48 meter in current year as compared to base year.

In case of wells the maximum decrease in depth of water table was observed in marginal farm (26.36%) followed by medium (21.18%), large (19.69%) and small farm (18.12%), while in case of tube-wells, the maximum decrease was found in marginal farm (12.43%) followed by large (7.79%), medium (4.42%) and small (3.81%) farm.

Amongst all the sources of irrigation, the increase in number of irrigation through tube-wells and wells ranged between 25.00 (marginal) to 64.00 (small) and 31.03 (small) to 39.29 (large) per cent respectively in current year over the base year across different size of holdings. Thus, not only area under irrigation through all the sources of irrigation was found to be increased due to remarkable decrease in depth of water table almost in all the sources, but the number of irrigations by all the resources was also increased across different size of holdings.

The size of holding of an average farmer was found to be increased by 2.14 per cent in the current year as compared to the base year. His cultivated

area was also found to be increased by 4.88 per cent. The area under uncultivated waste land, non-agriculture and grazing land, current fallow and old fallow was found to be decreased by 28.57, 14.71, 14.29 and 14.06 per cent respectively due to implementation of the IWMP in the State.

The cropping intensity of an average farm was found to be increased by 11 per cent from 151 (Base year) to 162 per cent (Current year) during the period under study. The net and gross cropped area was also found to be increased by 4.88 and 11.15 per cent respectively.

The area under rabi crop (7.51%) showed more percentage change as compared to kharif crops (7.34%) due to availability of irrigation. Amongst different kharif crops the area of all the crops found to be increased except sesame (-20.00%), bajra (-22.22%) and kutki (-20.00%). Amongst rabi crops the area of all the crops found to be increased from 14.05 per cent (Wheat) to 100 per cent (Lentil) except gram (-17.07%). The area of summer moong was also found to be increased by 67.67 per cent in the current year as compared to the base year. Amongst different size of farms the cropping intensity of medium (16.00%) farmers showed maximum change in as compared to small (10.00%) marginal (12.00%) and large (5.00%) size of farms.

Due to the efficient implementation of IWMP in the State the productivity of all the crops found to be increased from 3.10 (Pea) to 31.60 (Moong) per cent during the period under study. The maximum increase in productivity was found in moong, sesamum, paddy and tur i.e. 21.60, 12.06, 10.56 and 10.01 per cent respectively while, amongst the remaining crops grown in the region the change in productivity ranged between 3.10 (Pea) to 9.57 (Lentil) per cent at overall level is different size of holding. The change in productivity across different size of holdings was found to be increased and ranged between 19.61 (Medium) to 23.10 (Large) per cent in moong, 9.21 (Small) to 14.94 (Marginal)

per cent in sesamum, 7.66 (Small) to 14.00 (marginal) per cent in tur and 10.25 (Small) to 10.25 (Medium) per cent in paddy.

As the result of increase in area and productivity of the crops the production of an average farmer was also found to be increased from 3.47 (Mustard) to 118.98 (Lentil) per cent in the current year as compared to the base year. The change in production of lentil was found to be increased more (118.98%) as compared to moong (102.80%), cotton (61.51%), zaid Moong (57.56%), cotton (55.09%), sugarcane (43.28%), kodo (41.65%), pea (28.76%), maize (26.35%), wheat (23.40%), tur (21.05%), paddy (19.76%), soybean (13.666%), urad (8.07%), jowar (5.64%) and mustard (3.47%), while the production of kutki, bajra, gram, and seasame was found to be decreased by 15.86, 15.82, 10,46 and 10.32 per cent respectively in the current year over the base year due to decrease in area under cultivation.

The yield gap between potential, highest and average yield of major kharif (Soybean and Paddy) and rabi (Maize, Wheat and Gram) have also been observed in the study area. A considerable yield gap (III) of 47.33 per cent was found between potential (15 q/ha) and average farmer yield (7.9 q/ha) in soybean. Out of this total yield gap (yield gap-III), a gap of 20.7 (yield gap-I), and 33.56 per cent (yield gap-II), was found between potential (15 q/ha) & highest farm yield (11.89 q/ha), and highest & average farm yield (7.9 q/ha), respectively.

A yield gap (III) was found to be 29.20 per cent between potential (30 q/ha) and average farmer yield (21.24 q/ha) in paddy. Out of this total yield gap (yield gap-III), a gap of only 1.6 (yield gap-I) and 28.05 per cent (yield gap-II), was found between potential (30 q/ha) & highest farm yield (29.52 q/ha), and highest & average farm yield (21.24 q/ha), respectively.

A considerable yield gap (III) of 22.70 per cent between potential (20 q/ha) and average farm yield (15.46 q/ha) was recorded in maize. Out of this

total yield gap (yield gap-III), a gap of 12.2 (yield gap-I), and 11.96 per cent (yield gap-II) was found between potential (20 q/ha) & highest farm yield (17.56 q/ha), and highest & average farm yield (15.46 q/ha), respectively. A substantial yield gap (III) of 26.83 per cent between potential (35 q/ha) and average farmer yield (25.61 q/ha) was found on an average wheat grower's farms. Out of this total yield gap (yield gap-III), a gap of 1.1 (yield gap-I), and 26.00 per cent (yield gap-II) was found between potential (35 q/ha) & highest farmers yield (34.61 q/ha), and between highest & average farm yield (25.61 q/ha), respectively.

A sizeable yield gap (III) of 34.07 per cent between potential (15 q/ha) and average farmer yield (9.89 q/ha) was found in gram on an average farmer's field. Out of this total yield gap (yield gap-III), a gap of 10.1 (yield gap-I), and 26.63 per cent (yield gap-II), was found between potential (15 q/ha) & highest farmers yield (13.48 q/ha), and between highest & average farmer yield (9.89 q/ha), respectively.

The respondents of the study area were found to adopt HYVs of crops but only few of them were used to treat their seed with the rhizobium culture, PSB culture and fungicide. The majority of them are not aware with the benefits of line sowing, ridge and furrow, SRI, SWI etc. The majority of farmers nither analyzed their soil samples from soil testing labs and nor applied recommended dose of fertilizers in cultivation of crops and only few of them use micronutrient in their field. The majority of them were also not able to appling insecticides, weedicides and fungicides to protect their crops from insect, weeds, and diseases. Due to this a remarkable difference in adoption of technologies was observed amongst different size of farms.

An effort was made to analyse constraints in adoption of these recommended technologies during the course of investigation and found that the farmers are not able to adopt HYVs seeds due to lack of information, non-

availability of desire variety of seeds, low germination as reported by 18.29, 74.32 and 2.18 per cent respondents, respectively. The majority of farmers still adopting broadcasting method of sowing due to unavailability of seed drill and machinery on hired basis. The majority of farmers were not able to treat seeds with rhizobium culture, PSB culture and fungicides due to their unavailability at the time of sowing (39.93%), non availability of good quality of culture (41.24%) and lack of knowledge about method of seed treatment (12.62%) in the study area. Majority of farmers reported that they did not appling recommended doses of manures in their field due to unavailability of FYM & compost (88.57%). The farmers were not able to appling recommended dose of fertilizers in crop cultivation due to high cost of fertilizer, lack of knowledge about recommended doses of fertilizers and lack of capital as reported by 22.36, 11.8 and 11.8 per cent of respondents, respectively. Only 37.89 per cent respondents were reported that fertilizers are not required for cultivation of crops as they were using manures in their fields. The farmers were not able to apply micro nutrients in cultivation of crops due to lack of knowledge (31.59%), unavailability at time (7.57%), high cost of micro nutrients (25.66%) and lack of capital (4.09%). The majority of farmers (51.09%) also reported that micro nutrients are not required for cultivation of crops as they did not tested their soil The majority of farmers were not found to apply plant protection chemicals i.e. insecticides, pesticides, fungicides and weedicides in cultivation of crops due to lack of information (19.42%) and chemicals are harmful to human health (1.46%).

5.4.2 Conclusions drawn during supervision

The findings which were observed during the supervision are given below:

1. It is also observed during the investigation that breeder seed was distributed to beneficiaries and majority of them sold the produce in the

market. It should not be distributed directly to the farming community; it is waste of precious public property until and unless it will not be channelized in a proper manner. The purpose for which breeder seed is being produced is not fulfilled in this Mission.

2. The functioning of Water Use Committees was not found up to the mark. The most of the members' even secretaries of these committees were found to be illiterate. They were not even aware with the role and objective of the Mission.
3. It has been observed during the course of investigation that field staff of IWMP was used to transfer frequently from one place to another. This created so many problems in planning, implementation and developmental activities of the Mission.
4. Almost all the field staff reported that the guideline of the productivity component was changed frequently and due to this target were not achieved and budget of this component could not be utilized properly in the area under study.
5. The most of the farmers reported that agricultural labourers were not available during peak operational periods of cultivation of crops viz; at the time of sowing and harvesting. The problem was arise due to implementation of MGNREGA and other social welfare schemes such as Chief Minister Annapurna Yojana, in which wheat and rice are being distributed to poorer at the rate of Rs.1.00 and 2.00 per kg, respectively. The labour's are now able to get ration for a month if they work for 2 days only.
6. It was also found during supervision that maintenance of some water structures was observed poor. It is not only wastage of most precious

water resource but at the same time the productivity of the crops was also affected to a great extent.

7. During the course of investigation, it was found that the majority of farmers were not aware with the benefits of soil testing. Even they do not know the recommended package of practices for cultivation of crops viz; High Yielding Variety seeds, seed treatment, manures and fertilizer application, plant protection techniques, marketing of produce etc.
8. The IWMP programme is target oriented and it was found that the seed or other benefits were distributed to the same beneficiary repetitively in a year.
9. It is also observed during the course of supervision that the team of IWMP was not coordinating with other line departments i.e. agriculture, horticulture, livestock and animal husbandry, forest etc.
10. Farmers were not adopting soil test based fertilizers application and soil test samples were not found to be supported by sufficient number of soil test laboratories.

Fig. 5.1: *Astha Mulak* work under IWMP- Mandla

11. Most of the watershed farmers of the area were found to be unaware about the whole programme, though *Astha Mulak* works have been completed under the Mission to develop the faith amongst the farmers with their work.

12. Majority of the farmers reported that machineries and implements were not available in sufficient quantity, which is the need of the hour for quick operation and where problem of labour is more severe.

Fig. 5.2: Poor maintenance of watershed structures

13. Most of the farmers were found to be illiterate and less aware about the Mission; and their benefits which lead to improper use of the available resources.

14. It has been observed that in some region especially in Northern hills of Chhattisgarh, Kymore Plateau and Satpura Hills, Kodo & Kutki (Climate resilient crops) are found to be replaced by paddy. Similarly Sugarcane is being introduced in the watershed area. In these crops the requirement of water is more as compared to traditional agriculture.

15. It was also observed that Blue Bull and Wild Boar became a problem in cultivation of crops especially in adjoining districts (Panna, Chhattarpur, Datia etc.) of Uttar Pradesh. The farmers reported that these wild animals used to feed all the crops except Mustard.

Fig. 5.3: Problem of Blue Bull and Wild Boar in cultivation of crops

In nut shell it has been observed that over all progress of the Integrated Watershed Management Programme with respect to change in irrigation potential, land use pattern, cropping pattern, production and productivity of crop are noteworthy, which could happen due to strong determination of implementing agency in implementation of the programme in efficient and effective manner, however yield gap of major kharif and rabi crop shows that still yield can be enhanced by adapting recommended package of practices and minimizing the constraints hampering the level of productivity.

A remarkable progress in area under irrigation, production and productivity was not only observed in the area under study but it was seen across various sizes of holdings which show the inclusiveness in implementation of the programme. Land use pattern indicate the net cultivated area and operational holdings of farmers were increased and cropping pattern was found to be shifted from less to more remunerative crops.

5.5 Suggestions

The following suggestions are made from the findings and observations during the course of investigation:

- The breeder seed should not be distributed directly to the farmers rather it must be given to the registered seed certification agency/ seed producer company and after multiplication into foundation and certified seed it can be distributed to the farmers of watershed area otherwise it goes waste because most of the farmers were found to sell their seed in the market directly as grain. It's simply wastage of public resources. Instead of distribution of seed to majority of farmers one or two demonstration in a village should be planned for complete transfer of technology with full package of practices in the field of key farmers and to show the impact Kisan Mela should be organized. If there is a problem or incidence of insects or disease, a field day should be organized in front of all the farmers of the Village so that they will learn by seeing, it is for their better and proper understanding of all the package of practices of crop cultivation.
- Online portal of government seed distribution agency needs to be created to show the variety wise and class wise availability of seed with the facility of online purchase/booking.

- Literacy must be pre-requisite while selecting the members of the Water Use Committee and some key persons should be involved for effective implementation of the programme.
- It has been noticed that usually there is a delay in getting technical and administrative sanctions from the respective authority of the area. Looking to the importance of seasonality in various operations of agriculture it should be given top priority or some necessary arrangement (Online provisional sanction) required to be made to stop this delay.
- All the staff selected for the particular watershed should not be changed during the project period until and unless it became essential. Staff should be selected more in advance i.e. before the PRA of the watershed area and all the team members including Team Leader must be involved in this including other activities of planning so that it can be effectively implemented when ever and where ever it is required without hampering the progress of the project. The possibility to recruit permanent staff needed to be explored.
- Utmost care should be taken while preparing the guideline. The comments obtained from various stakeholders and supporting departments including valuable suggestions from the experts must be given due importance at the time of preparation of guideline so that once it is prepared it should not be changed during the project implementation period otherwise it hampers the progress to a great extent.
- Labour for agriculture is becoming serious problem now a day in the State due to implementation of the MGNREGA and other social welfare schemes. There is a need to stop the MGNREGA work during the critical labour intensive activities of the agriculture and need to stop social welfare schemes which are making persons lazy/ idle and creating the environment of no work culture which ultimately leads to inculcate

antisocial practices amongst them which will create the problem for social harmony in the long run.

- The maintenance funds must be properly utilized through plantation near the channel to check soil erosion and channels must be cleared in every 2nd or 3rd year to avoid problem of siltation so that the benefits of such a huge investment can be harvested year after year.
- As it is observed during the course of investigation that field staff and farmers were not found to be well acquainted with latest technology of production and marketing of farm products. Hence, need based training programme based on the agriculture related problem of the area must be organized for the field staff of the IWMP followed by producer before the start of the season in the nearest KVKs. The whole training must be designed taking the view of the field staff and producers of the area which will directly reflect into the productivity of crops.
- It is also found during the course of investigation the field staff was not able to achieve the targets related to productivity mission due to duplicity of same work viz. distribution oh HYVs seeds, formation of SHGs etc. by the field staff of other departments viz. agriculture, horticulture, veterinary etc.
- Sufficient soil testing laboratories infrastructure needed to be created at least at block level for accuracy with the facility of online quick response.
- Efforts should be made to introduce need based integrated farming system. At least one Seed Producer Company, Producer Company, Custom Hiring Centre are required to be established in each and every location of IWMP.
- Proper awareness about IWMP among students, rural youth and farm women are required to be created in the area.

- The practice of bottom-up approach is found to be appreciable but if any change/modification is needed at top level then consultation with Team Leader is required for betterment of the Mission.
- All the developmental programme/activities must be covered under the umbrella of IWMP with proper convergence and synergy between the line departments.
- As the ultimate Goal of Mission is overall development of the watershed area and every part of the land comes under the one or another Watershed, Sincere efforts are required to be made in such a way, so that all the developmental programmes related to agriculture and rural development concerned to any Ministry of Government should be amalgamated under the Umbrella of IWMP. This will not only solve all the problems related to agriculture and rural development at one end but duplicacy of the work can also be checked by protecting precious resources through generating efficiency in a system to serve the rural mass in a better way on the other.

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CHAPTER VI

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Appendix-I

Table 1: List of beneficiaries of Selected Blocks.

S.No.	District	Block Name	Marginal	Small	Medium	Large	Total
1	Alirajpur	Sondhawa	10	10	8	1	**29**
2	Barwani	Niwali	15	10	10	10	**45**
3	Betul	Anther	10	10	10	4	**34**
4	Jhabua	Rama	12	13	10	2	**37**
5	Khandwa	Khandwa	10	10	10	1	**31**
6	Chhinwara	Parasia	10	10	10	10	**40**
7	Dhar	Gandhwani	14	10	9	9	**42**
8	Khargone	Bhagwanpura	10	10	10	0	**30**
9	Ujjain	Tarana	10	10	10	3	**33**
10	Ratlam	Bajna	10	11	10	10	**41**
11	Morena	Sabalgarh	28	13	4	0	**45**
12	Tikamgarh	Jatara	10	10	10	7	**37**
13	Rewa	Jawa	10	10	10	10	**40**
14	Satna	Maihar	28	11	10	10	**59**
15	Narsinghpur	Babai chichli	10	10	10	9	**39**
16	Vidisha	Nateran	22	10	10	8	**50**
17	Damoh	Damoh	10	3	1	1	**15**
18	Katani	Dhirmarkheda	16	13	10	11	**50**
19	Mandala	Bijadandi	10	10	10	10	**40**
20	Jabalpur	Kundum	16	10	10	10	**46**
21	Seoni	Lakhnado	10	10	5	3	**28**
22	Bhopal	Barasia	23	10	10	1	**44**
23	Indore	Mhow	10	10	3	1	**24**
24	Mandsaur	Malhargarh	19	18	18	5	**60**
25	Neemach	Jawad	11	11	11	1	**34**
26	Gwalior	Dabara	5	10	10	10	**35**
27	Datia	Seonda &Bhander	22	25	16	10	**73**
28	Panna	Panna	10	10	10	2	**32**
29	Chhatarpur	Badamalhera	10	10	7	3	**30**
30	Sagar	Kesli	10	10	10	10	**40**
31	Sagar*	Sagar	10	10	7	1	**28**
32	Shivpuri	Khaniyadhana	10	10	10	10	**40**
33	Guna	Bamori	10	14	10	0	**34**