AN ECONOMIC ANALYSIS OF DRIP IRRIGATION SYSTEM ON MAJOR VEGETABLES OF CHHATTISGARH PLAIN

M.Sc. (Ag.) THESIS

by

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CERTIFICATE – I

This is to certify that the thesis entitled **"AN ECONOMIC ANALYSIS OF DRIP IRRIGATION SYSTEM ON MAJOR VEGETABLES OF CHHATTISGARH PLAIN"** submitted in partial fulfillment of the requirements for the degree of **"MASTER OF SCIENCE IN AGRICULTURE"** the Indira Gandhi Krishi Vishwavidyalaya, Raipur, is a record of the bonafide research work carried out by **SARITA PAINKRA** under my guidance and supervision. The subject of the thesis has been approved by student's Advisory Committee and the Director of Instructions.

No part of the thesis has been submitted for any other degree or diploma (certificate awarded etc.) or has been published/published part has been fully acknowledged. All the assistance and help received during the course of the investigations have been duly acknowledged by her.

Date: 3.8.2013

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CERTIFICATE - II

This is to certify that the thesis entitled **"AN ECONOMIC ANALYSIS OF DRIP IRRIGATION SYSTEM ON MAJOR VEGETABLES OF CHHATTISGARH PLAIN"** submitted by **SARITA PAINKRA** to the Indira Gandhi Krishi Vishwavidyalaya, Raipur in partial fulfillment of the requirements for the degree of M.Sc. **(Ag.)** in the **DEPARTMENT OF AGRICULTURAL ECONOMICS** has been approved by the external examiner and student's Advisory Committee after oral examination.

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"Education plays of fundamental role in personal and social development and teacher plays a fundamental role in imparting education. Teachers have crucial role in preparing young people not only to face the further with confidence but also to build up it with purpose and responsibility. There is no substitute for teacher pupil relationship". I start in the name of God-who has bestowed upon me all the physical and mental attributes that I posses and skills to cut through and heal a fellow human.

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INTRODUCTION

CHAPTER – I

INTRODUCTION

1.1 Problems justifications:

Increasing competition with the other water users in the future would limit the water availability for expanding irrigated area. In traditional surface irrigation methods, the losses in water conveyance and application are large. These losses can be considerably reduced by adopting drip irrigation methods. Among all the irrigation methods, the drip irrigation is the most efficient and it can be practised in a large variety of crops, especially in vegetables, orchard, plantation and flowers. In drip irrigation, water is applied near the plant root through emitters or drippers, on or below the soil surface, at a low rate varying from 2 - 20 litres per hour. The soil moisture is kept at an optimum level with frequent irrigations. Drip irrigation results in a very high water application efficiency of about 90-95 per cent. (Ghosh, 2009).

Drip technology also improves irrigation efficiency by reducing evaporation from the soil surface, reducing or eliminating runoff and deep percolation, and eliminating the need to drastically over- irrigate some parts of the field to compensate for uneven water application. The application or injection of fertilizers and other chemicals can also be optimized through the use of drip irrigation, weed growth can be reduced, and salinity problems can be mediated. Relative to highly pressurized sprinkler irrigation systems, drip irrigation may require less energy. Drip irrigation systems also are very adaptable to difficult soil and terrain conditions.

Vegetables are very popular and have occupied important place in the daily foods of most of the Indian population for nutritional sufficiency. As a result the country has emerged as second largest producer of vegetable after china. Vegetables form the most important component of a balance diet. Vegetable being a rich source

of vitamins and minerals, occupy an important place in the food basket of Indian consumers. Their consumption in sufficient quantities produce taste, palatability, increases appetite and produce fibers. They also produce valuable roughage, which promotes digestion and helps in preventing constipation. The vegetable production in India has increasing trends. Its production has raised from 88.622 million tons with an area of 6.156 million hectare during 2001-02 to 156.3 million tons from area of 8.98 million hectare during 2011-12. The production is to be raised to 225 million tons by 2025, to cater the minimum requirement of vegetables for the ever increasing population. The huge gap between present production and future requirements necessitates enhanced vegetable production. But, urbanization, and industrialization impose constraints of decreased arable land as well as share of water to agriculture year after year. Consequently, agriculture in the future has to produce ever increasing quantities of food with decreasing quantities of water available for irrigation. Therefore, efficient utilization of water for irrigation assumes great significance.

Traditional irrigation methods utilized in about 90 per cent irrigated area in country have low field level application efficiency of 40-50 per cent. Whereas, drip irrigation may achieve field level application efficiency of 80-90 per cent, as surface runoff and deep percolation losses are minimized. It improves irrigation control with smaller frequent application, supplies nutrients to the crop as needed, results in less weed growth and improved crop yields (50 per cent) and water use efficiency (119 per cent). Moisture availability to crop with drip irrigation remain near the field capacity which enables plants to uptake soil water with least stress and results higher yield and quality produce. Drip irrigation allows more crops per unit water.

Drip irrigation makes possible crop cultivation in an area where available water is insufficient to irrigate through surface irrigation methods. It is suitable for

areas that are presently under cultivation, and can also be used efficiently in undulating terrain, rolling topography, hilly areas, barren land and areas which have shallow soils. It has vast potential of application of 27 million hectare (M ha) land in India. At present, about more than 1.3 M ha land under vegetables and high value crops is being irrigated through drip irrigation in India.

The drip irrigation can be made more applicable for irrigating a wide range of crops by installing the laterals below the soil surface, called subsurface drip irrigation, defined as application of water below the soil surface through the emitters, with discharge rates generally in the same range as surface drip irrigation. Worldwide studies reveal advantages of surface drip irrigation of many crops over other irrigation methods in terms of reduced evaporation loss and precise placement and management of water, nutrient and pesticides leading to more efficient water and nutrient use, enhanced plant growth, crop yield and quality.

Among vegetable crops grown under surface drip irrigation system, Tomato is the most popular one followed by Lettuce, Peas, Sweet Corn, Melons, Potato, Cabbage, Beans, Squash, Carrot, Onion, Broccoli and Asparagus. Few studies conducted in India also indicate great potential of surface drip irrigation for enhancing yield and water productivity in vegetables. However, lack of appropriate design of surface drip irrigation (SDI) system affect uniformity of application of water and nutrients in the soil required for proper plant growth and crop yield. Depth of placement of laterals is one of the important considerations in design of surface drip irrigation. It should be sufficient to avoid damage from tillage implements but shallow enough to wet the crop root zone. More specific information is required to determine lateral depths for specific soil and crop combinations. In India, little research is reported on above aspect; and recommendations regarding placement depths of

surface drip irrigation laterals for many vegetable crops are lacking. Therefore, studies need to be conducted to optimize and validate lateral placement depths of surface drip irrigation with respect to different emitter discharge rates and emitter spacing under various soils for enhanced water productivity in vegetables. (Singh, 2013).

According to the information as available during 2001, the area under Drip Irrigation estimated to have been increased to about 4.50 lakh hectares, which includes about 3.50 lakh hectares covered under the Government of India Schemes and 1.00 lakh hectare covered by a large number of institutions, commercial organizations, universities, large public/private sector companies, NGOs, etc. (Srivastava *et al.*, 2012).

The share of production of vegetables in Chhattisgarh is 60.8 percent of total production of vegetable in india. And it is produced by traditional irrigation system. We can enhance its production by adopting the micro irrigation techniques i.e. drip irrigation system. The vegetables produced by the drip irrigation is having good quality because plant received optimum water for its growth and development it result is more yield and due to that farmer's get high economic value vegetables and high net return.

The total area covered by drip irrigation in Chhattisgarh is 6,360 ha and in India was 18, 97,282 ha for all the crops. The maximum area covered by drip irrigation is in Maharashtra (6,04,440 ha) followed by Andhra Pradesh (5,05,205 ha) and Gujarat (2,26,773 ha). The total vegetables area of drip irrigation in India is 33,764 ha. (Anonymous, 2012)

In Chhattisgarh area under vegetable production for the year of 2011-12 was 351549.52 ha. And production under vegetable crop was 45,82,629.64 Mt. The total

area covered by vegetable production in Rajnandgaon and Durg district was 13,137.00 ha and 27,380.00 ha and production under vegetable crop in Rajnandgaon and Durg district was 1,95,560.40 Mt. and 4,94,206.00 Mt.

Studies show that drip irrigation reduces water use by 30-70 per cent and increases yields by over 50 percent. At present, 75 percent subsidy is given to 2 hectares marginal and small farmers and 50 percent subsidy is given to 5 hectares medium and large farmers in Chhattisgarh.

Looking in the economic importance of drip irrigation in the study area, this study will be under taken with following specific objectives:

1.1 Objectives:

1. To workout the economics of major vegetables in drip irrigation system.
2. To examine the changes in cropping pattern with the adoption of drip irrigation.
3. To identify the factors affecting for the adoption of drip irrigation.
4. To find out the problems in adoption of drip irrigation system and suggest some policy measures to overcome them.

1.2 Setup:

Following Introduction, Review of literatures is presented in Chapter-II, Materials and Method are presented in Chapter-III, Chapter-IV, presents the Results and Discussion. The major outcomes and direction for future are suggested in the the last chapter of Summery, Conclusions and Suggestions for future research work.

REVIEW OF LITERATURE

CHAPTER- II

REVIEW OF LITERATURE

In this chapter, an attempt has been made to review pertinent literature keeping in view the problem entitled, "An economic analysis of drip irrigation system on major vegetables of Chhattisgarh plain". A brief account of the work reported by the past researcher has been discussed under various objectives of the study:

Ingle *et al.* (1989) found that the drip irrigation has caught the attention of the farmers with substantial amount of subsidy available with adoption of the drip irrigation. Many farmers have installed drip irrigation set for various crops. He furthered identified various constraints in the easy implementation of drip irrigation among the vegetable farmers. In this regards clogging of the emitters, lack of after sales services, faulty design and layout and lack of knowledge to the farmers were common constraints. He suggests for organized proper training camps for the farmer so they can maintain and repair their drip sets with out of heavy investment.

Jadhav *et al.* (1990) reported that yields of tomato cultivation pusa *rabi* were 48 t per ha for a drip irrigation system with pressure compensating emitters and 32 t per ha when furrow irrigation was used. The cost: benefit ratios were 5.15 and 2.96, respectively, for the drip and furrow methods.

Shivemaggi (1990) observed that small farmers were lagging being in adoption drip irrigation in areas where water was inadequately available. According him the constraints were availability subsidy and poor risk bearing capacity farmer. He observed the training need to farmer relation of adoption of drip irrigation in Hyderabad district. Found that the economics status and land holding had relationship extend of utilization of drip irrigation and level adoption of improved farm practices.

Gajare *et al.* (1991) studies the effectiveness of communication media in the transfer of drip irrigation technology from manufactures and government agencies to the farmer's field. They found that there is high impact of the different communication aids in knowledge gain about drip irrigation technology. They furthered suggested that it is necessary to used effective communication methods to popularize the drip irrigation system on the large scale.

Hochmuth (1992) analyzed that the fertilizer application by drip irrigation is becoming a common practice for many vegetable crops, especially in Florida. Vegetable producers view drip irrigation as a tool to reduce water use, increase fertilizer efficiency, and improve profits, while simultaneously reducing the potential risk to the environment due to nutrient enrichment of surface and groundwater.

Prevatt (1992) studied that the three vegetable irrigation systems, semi-closed subirrigation (seepage), fully enclosed subirrigation (seepage), and drip irrigation, were evaluated for use on sandy soils with naturally high water tables to determine comparative irrigation costs for tomato production. Investment, fixed (ownership), and variable (operating) costs were estimated for each irrigation system. The investment costs of the drip irrigation system were significantly greater then those for the semi-closed and fully enclosed irrigation systems. The variable costs, however, for the semi-closed system were considerably and drip irrigation systems. The semi-closed irrigation system, therefore, was determined to be the least-cost tomato irrigation system under present fuel and nonlimiting water supply conditions.

Regassa *et al*. (1994) found that the Microirrigation technologies lead to poverty reduction through substantial increases in farm income due to an increased area of cultivation, better crop yields, enhanced output quality, early crop maturity and hence higher unit prices, and reduced cultivation costs, particularly for operations

like irrigation and weeding. Microirrigation technologies enhance nutritional security by enabling the production and consumption of vegetables, particularly leafy vegetables, which are usually missing in the traditional staple diets of many cultures.

Batal (1996) revealed that the easy possible and economically viable irrigation water potential have already been developed in india, but the demand of water for different purpose has been growing continuously. The water use efficiency in agricultural sector is the only in the range of 30-40 per cent in india, indicating that there is considerable scope for improving the existing water use efficiency.

Narayanmoorthy (1997) narrated that drip irrigation not only save the irrigation does of to of but also increased the productivity of crop and the cost of cultivation especially in labour intensive operation. Environmental problem associated with the surface method of irrigation such as water logging and salinity are also completely absent under drip method of irrigation. He conducted a massive survey programme through out country to find out the reason behind less adaptabilities of drip irrigation among the vegetable growers. Finally he concluded that the slow growth of drip irrigation in india is not due to economic reason but it is due to lack awareness among the farmers about the real economic and resource-related advantages of drip irrigation. He proposed for establishment of expert committee to access information for enhancing the area under drip irrigation. He also suggested for development of agro-processing industries near by field of drip-irrigated areas so as farmer could get fare price of his produce.

Polak *et al*. (1997) analyzed that the in areas where water is scarce, drip irrigation provides the most efficient way to conserve irrigation water, but its cost of 54630/- an acre is prohibitive for most small farmers in developing countries. The cost was reduced by 90 percent by (1) making dripper lines moveable, so that each

line reaches ten rows instead of one; (2) replacing 25-cent emitters with simple 0.70 mm holes punched by a heated needle; and (3) using 163.89/- off-the-shelf 20 liter containers with cloth filters in place of expensive filter systems. Small farmers reported that the low cost trickle irrigation system cut labor requirements in half, and doubled the area irrigated by the same amount of water. The low cost drip system is likely to be widely adopted by small farmers in semi-arid and hilly regions.

Camp, (1998) studied that the subsurface drip irrigation has been a part of drip irrigation development in the USA since its beginning about 1960, but interest has escalated since the early 1980s. Yield Response for over 30 crops indicated that crop yield for subsurface drip was greater than or equal to that for other irrigation methods, including surface drip, and required less water in most cases. Lateral depths ranged from 0.02 to 0.70 m and lateral spacings ranged from 0.25 to 5.0 m. several irrigation scheduling techniques, management strategies, crop water requirements and water use efficiencies were discussed. Injection of nutrients, pesticides, and other chemicals to modify water and soil conditions is an important component of subsurface drip irrigation. Some mathematical models that simulate water movement in subsurface drip systems were included. Uniformity measurements and methods, a limited assessment of root intrusion into emitters, and estimates of overall system longevity were also disussed.

Sufficient information exists to provide general guidance with regard to design, installation, and management of subsurface drip irrigation systems. A significant body of information is available to assist in determining relative advantages and disadvantages of this technology in comparison with other irrigation type. Subsurface drip provides a more efficient delivery system if water and nutrient applications are managed properly. Waste water application, especially for turf and

landscape plants, offers great potential, Profitability and economic aspects have not been determined conclusively and will depend greatly on local conditions and constraints, especially availability and cost of water.

Muralidhar (1998) reported that among the methods of water and fertilizer application fertigation method resulted in higher gross and net returns hence maximum cost: benefit ratio of 1:4.8 followed by drip method 1:3.81 and furrow method 1:3.47 in capsicum.

Samual and Singh (1998) observed that due to increased awareness on the need for water conservation along the friendly support of the government, substantial areas have been covered under micro irrigation in the horticultural sector during the past years. The growth has been significantly remarked in the state of Andhra Pradesh, Maharashtra, Karnataka and Tamil Nadu. However, considering that areas of about 11Mha area available under fruits and vegetables crops, the area covered under drip irrigation is hardly sufficient. Effort are therefore needed to step up pace of coverage.

Sivanappan (1998) concluded the four reasons for adaptability of the drip system of irrigation in india. These are increase yield, high quality of produces and less consumption inputs- labours, fertilizers, chemicals etc and finally saving of water. Therefore the farmers of india are also aware about the importance of this water saving system just likes a farmer in Germany and Israel. He found the high investment cost for drip system is the chief constraint to large scale introduction in india. Its installation cost is about Rs- 65000-75000 per ha for closely spaced crops like vegetables, is the prohibitive cost to small and marginal farmers in the country.

Yohannes (1998) conducted that the higher yield and increased water use efficiency has been very often attributed to drip irrigation than the conventional

furrow irrigation. The purpose of this study was to examine the effects of drip and furrow irrigation systems and plant spacing on the yield of tomato (Lycopersicon esculentum var. Marglobe) and water use efficiency. The experiment was conducted at Dire Dawa, Ethiopia on a deep clay loam soil in the rain-free period of the 1991/1992 and 1992/1993 seasons. Two types of emitters, self- compensating and inline emitters, were used for the drip system with a discharge of 0.9 I/h and 1.2 I/h, respectively. Tomato was grown at spacing of 35 cm, 50cm between plants. Higher yields of tomato were obtained with drip irrigation in both seasons as compared to furrow irrigation. No significant difference in yield was found in the 1992/1993 season among the two types of emitters. A similar trend was also observed on the effect of irrigation systems on fruit size and plant height. Plant spacing did not show any significant effect on fruit size and plant heights in both seasons. No of plant spacing irrigation interaction was observed for yield, fruit size and plant heights in all the seasons. The water use efficiency (WUE) and irrigation application efficiency were determined for both irrigation systems, and it was found that the drip system showed the highest values as compared to furrow irrigation.

Ahire *et al.* (1999) compared the socio-economic status of drip users and non drip users. They concluded that the drip adopters were better off then the non drip adopters in respect of education, occupation, annual income, irrigated land holding and the caste. They furthered found that the drip adopters were more resourceful then their counterpart non drip adopters. The living conditions of the farmers from drip adoption groups were better than those from non drip adopters.

Gogai (2000) concluded that the level of knowledge and extend of adoption of trained farmer on use of drip irrigation vegetable crop were significantly higher then the untrained farmers. This can be attributed to the impact of traings programme.

Lack of availability of subsidy, high cost, inadequate supply of electricity and lack of contact were the major problems in adopting the drip irrigation in vegetable crops.

Patel *et al.* (2000) identified the major factors of motivation for enhancing the adoption of drip irrigation. They concluded that the dealer or agents of the drip irrigation system and progressive farmers who have already adopted drip irrigation system were the important inspiration source. They play an important role in inspiring the farmers to introduce drip irrigation system for the first time. These two sources were found to be adequate to inspire majority of the farmers to introduce the drip irrigation system.

Chattraj (2001) emphasized to development a good strength of monitoring for proper sanctioning of loan under subsidy scheme it is one of most crucial factors to achieve the desired target area under drip irrigation . Drip irrigation plays an important role in process to improve the productivity and performance of land and farmer both. Farmers participate in adoption of drip irrigation their for he has expressed deep cushion in improving the monitoring, knowledge and skill to access technology and other support service proper manner for bringing significant changes in cropping pattern under drip irrigation. It is essential understand the realities and faced the situation.

Postel *et al.* (2001) studied the impact of different communication media on the adoption rate of drip irrigation. They found that the newspaper, radio and television have a good impact on rural communities I order to disseminate the useful information. They recommended the radio as the most innovative communication media in the rural areas.

Skaggs (2001) studies that the possibility that drip irrigation technology could increase yields, reduce the incidence of crop diseases, and improve fruit quality has

been identified as a critical research issue for the New Mexico chile pepper industry. Numerous hypotheses have been expressed regarding the low incidence of drip irrigation usage among New Mexico farmers. A survey of farmers was conducted in 1999 to assess commercial chile pepper producers' attitudes toward and knowledge of drip irrigation technology. The results of this research provide information useful to extension personnel, other researchers, and chile industry members. Results also raise questions about the impact of widespread drip irrigation adoption on multi-user irrigation systems, such as those found in New Mexico.

Shinde et al. (2002) studied that an experiment was conducted on clay soil with different systems of irrigation and fertigation to study the effect on growth, yield and economics of brinjal cultivation. From the two years pooled data it was observed that drip irrigation with 125 per cent RDSSF recorded significantly higher values of most of the growth attributes viz., plant height (cm) and spread of plant (cm) over remaining treatment combination of fertilizer with drip, micro-jet and control. However, micro-jet with 100 per cent of RDSSF recorded significantly higher values of most of the yield attributing characters viz., average number of fruits per hill and weight of fruits per hill (kg) over remaining treatment combination of fertilizer with drip, micro-jet and control. Further, micro-jet + 100 per cent RDSSF recorded higher fruit yield, gross income and net income. The higher cost: benefit ratio was recorded by micro-jet + RDCF treatment, while drip + 125 per cent of RDSSF recorded highest water use effiency.

Cetin *et al*. (2003) focused on the need of investment and cost guideline for drip adoption to evaluate the economics of his produce as quickly as possible and to minimize economic loss during the productive life of vegetable. He suggests comparing conventional method of irrigation at the farmer field. They told that the

drip irrigation system is a profitable investment. The system reached a discounted payback in the fourth year after investment if proper training for operation and maintenance be given to the growers. They quantify their costs and benefits for fruit trees and found it cost- effective as compared to the other methods of irrigation.

He also conducted the field experiments and compares the drip irrigation with others conventional irrigation system on the various vegetable crops and resulted the water use efficiency (90-95 percent) and higher fertilizer use efficiency.

Reddy *et al.* (2004) studied that the drip irrigation systems are increasingly being used by the Indian farmers to irrigate about 35 crops. The present paper discusses the economic feasibility and prospects of adopting drip irrigation for fruits, vegetables, sugarcane and cotton, Out of 6.5 M ha cultivated area under the above crops, 5.5 M ha is suitable for drip irrigation. The total projected area under drip irrigation is about 0.98 M ha by 2005 AD. An economic analysis of selected crops under drip shows that the net profits range from Rs. 4700 to Rs. 19780/ha. Fruit crops are more favored with a maximum B:C ratio of 3.43 followed by sugarcane 2.41. The projected capital requirement up to 2005 AD is about Rs.22687 million to bring an additional 0.76 M ha area under drip irrigation, from the 1998 level. The corresponding net profits are estimated at Rs.12182 millions per year. This implies that there is a need to accelerate the rate of increase in area under drip irrigation.

Namara *et al.* (2007) found that the some of the innovations reduce cost of production, improve the quality of produce and entail positive environmental externalities. However, the current level of adoption of these innovations is not satisfactory due to insufficient labour and organic fertilizer availability problems, uncertain irrigation water supply, crop specificity and complexity, lack of capital, high knowledge and technical skill requirements. To realize the potential benefits of

these innovations to the poor the following actions are suggested: (1) provision of subsidies; (2) targeted training opportunities; (3) encouragement of private participation in the supply chain of inputs; (4) focus on short pay-back period technologies; (5) strengthening of public research on the systems.

Bhanu Rekha *et al.* (2008) analyzed that the water and fertilizer are the two important inputs for agricultural production and are inter relatedin their effect on plant growth and yield. Since, water and fertilizer are costly inputs, every effort must be made to enhance water and fertilizer use efficiency by reducing their wastage. In recent years fertigation – a technique of application of both water and fertilizers via an irrigation system was shown to be very effective in achieving higher water and fertilizer use efficiency. In this method both water and fertilizer are delivered precisely in the crop root zone as per the crop needs and according to crop developmental phase. Increased growth and yield with drip irrigation has been reported in several crops and the increase in yield ranged between 7-112 percent depending on the crops varieties and method of irrigation compared. The water and fertilizer saving through drip fertigation have been reported to be 40-70 and 30-50 percent respectively.

Jalajakshil *et al*. (2009) analyzed that the impact of Krishik Bandhu (KB) drip irrigation has been reported on productivities, incomes and benefit-cost ratios of Sugarcane, Banana, Chilli**,** and Cotton in 51 villages of Tamil Nadu, Maharashtra and Madhya Pradesh states. The crop productivities, income and benefit- cost ratios under drip irrigation method have been found far higher in all the crops and in all the selected regions of these three states compared to those under the conventional flood irrigation method. The Krishik Bandhu (KB) drip irrigation technology has found to be far superior then the flood irrigation method.

Kumar *et al*. (2010) concluded that the micro irrigation in general and drip irrigation in particular has received considerable attention from policy maker, researchers, economists etc. For it perceived ability to contribute significantly to groundwater resources development, agricultural productivity, economic growth, environmental sustainability. In this paper, the impact of drip irrigation has been studied in farming system in terms of cropping pattern, resources use and yield. The drip method of irrigation has been found to have a significant impact on resources saving, cost of cultivation, yield of crop, farm profitability. Hence, the policy should be focused on promotion of drip irrigation in those regions where scarcity of water and labour is alarming and where sift toward wider- spaced crops is taking place.

Vijayakumar *et. al* (2010) studied that the Field experiments were conducted (Field No. NC-17) at Agricultural Research Station, Bhavanisagar during 2007 and 2008 to maximize the water and fertilizer use efficiency in Brinjal crop. In Brinjal, higher yields (42.33 t ha^{-1} in I crop and 37.90 t ha^{-1} in II crop) were recorded in treatment of drip irrigation. The highest water use efficiency of 111.5 kg ha^{-1} mm^{-1} were recorded in drip irrigation.

Palanisami *et al*. (2011) studies that the adoption of micro-irrigation projects has resulted in water saving, yield and income enhancement at the farm level. However, the overall impression is that they are capital-intensive and suited to large farms. In this context, a study was undertaken in nine states, mainly to examine the actual area covered compared to the potential area and to understand the adoption level of mi as well as to analyse the cost and returns under different farm categories. The results indicated that only about 9% of the mi potential is covered in the country. Key suggestions include reduction in capital cost of the system, provision of technical support for operation after installation, relaxation of farm size limitation in providing

subsidies and the establishment of a single state level agency for implementation of the programme.

Woltering *et. al* (2011) analyzed that the Low pressure drip irrigation is being promoted in Sub Saharan Africa as an alternative to traditional methods of small scale irrigation of vegetables. The African Market Garden (AMG) is a horticultural production system for smallholders based on low-pressure drip irrigation combined with an improved crop management package. The agronomic and economic performance of the AMG is compared to two gardens irrigated manually with watering cans. One of these gardens is managed according to the same improved crop management package as in the AMG, this treatment is called Improved Management (IM). The other garden is managed according to common practices of vegetable producers in the area, this treatment is called the Farmer Practice (FP). Crop productivity, labor and water use were monitored for two vegetable species (okra and eggplants). The experiment was performed on-station in Niger on three adjacent 500m2 plots in a sandy acid soil. It was found that improved crop management practices greatly enhance crop productivity over traditional methods at comparable production costs. The AMG gave higher crop yields and higher returns to investment than the treatments irrigated with watering cans. Labor accounts for up to 45 per cent of the production cost in vegetable gardens irrigated by hand, where 80 per cent of the producer time is spent on irrigation. The total labor requirement for the drip irrigated AMG was on average 1.1 man hours per day against 4.7 man hours per day for the Farmers Practice on a 500m2 garden. Returns on labor are at least double for the AMG against the other treatments. The returns on land from eggplant were found to be US$ 1.7, 0.8 and 0.1 per m2 for the AMG, IM and FP respectively. The returns on water for the cultivation of eggplant are around US$ 2 per m3 in the AMG, against

US$ 0.1 in the Farmers Practice. This experiment showed the strong positive impact of drip irrigation and improved crop management practices on profits at minimal environmental costs, indicating that transformation of existing practices poses a considerable potential towards sustainable agricultural development.

Heumesser (2011) analyzed that the irrigated agriculture will play a crucial role to meet future food demand, but a sustainable water resource management in agriculture is crucial as well. Therefore, the European Water Framework Directive promotes several measures, e.g., the adoption of adequate water pricing mechanisms or the promotion of water-saving irrigation techniques. Since production conditions such as weather and climate development are uncertain, farmers might be reluctant to invest in a water-saving but capital intensive irrigation system. We apply a stochastic dynamic programming approach to analyze a farmer's optimal investment strategy for either a water–saving drip irrigation system or sprinkler irrigation system under weather uncertainty and assess the probability of adopting either irrigation system until the year 2040. We design two policy scenarios: (i) irrigation water pricing and (ii) equipment subsidies for drip irrigation, and investigate how they affect the farmer's optimal investment strategy. Our case study analysis is performed for the region Marchfeld, a typical semi-arid agricultural production region in Austria. We find that investment in drip irrigation is unlikely unless subsidies for equipment cost are granted. Even water prices do not increase the probability to adopt a drip irrigation system, but rather decrease the probability to invest into either irrigation system.

Srivastava *et al.* (2012) focused that the considerable savings in water can be achieved by adoption of drip/ sprinkler (micro) irrigation systems in water scarcity areas, having conditions conducive to their application. However, eliminated in drip method in which water is directly trickled in the soil near the root zone of the crop

resulting in considerable saving and is particularly more suitable to row crops. 25 to 60 per cent water is saved in drip method and increased yield up to 60 per cent is obtained compared with conventional surface irrigation methods.

Kumar (2012) analyzed that factors limiting or enhancing the adoption of drip irrigation systems, and policy actions needed at different levels to speed up the adoption of drip irrigation and groundwater development. The drip method of irrigation is found to have a significant impact on resources saving, cost of cultivation, yield of crops and farm profitability. The adoption of drip irrigation is significantly influenced by experience, farm size, proportion of wider spaced crops and participation in non-farm income activities. The policies should focus on promotion of drip irrigation in those regions where scarcity of water and labour is severe and where shift towards wider-spaced crops is taking place.

Singh et. al (2013) analyzed that the vegetables are very popular and have occupied important place in the daily foods of most of the Indian population for nutritional sufficiency. The vegetable production in India has increasing trends. Its production has raised form 88.622 million tons with an area of 6.156 million hectare during 2001-02 to 156.3 million tons from area of 8.98 million hectare during 2011-12. The production is to be raised to 225 million tons by 2025, to cater the minimum requirement of vegetables for the ever increasing population. The huge gap between present production and future requirements necessitates enhanced vegetable production. But, urbanization, and industrialization impose constraints of decreased arable land as well as share of water to agriculture year after year. Consequently, agriculture in the future has to produce ever increasing quantities of food with decreasing quantities of water available for irrigation. Therefore, efficient utilization of water for irrigation assumes great significance.

Traditional irrigation methods utilized in about 90 per cent irrigated area in country have low field level application efficiency of 40-50 per cent. Whereas, drip irrigation may achieve field level application efficiency of 80-90 per cent, as surface runoff and deep percolation losses are minimized. It improves irrigation control with smaller frequent application, supplies nutrients to the crop as needed, results At present, about more than 1.3 M ha land under vegetables and high value crops is being irrigated through drip irrigation in India.

MATERIALS AND METHODS

CHAPTER – III

MATERIALS AND METHODS

This chapter deals with the materials and research methodology adopted for the present study with respect to the selection of study area, selection of respondents, collection of data and analytical techniques. The details of the method and technique adopted for the present study is described as below:

3.1Format of Investigation:

The present study was under taken to assess the economic practicability of drip irrigation in the Durg and Rajnandgaon district where irrigation systems could be converted from conventional to drip irrigation system for vegetable production. Therefore to evaluate the objective of study the present result is based on the procedure mention below.

3.1.1Selection of study area:

There are 27 districts in Chhattisgarh state. Out of 27 districtsDurgand Rajnandgaon district was selected purposively.From Durgdistrict, Durgand Dhamdha blockswere selected purposively. From Rajnandgaon District, Rajnandgaon and Dongargaon were selected purposively for the present study. The purpose of present study was to compare the drip method with conventional method of irrigation for vegetable production. Therefore a complete list of drip adopter farmers and vegetable growing villages were collected from the Deputy Director of Horticulture (DDH) office situated at the district headquarter. Four villages were selected on the basis of maximum area under drip irrigation namelykotni, mohlai from Durg block and kanharpuri, jatagharra from Dhamdha block in Durg district. Janglesar, mohad villages from Rajnandgaon blocks and mchanpar, kohka villages from Dongargaon blocks in Rajnandgaon district was selected purposively.

3.1.2 Selection of respondents (vegetable growers):

Farmers adopting drip irrigation system with vegetable crops were considered as respondents. For the present study 60 vegetable growers were selected from Durg and Rajnandgaon Districts.Therefore among the major vegetable growing farmers, the farmers using drip method of irrigation were selected. In the last a sample of 40 drip adopter and 20 non drip adopter farmers having good land holding were chosen randomly as the respondents and personally interviewed to acquire useful information for representing the result of the study. These drip adopter respondents were compared with those respondents practicing conventional method of irrigation for vegetables production. The selected farmers were categorized into small (1-2 ha), medium (2-4 ha) and large (above 4 ha). In total 60 farmers were selected for the study comprise of 10 small, 10 medium and 20 large farmers for drip adopters and 12 small, 5 medium and 3 large farmers for non-drip adopters.

3.1.3 Selection of vegetable crops:

Durg and Dhamdha block in Durg district and Rajnandgaon and Dongargaon block in Rajnandgaon district has earned a fame of producing vegetables like Tomato, Brinjal, Cabbage, Capsicum, Okra etc. Thus in the study area, a variety of vegetable crops are grown successfully. Out of these, five vegetable crops namely Tomato, Brinjal, Okra, Cabbage and Chilli, were selected for the study since maximum potentiality of drip irrigation are being use to irrigate such crops. Similarly these vegetables are also being raised on commercial scale by those farmers using conventional method of irrigation.

3.2Method of enquiry and collection of data:

Primary data from sampled farmers was collected through personal interview with the help of pre tested schedule/questionnaire on different aspects of drip

irrigation system. Data will also include all types of problems and constraints which are faced by the farmers in drip irrigation system. The data pertaining for the year 2011-12.

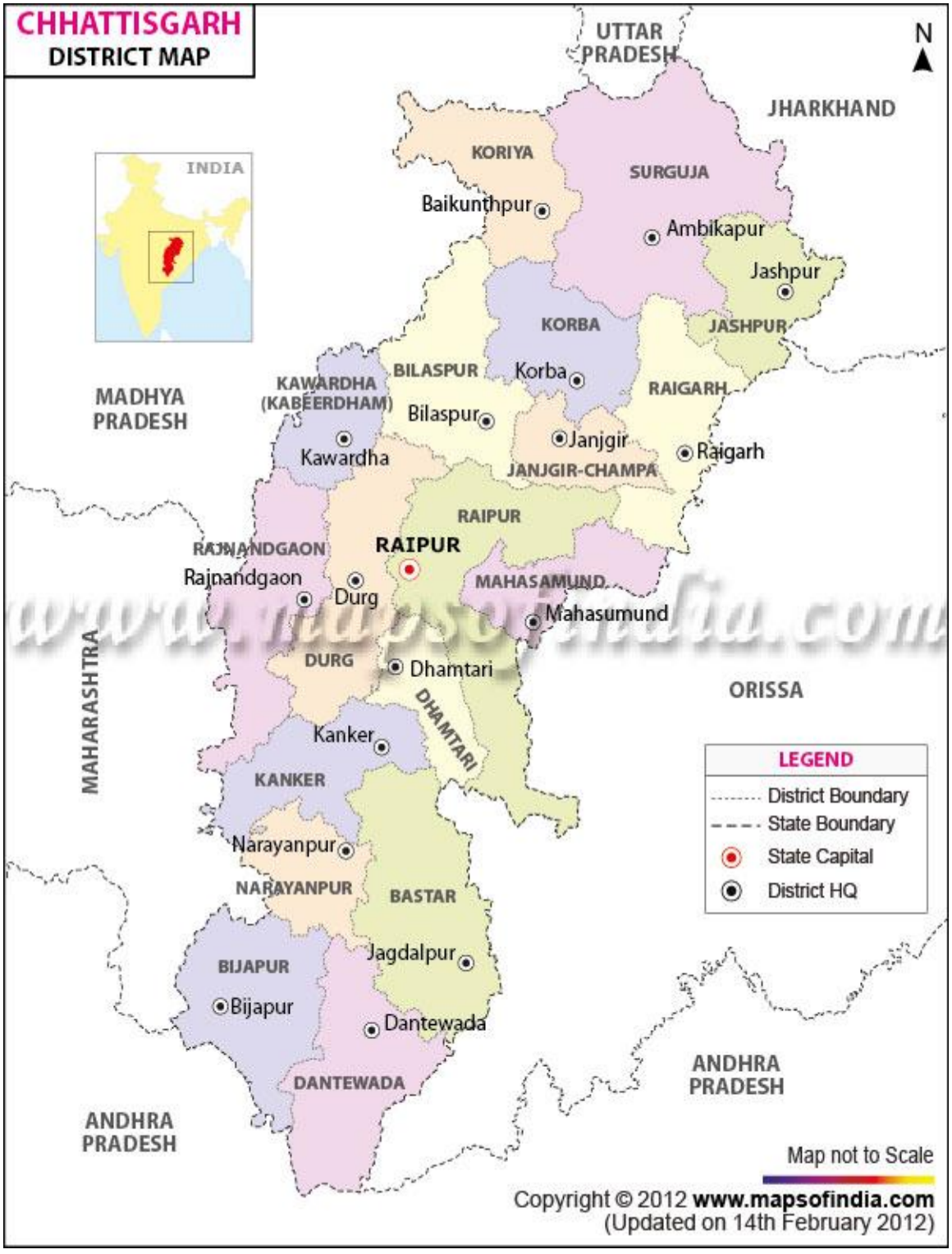
3.2.1 Primary data collection:

With respect to the different objectives of the study, the primaryinformation was collected by personal interview through the awell designed, pre-tested questionnaire (Appendix), during the study year 2011-12. This primary information included the land holding, cropping pattern, area under drip irrigation, area under vegetable crops, input cost, cost of drip irrigation, labours cost, irrigation charges, yields response, reason for drip adoption, saving of water, and the agencies from where they brought the drip system of irrigation.

Similarly information on the monetary gap about cost of cultivation through drip method of irrigation and conventional method of irrigation were also collected. It included the fixed cost of establishment of drip irrigation, total operating cost of drip irrigation, depreciation and maintenance &repair cost for drip irrigation system. The reasons behind adoption on drip system of irrigation were also discussed with the respondent and information was gathered.

Information regarding change in the cropping pattern of the respondent was also collected during the investigation.

Map No. –3.1 Map of Chhattisgarh state



Map-3.2: Map of the study area

3.2.2 Secondarydata collection:

The secondary data were collect from village patwari, Block office, Commissioner Land Record, Department of Agriculture, Department of Horticulture. The data collected from these sources are land utilization pattern, area under vegetables , sources of irrigation, irrigated area of different block, cropping pattern , soil types, area under drip irrigation, and profile of block etc. existing in the study area.

3.3 Period of enquiry:

The detail enquiry was done for the agricultural year 2011-12.

3.4Analytical Tools:

The primary data compiled and tabulated in order to achieve the desired objectives and analyzed by applying suitable statistical methods/tools for proper presentation of results.

3.5 Economics of crop production:

Cost studies in agriculture provide basic information and knowledge in formulation and evaluation of economic policies both at micro and macro level. Analytical results of cost data serve three sets of purpose (i) Help farmers in making readjustments and reallocations in the organization. Operation and management of their farms and resource endowments in order to achieve optimum level of production, income and employment, (ii) Make available basic inputs- output data in formulating policies and programmes at the national level such as price policy, and (iii) Generate and accumulate basic economic data for academic pursuits such as teaching and research aids and materials.

Owned inputs which were used in production of major crops as follows:

1. Family Human Labour

The value of family human labour used on the farm was imputed at the hiring wage rates prevailing in the area.

2. Bullock Labour

Own bullock labour was charged at the hiring rates for bullock pair prevailing in the locality.

3. Seed

The cost of home grown seed was calculated at the market rates prevailing in the area at the time of sowing.

4. Manures

Farm yard manures produced on the farm are valued at the prevailing rates in the locality (i.e. per cart load basis)

Purchased manures are charged at the actual prices paid plus transportation coast. The residual effect of the farm manures has been ignored.

5. Fertilizers

Fertilizers, such as IFFCO, Urea are charged at the actual price paid plus transportation cost.

6. Plant protection charges

This includes the actual cost of insecticides, pesticides, fungicides, used plus the hiring charges of appliances.

7. Irrigation charges

The cost under this head is exclusively related to irrigated crops. The actual source of irrigation is canal, tanks and nala. The days of human labour put in for irrigation are taken into account as irrigation charges.

8. Land revenue and other cases

The land revenue and other cases were apportioned among the crops followed on the basis of the proportionate area under crops and their duration.

9. Rental Value Of Land

The rental value of land was imputed by 1 per cent of the gross value of the product.

10. Interest on Working Capital

The rate of interest charged was 3 per cent for working capital i.e. items of cost ‘ A’ and charged for half of the growing season of the crop.

11. Evaluation of Output:

Farm produce is cultivated at the actual price received by the farmers. Unsold produce is evaluated at the price fixed by government of Chhattisgarh state.

12. Measure of Comparison:

The following measures of comparison have been adopted:

a) Cost of cultivation per hectare

b) Net income per hectare

c) Cost of production per quintal

d) Material cost per hectare

e) Input-output ratio

f) Income analysis

g) returns

The following measures of comparison have been adopted:

a) Cost of cultivation per hectare

Cost of cultivation per hectare at the different cost concepts has been worked out for the sample holdings. It is worked out by dividing the total cost by the area under the crops.

b) Net income per hectare

Net income per hectare at the different cost concepts has been worked out by deducting the respective costs from the gross monetary returns per hectare.

c) Material cost per hectare

Material cost concept has been introduced recently. Material cost includes seeds, manures, fertilizers, irrigation and plant protection chemicals etc.

d) Input-output ratio

Input-output ratio indicates the efficiency of input. It is computed as under:

$$\text{Input –output ratio} = \frac{\text{Gross return}}{\text{Total input cost}}$$

e)Returns

Returns were noted in physical quantities i.e. quintals and the monetary values were calculated by taking into consideration their average market price.

3.6Socio - Economic profile of the study area

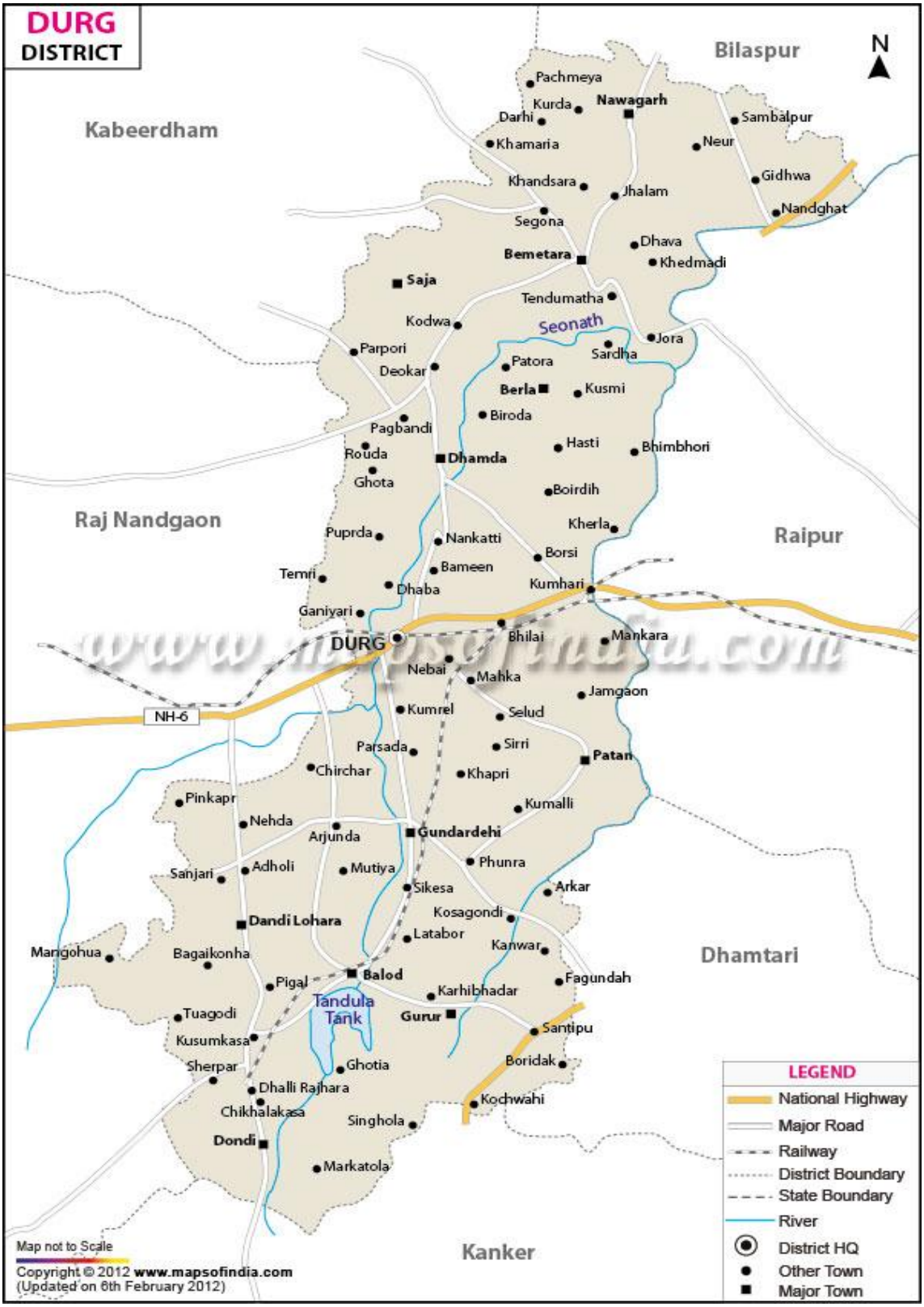
This section describes the overview of study area and the format of investigation employed. It includes profile of study area, climatic state, soil types, sourcesof irrigation, land utilization pattern and status of vegetable flora existing in the area under p study. Map-1 shows the location of the study area.

3.6.1 General features of the Durg and Rajnandgaon district under Chhattisgarh plain

This agro climatic zone covers 50 per cent of the geographical area of the state. The plains cover districts of Raipur, Mahasamund, Dhamtari, Durg, Rajnandgaon, Kawardha, Bilaspur, Korba, Janjgir-champa and a part of Kanker district (Narharpur&Kanker blocks) along with a part of Raigarh district.

3.6.1.1Geographical Features of the Durg district

This district is situated between 17-23.7^0 N latitude and 80.43-83.38^0 E longitudes in central western part of Chhattisgarh, with more than 15.93 lakh population. The total geographical area of the district is more than 2.32 lakh hectare.District is 317 meters above mean sea level. Durg district comprise of the 3 tehsil, 3 blocks,1 sub-division and 388 villages. The district is bounded by Bemetara district in the north, Rajnandgaon district in the west, Balod district in the south and Raipur district in the east. Durg district is situated on the Howrah-Mumbai main line of south-eastern railway. National Highway No. 6 also passes through the district.



Map 3.3: Durg district of map

Table 3.1:Geographical features of Durg District

S.No.	Particulars	Details
1.	Durg district: Location	Southwestern part of Chhattisgarh State
2.	Latitude	between 17-23.7^0 N
3.	Longitude	between 80.43-83.38^0 E
4.	Height from Sea Level	317 meters above
5.	Climate	Mainly three seasons- Summer, Winter, Rainy
6.	Total Population (Census 2011 (provisional))	3343872
a.	Urban Population	1284765
b.	Rural Population	2059107
7.	Literates	
a.	Urban Population	973,225
b.	Rural Population	1330153
8.	Average Literacy	
a.	PercentageUrban Population	85.59
b.	PercentageRural Population	74.88
9.	Different category of farmers-	
a.	Marginal	76013
b.	Small	27553
c.	Large	21666

Source: District Statistical Booklet (2011-12), District Planning and Statistical Office, Durg (Chhattisgarh)

Table 3.2: Administrative profile of the Durg district

S. No.	Administrative unit	Unit (In No.)
1.	No. of Sub Divisions	2
2.	No. of Tehsils	3
3.	No. of Blocks	3
4.	No. of Gram Panchayat	267
5.	No. of Village	388
7.	Nagar Palika	2

3.6.1.1.1 Land Utilization Pattern of Durg District

The district has total geographical area of 2.32 lakh ha. About 0.37 lakh ha.area was covered by the total horticulture area. The rabi cropped area and net irrigated area is about 51377 ha. and 1.01 lakh ha. respectively. The detail information about the land use pattern is presented in table 3.3.

Table 3.3: Land Utilization Pattern of Durg District

S.No.	Particulars	In ha.
1	Geographical area	2.32 lakh ha.
2	Net sown area (63per cent of its geographical area)	1.46 lakh ha
3	Total horticulture area(25 per cent of its net sown area)	0.37 lakh ha
4	Proposed horticulture area (after 5 years 2014-15) (27 per cent of its net sown area)	0.39 lakh ha
5	Percentage increase from 2011-12 to 2014-15	5
6	Percentagesoil (medium to light)	41
7	Average rainfall	1074mm.
8	1. Farm families (6.00per cent ST, 15.00per cent SC)	1.25 lakh
9	60 per centmarginal farmers own land	21
10	22 per cent small farmers own land	23
11	18 per cent others own land	85
12	Average land holding/family	1.16 ha
13	Under fruits- a. **Banana (**of the total cropped area of fruits (4998 ha.) b. Chili (of the total cropped area of spices (4135 ha.) c. Tomato (of the total cropped area of Vegetable (27380 ha)	 occupies 1475 ha occupies 2150 ha occupies 3775 ha
14	Rabi cropped area (Which constitutes only 35 per cent of the net sown area)	51377 ha
15	Net irrigated area	1.01 lakh ha. (69 per cent)

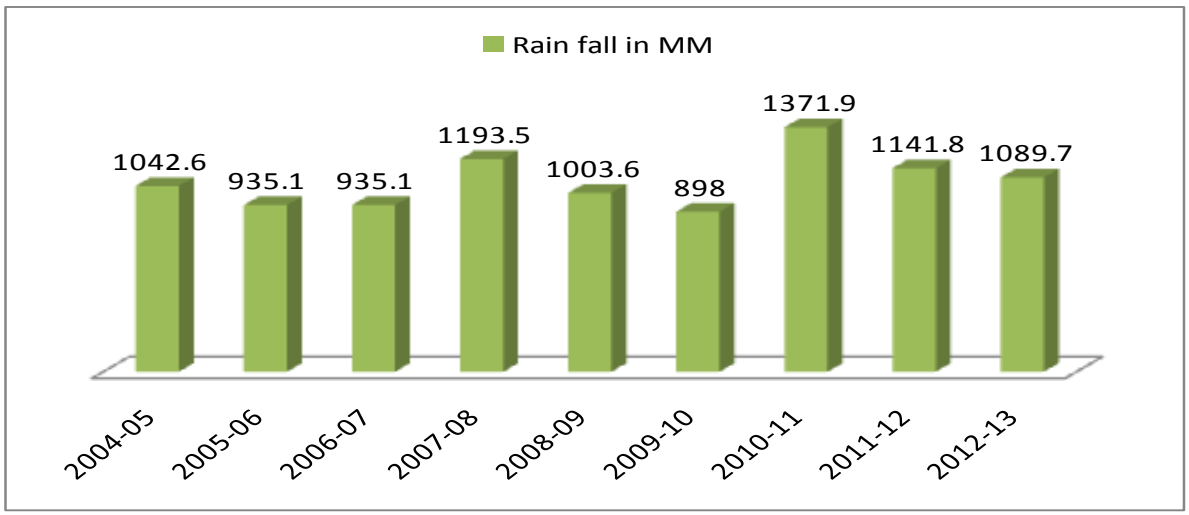
Source: District Statistical Booklet (2011-12), District Planning and Statistical Office, Durg (Chhattisgarh)

3.6.1.1.2. General climate feature

The general climate of Durgdistrict is dry sub-humid type where the annual potential evapo-transpiration is slightly higher than the annual rainfall. The average annual rainfall of the district is around 1072 mm and about 90 to 95 percent of this year is received during southwest monsoon season (June-October). The monsoon sets in around 10th June in the tip of the Bastar are the wettest months. 3 Rainfall in October month occurs due to cyclonic activity in the Bay of Bengal and October rainfall if most crucial for the productivity of rice in the district which adversely affect main rabi season and early rabiseason vegetable crops and increase input cast.

The atmospheric humidity is very high (>90 per cent) during monsoon months and starts decreasing from October onwards and reaches as low as 15-20 percent during peak summer months.

Average Rain Fall of the District in Mission Period and before Mission Period



3.6.1.1.3. Soil Type

District has four different type of soils Bhata, Matasi, Dorsa and Kanhar. Bhata soil also known as Lateritic soil mainly rich from gravels, sand and iron. Matasi soil also known as sandy loam humus rich soil and best for Horticultural crops with irrigation facility. Dorsa soil also known as clay loam soil which is rich of clay

particles and Kanhar soil which has very poor drainage and good for water loving crops like rice etc.(In the district Bhata and Matasi soil covers about 40 per cent of the cultivated land . In this type of soil have greater potential and scope to increase horticultural crops area by providing irrigation and fencing facilities).

3.6.1.1.4. Agro- Climatic Zones

This district comes under agro-climatic central zones of plain.

3.6.1.1.5. Present Irrigation Scenario

District has 62 per cent cultivated area under irrigation through different sources of irrigation which is presented in following diagram. Horticultural crops required assured irrigation which should be through be tube wells or through well and pump or river and pump, through such type of irrigation district has more than 0.95 lakh hectare area out of which we have covered under horticulture today about per cent that area.(Through crop diversification district has greater opportunity to cover all the tube well irrigated area under horticulture crop with the development of required drainage channel)

Table 3.4: Irrigated area under Different Source total= 101197 ha.

S.No.	Irrigation Source	Total no. of Irrigation Source	Area
1.	Canal	108	55087
2.	Tank (Small)	203	7880
3.	Tube well	7197	44221
4.	Wells	2075	1122
5.	Other source	-	6893
	Total	9583	115203

Source: District Statistical Booklet (2011-12), District Planning and Statistical Office, Durg (Chhattisgarh)

3.6.1.1.6. Importanceof Horticulture

Horticulture plays important role in livelihood security of poor farmers. It provides food security and perennial source of income to poorest of poor. It is a dynamic tool for ensuring ecological sustainability.

i) Food Security

Food security envisages adequacy, stability as well as economic and physical access to food to all people at all times. There may be enough food but if the poor do not have access to it, the food security will not be complete. Enhances horticulture production helps-

a. Direct contribution to food basket.
b. Sale of surplus horticulture produces enables to have access to food.

ii) Perennial source of income

Land and Water are two most important natural endowments but they are renewable but finite resources. However, with judicious mix of interventions like development of irrigation facilities, application of improved and modern horticulture practices and creation of other income generation activities based on natural resources, the possibilities of creating perennial source of income can be enhanced. Perennial source of income can be ensured through.

a. Development of infrastructure especially for irrigation.
b. Value addition and processing of horticulture produce.
c. Vermi-composting in rural areas to promote organic farming.

Table 3.5: Basic Information about the DurgDistrict

S. No	Particular	Area in Ha.
1.	About Geographical Area	232000
I	.(i) Area under Cultivation	146400
	(ii) Percentage of cultivated land over geographical area	63
a	(i)Agricultural Land	115583
	(ii)Percentage of agricultural land over total cultivated land.	79
b	(i) Horticultural Land	37653
	(ii)Percentage of Horticultural land over cultivated land	32
	(iii)Percentage of forest area under geographical area	----
III	(i)Area under not cultivable land	40032
	(ii)Percentage of not cultivable land over geographical area.	17
IV	(i)Area under Pasture	19067
	(ii)Percentage of Pasture land over Geographical area	8
V	(i) Cultivable Fellow land	11927
	(ii)Percentage of cultivable Fellow land over Geographical area	5
VI	(i) Present cultivable Fellow land	4710
	(ii) Percentage of present cultivable Fellow land over Geographical area	2

Source: District Statistical Booklet (2011-12), District Planning and Statistical Office, Durg (Chhattisgarh)

3.6.1.2General features of the Rajnandgaon district

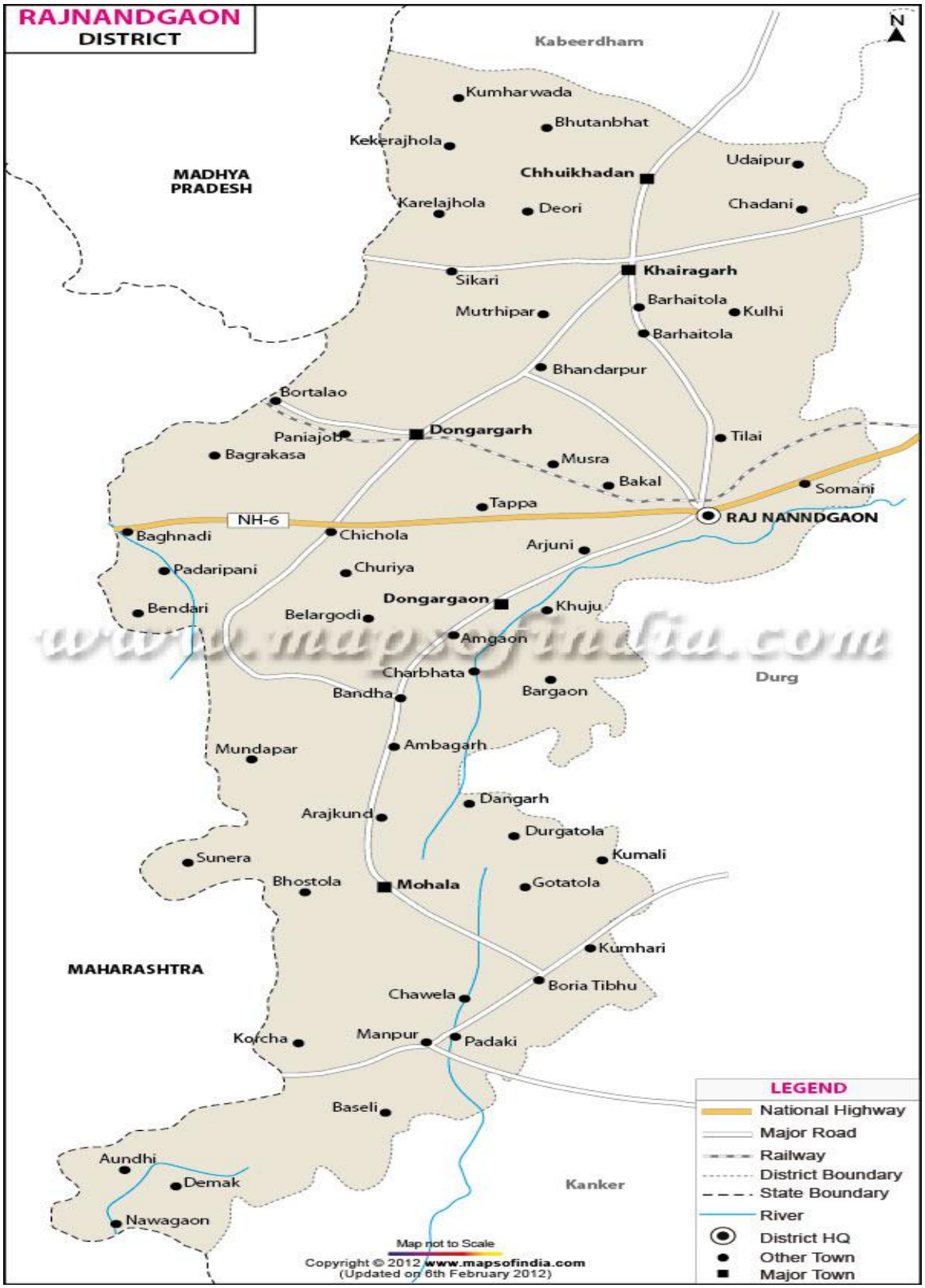
The Rajnandgaon District is located in the centre of the Chhattisgarh state and lies between20^0 07’ and 22^0 29’ north latitudes and 80^0 23’ and 81^0 24’ eastern longitudes with varying elevation ranging from 330 to 350 meters above mean sea levels. This district has covering an area of 8023 sq. km. It was formed on 26th January in 1973, by separating from the Durg district. It was originally called Nandgram, but was again divided on 1st July 1998 and the new district of Kawardha was formed. The total population of the district is 12,83,224, consisting of 6,34,342 males and6,48,882 female population.The river Sheonath and its tributaries

Kharkhara, Sonbarsa, Amner, Surhi, Karra, Murkati, Sankari, Fonk and Hanf flow through the district. The three blocks of Rajnandgaon District are Mohla, Manpur and Chowki. The main tribes that inhabit the district are Gond, Kanwar, Halba and Baiga, who are nearly 25.16 per cent of the total population of the district. These tribal areas are adjoining to Gadchiroli District of Maharastra and Baster District of Madhya Pradesh. Since Rajnandgaon is located on the southeastern railways between the Bombay-Howrah line, it is can be easily accessed by the rest of India. It is well connected by the road as the National Highway 6 passes through the town of Rajnandgaon.

Table 3.6: Administrative profile of the Rajnandgaon District

S. No.	Administrative unit	Unit (In No.)
1.	No. of Sub Divisions	5
2.	No. of Tehsils	9
3.	No. of Sub-Tehsils	1
4.	No. of Blocks	9
5.	Tribal Blocks	3
6.	Revenue Villages	1685
7.	Forest Villages	5
8.	Revenue Circle	16
9.	Patwari Circle	283
10	Assembly Constituencies	6
11.	Parliamentary Constituency	1
12.	Nagar Palik Nigam	1
13.	Nagar Palika	2

Source: District Statistical Booklet (2011-12), District Planning and Statistical Office, Rajnandgaon(Chhattisgarh)



Map-3.4: Map of the Rajnandgaon district in Chhattisgarh

Table 3.7: Geographical features of Rajnandgaon District

S. No.	Particulars	Details
1.	Durg district: Location	**Western corner of the state**
2.	Latitude	20.07" North to 22.2"9 North
3.	Longitude	80.2 East to 81.2"4 East
4.	Height from Sea Level	330.70
5.	Climate	**Tropical**
6.	Main Crop	Paddy, Wheat
7.	Cropped Area	359098
8.	Double Cropped Area	91243
9.	Total Irrigated Area	68003
10.	Main Oilseed Crops	Soyabin, Tilhan
11.	Minerals	Limestone, China clay, Quartzite, Quartz, Granite, White Clay

Source: District Statistical Booklet (2011-12), District Planning and Statistical Office, Rajnandgaon(Chhattisgarh)

3.6.1.2.1Demographic features of Rajnandgaon District

Rajnandgaon surrounds the Kabirdham district in north, Kanker in south, Durg in east and Balaghat district of M. P. in west. The Rajnandgaon district is administratively divided in three sub-divisions along with 9 Block in which 696 gram panchayat and 1680 villages.

3.6.1.2.2 Present Irrigation Scenario:

In the district the net irrigation area is 93,450 ha. Which constitutes 25.58 per cent of net sown are, most important source of irrigation being surface water where irrigation by Canals & Tanks which constitutes 60.8 per cent of the net irrigation area. It is the district without power deficit, district.

Table 3.8:Demographic features of Rajnandgaon district

S.No.	Particulars	Rajnandgaon district
1.	Total Population (‘000 Nos)	1283224
a.	Male	634342
b.	Female	648882
c.	Total	1283224
d.	Urban	231647
e.	Rural	1051577
2.	Percentage of rural population to total population (per cent)	81.94
3.	Percentage of SC population to total population (per cent)	9.92
4.	Percentage of ST population to total population (per cent)	26.62
5.	Population Density per sq. km.	159
6.	Population Growth Rate (1991-2001)	17.83
7.	Percentage of district population to state population	6.43
8.	No. of Literates 2010 (Nos)	997676
a.	Male	554638
b.	Female	443038
9.	Literacy Rates (per cent)	
a.	Percentage of Male	87.2
b.	Percentage of Female	67.6
c.	Total	77.4
10.	Rural Literacy Rates (per cent)	
a.	Male	87.40
b.	Female	65.10
c.	Total	76.35
11.	Urban Literacy Rates (per cent)	
a.	Male	91.80
b.	Female	73.90
c.	Total	82.85
12.	Agricultural labour (per cent)	35.21
13.	Total Worker (per cent)	45.98
14.	Sex Ratio (Female/1000)	1023
a.	Urban	937
b.	Rural	1057

Source: District Statistical booklet (2010-11), District Planning and Statistical Office, Rajnandgaon (C.G.)

Table 3.9: Source wise irrigated area in Rajnandgaon District

S.No.	Source of irrigation	Area (in lac ha.)	percentage
1	Canals	0.53	56.67
2	Tanks	0.038	4.13
3	Tube-wells	0.23	24.35
4	Wells	0.096	10.35
5	Other Sources	0.041	4.44
Total-		**0.935**	**100**

Source: Horticulture Department of C.G. Government, District-Rajnandgaon (2012)

3.6.1.2.3 Land Utilization Pattern of Rajnandgaon District:

The land utilization pattern of the study area is presented in Table 3.10.It is clear from that the geographical area of the Rajnandgaon district is 802252 hectares. The net area in the Rajnandgaon district is 45.53 Per cent respectively. The percentage of forest area in study area is 32.34 per cent and cropping intensity of Rajnandgaon district was 136 per cent.

Table3.10:Land Utilization Pattern of Rajnandgaon District

S.No.	Particulars	In ha.
1	Geographical area (5.82 per cent of the state) Net sown area (63% of its geographical area)	802252 ha. 1.46 lakh ha
2	Net sown area (45.53 per cent of its geographical area) (25% of its net sown area)	365323 ha.
3	Total horticulture area during 2008-09. (3.8 per cent of its net sown area)	0.14 lakh ha
4	Proposed horticulture area (after 5 years 2014-15) (5.47 per cent of its net sown area)	0.2 lakh ha
5	Percentage increase after 5 years from the 2008-09	42.5
6	Percentageof soil (medium to light)	60
7	Forest covers (32.34 per cent of its geographical area)	2.59474 lakh ha
8	Average rainfall	1274 mm.
9	Farm families (27 per cent ST, 10 per cent SC)	2.55546 lakh

10	49.98 per centmarginal farmers own land	34.96
11	25 per cent small farmers own land	35
12	25.02 per cent others own land	30.02
13	Average land holding/family	1.42 ha
14	Under fruits- a. Mango (of the total cropped area of fruits (1818 ha.) b. Chili (of the total cropped area of spices (2217 ha.) c. Potato (of the total cropped area of Vegetable (9787 ha)	 Occupies 1032 ha Occupies 1055ha Occupies 1250 ha
15	Rabi cropped area (Which constitutes only 38 per cent of the net sown area)	1.419 lakh ha
16	Net irrigated area	93.450 lakh ha. (25.5 per cent)
17	Percentageof cropping intensity	135

Source: Horticulture Department of C.G. Government, District-Rajnandgaon (2012)

3.6.1.2.4 General climatic features

The most favoured factor of Rajnandgaon district is climate. Climatic conditions are very idle for growing most of the horticulture crop. Maximum temperature is 440C and the minimum temperature is 10-120C. Average temperature remains around 230to 240C. Relative humidity is also high which is congenial for optimum growth and cultivation of horticultural fruit crops like Banana, Mango, Lime, Guava, Papaya and Custard apple and vegetables like Tomato, Brinjal, Chilli, Bitter guard, Okra andKundru.

3.6.1.2.5 Cropping pattern of Rajnandgaon District

Paddy is the major crop occupying the largest area to the total cropped area (Table3.11). Chickpea, Soyabean and Wheat are other crops. The average yield of principal crops grown in the district is quite low.

Table 3.11: Cropping pattern of Rajnandgaon District

S. No.	Season/Crop	Area (in ha.)	Percentage to total area
A.	**Kharif**		
1.	Rice	158358.67	31.30
2.	Maize	4896	0.96
3.	Jowar	40	0.09
4.	Other cereals	7620	1.51
5.	Arhar	24560	4.86
6.	Moong	4147	0.82
7.	Urd	18532	3.66
8.	Tiwda	23977	4.74
9.	Soyabean	48470	9.58
10.	Groundnut	20	0.004
11.	Sunflower	97	0.01
12.	Til	4900	0.97
13.	Sugarecane	10.5	0.002
14.	Vegetables/Others	11067.5	2.18
	Sub Total	**306695.67**	**60.65**
B.	**Rabi**		
15.	Wheat	25560	5.05
16.	Rice	79179.33	15.65
17.	Maize	2448	0.48
18.	Jowar	20	0.003
19.	Sugarcane	10.5	0.002
20.	Gram	57534	11.37
21.	Pea	1565	0.31
22.	Masoor	1984	0.39
23.	Kulthi	4434	0.88
24.	Mustard	4158	0.82
25.	Linseed	10449	2.07
26.	Safflower	512	0.10
27.	Sunflower	194	0.03
28.	Ramtil	10	0.002
29.	Vegetables/Others	11067.5	2.18
	Sub Total	**199125.33**	**39.35**
	Total	**505821**	**100.00**

Source: Agriculture Department of C.G. Government, District-Rajnandgaon (2011-12)

RESULTS AND DISCUSSION

CHAPTER - IV

RESULTS AND DISCUSSION

This chapter deals with all those aspects of objectives, which were considered for representing the results of the present study. The findings, which were obtained during the investigation of the thesis problem, are given in this chapter into various sections. Each section of this chapter has been thoroughly discussed in context of the need of study. The present chapter has broadly been discussed under the following sub headings:-

4.1 General characteristics of the sample households.

4.1.1 Demographical characteristics of sample households

4.1.2 Land use pattern under drip irrigation

4.1.3 Change in cropping pattern with adoption of drip irrigation

4.2 Economics of the drip irrigation

4.2.1 Installation cost of drip irrigation

4.2.2 Cost of cultivation of selected vegetables

4.2.3 Feasibility of Drip irrigation for vegetable crops

4.3Factors affecting for the adoption of drip irrigation

4.4 Constraints in Implementation of Drip Irrigation program

4.5 Suggest policy alternative for enhancing the Drip irrigation

4.1 General Characteristics of the Sample Households:

4.1.1 Demographical characteristics of sample households:

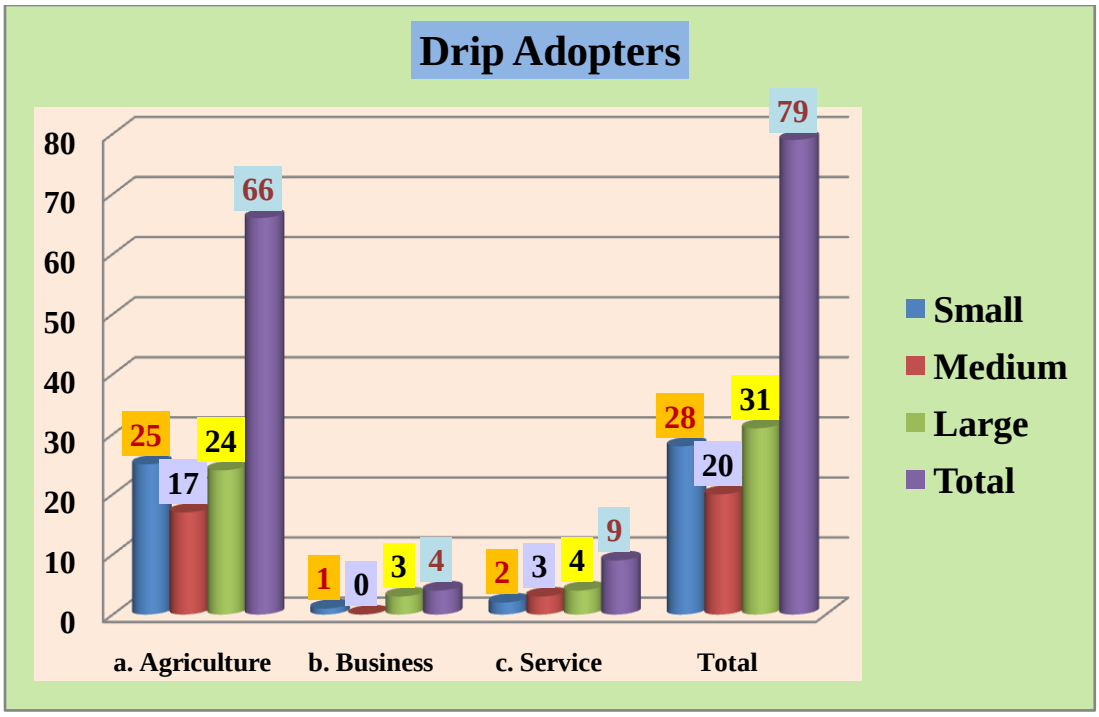
The demographic characteristics of the sampled farmers in the study area are described in Table 4.1 and Fig.4.1, Fig.4.2 and Fig. 4.3. It can be seen from the table that the average family size was 4.9 of drip farmers and 5.0 of non-drip farmer. The other backward caste, general shared 72.50 per cent and 27.50

Table 4.1 Demographical characteristics of sample households

S. No.	Particulars	Drip Farmers				Non-drip Farmers			
		Small	Medium	Large	Total	Small	Medium	Large	Total
1	**No. of sample household**	**10 (100)**	**10 (100)**	**20 (100)**	**40 (100)**	**12 (100)**	**05 (100)**	**03 (100)**	**20 (100)**
2	**Social group**								
	a. Other backward castes	08 (80.00)	06 (60.00)	15 (75.00)	29 (72.50)	11 (91.67)	04 (80.00)	03 (100.00)	18 (90.00)
	b. General	02 (20.00)	04 (40.00)	05 (25.00)	11 (27.5)	01 (8.33)	01 (20.00)	-	02 (10.00)
	Total	**10 (100)**	**10 (100)**	**20 (100)**	**40 (100)**	**12 (100)**	**05 (100)**	**03 (100)**	**20 (100)**
3	**No. of family members**								
	a. Male	30 (50.84)	24 (52.17)	52 (56.52)	106 (53.80)	31 (55.35)	17 (62.96)	07 (41.17)	55 (55.00)
	b. Female	29 (49.15)	22 (47.82)	40 (43.47)	91 (46.19)	25 (44.64)	10 (37.03)	10 (58.82)	45 (45.00)
	Total	**59 (100)**	**46 (100)**	**92 (100)**	**197 (100)**	**56 (100)**	**27 (100)**	**17 (100)**	**100 (100)**
	Average of family size	5.9	4.6	4.6	4.9	4.6	5.4	5.6	05.00
4	**Age group**								
	I. Below 14 years	11 (18.64)	04 (8.69)	20 (21.73)	35 (17.76)	19 (33.92)	03 (11.11)	04 (23.52)	26 (26.00)
	II. 14-60 years	42 (71.18)	40 (86.95)	71 (77.17)	153 (77.66)	36 (64.28)	24 (88.88)	13 (76.47)	73 (73.00)
	III. Above 60 years	06 (10.16	02 (4.34)	01 (1.08)	09 (4.56)	01 (1.78)	-	-	01 (1.00)
	Total	**59 (100)**	**46 (100)**	**92 (100)**	**197 (100)**	**56 (100)**	**27 (100)**	**17 (100)**	**100 (100)**

5	**Occupation working members**								
	a. Agriculture	25 (89.28)	17 (85.00)	24 (77.41)	66 (83.54)	37 (100.00)	18 (100.00)	06 (85.71)	61 (98.38)
	b. Business	01 (3.57)	-	03 (9.67)	04 (5.06)	-	-	-	-
	c. Service	02 (7.14)	03 (15.00)	04 (12.90)	09 (11.39)	-	-	01 (14.28)	01 (1.61)
	Total	**28 (100)**	**20 (100)**	**31 (100)**	**79 (100)**	**37 (100)**	**18 (100)**	**07 (100)**	**62 (100)**
6	**Education**								
	a. Illiterate	12 (20.33)	05 (10.86)	10 (10.86)	27 (13.70)	18 (32.14)	08 (29.62)	04 (23.52)	30 (30.00)
	b. Primary	16 (27.11)	07 (15.21)	10 (10.86)	33 (16.75)	15 (26.78)	03 (11.11)	02 (11.76)	20 (20.00)
	c. Middle	18 (30.50)	11 (23.91)	17 (18.47)	46 (23.35)	12 (21.42)	06 (22.22)	06 (35.29)	24 (24.00)
	d. Higher secondary school	10 (16.94)	17 (36.95)	25 (27.17)	52 (26.39)	11 (19.64)	09 (33.33)	02 (11.76)	22 (22.00)
	e. Above higher secondary school	03 (5.08)	06 (13.04)	30 (32.60)	39 (19.79)	-	01 (3.70)	03 (17.64)	04 (4.00)
	Total	59 (100)	46 (100)	92 (100)	197 (100)	56 (100)	27 (100)	17 (100)	100 (100)
	Literacy per cent	**79.67**	**89.14**	**89.14**	**86.3**	**67.86**	**70.38**	**76.48**	**70.00**

Note: Fighers in the parenthesis indicate the percentages to total number of family member



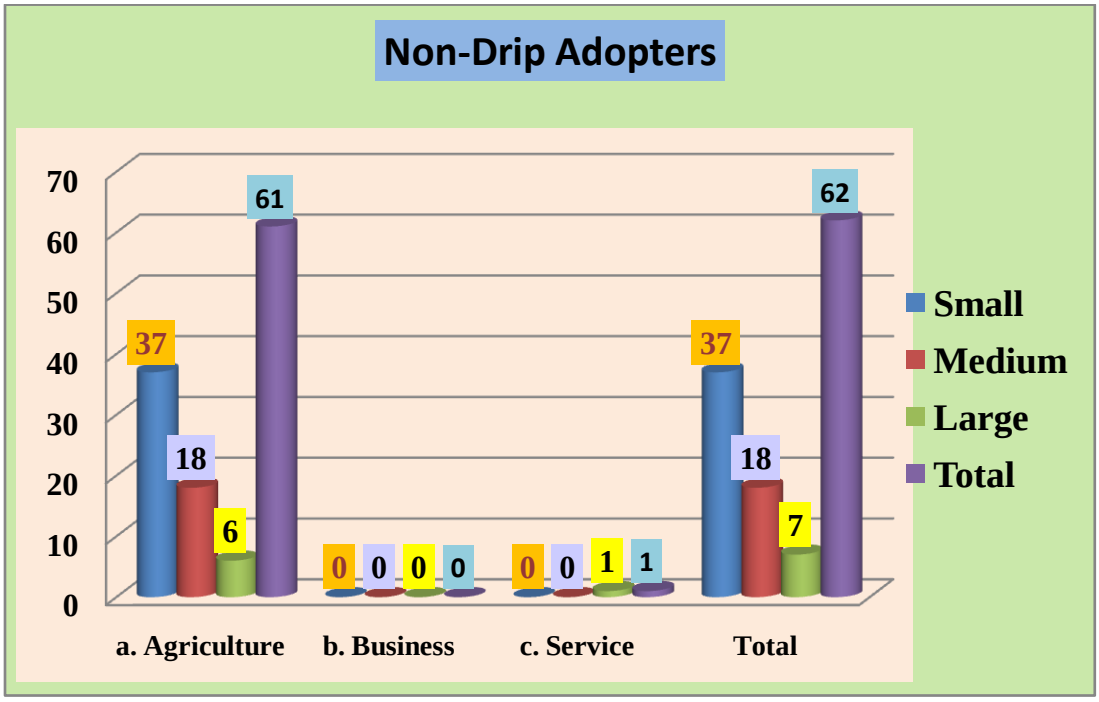


Fig.4.1: Occupation of drip adopters and non-drip adopers

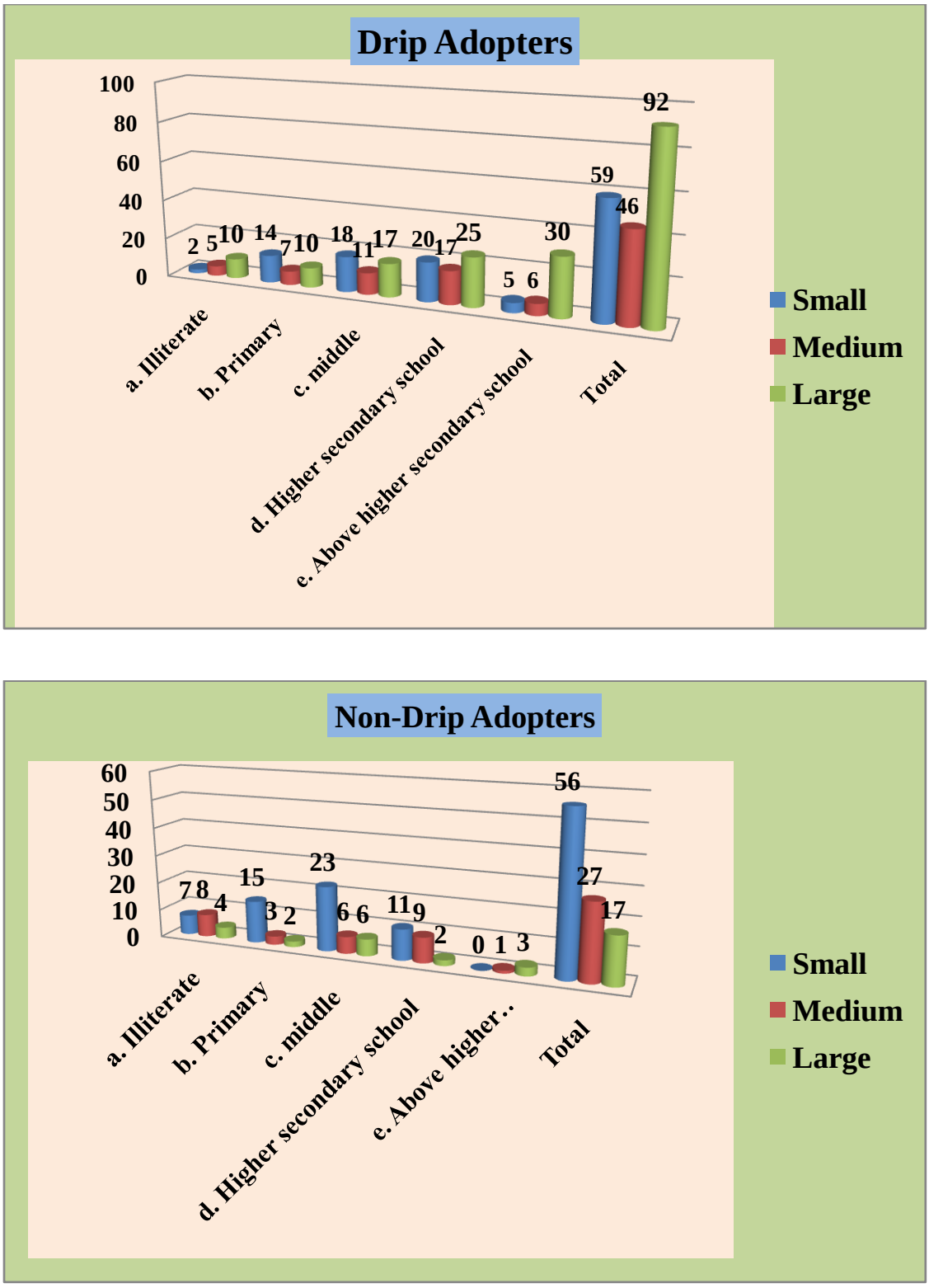
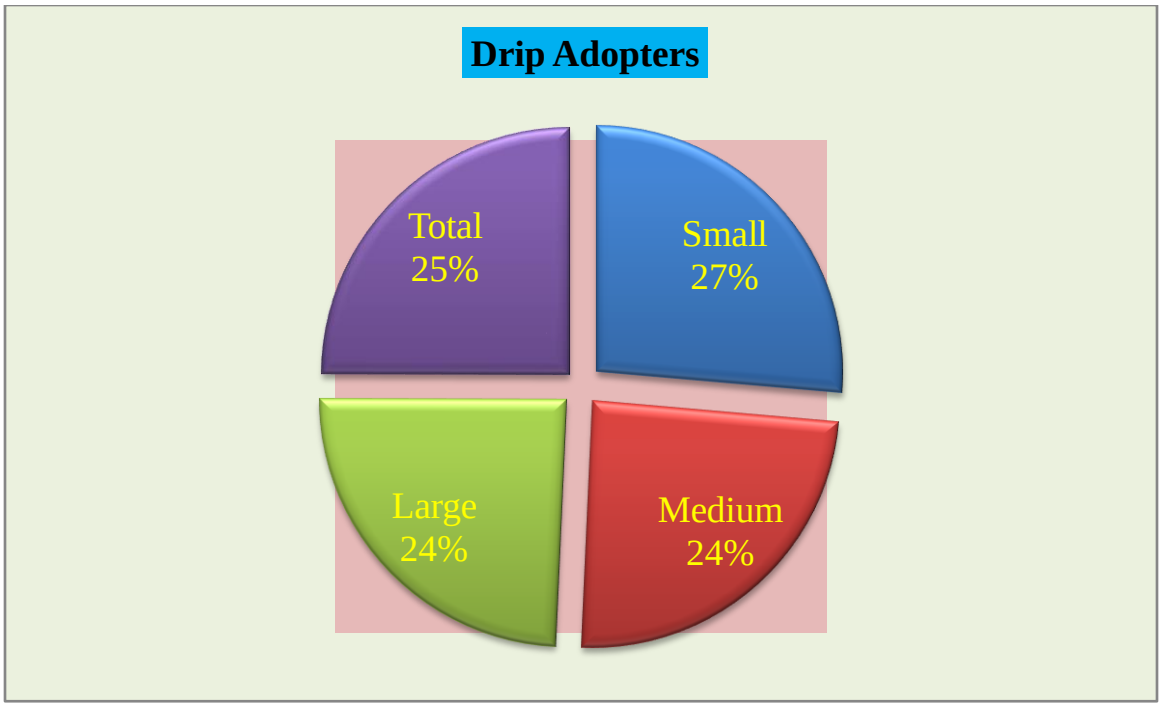


Fig.4.2: Education of drip adopters and non-drip adopters



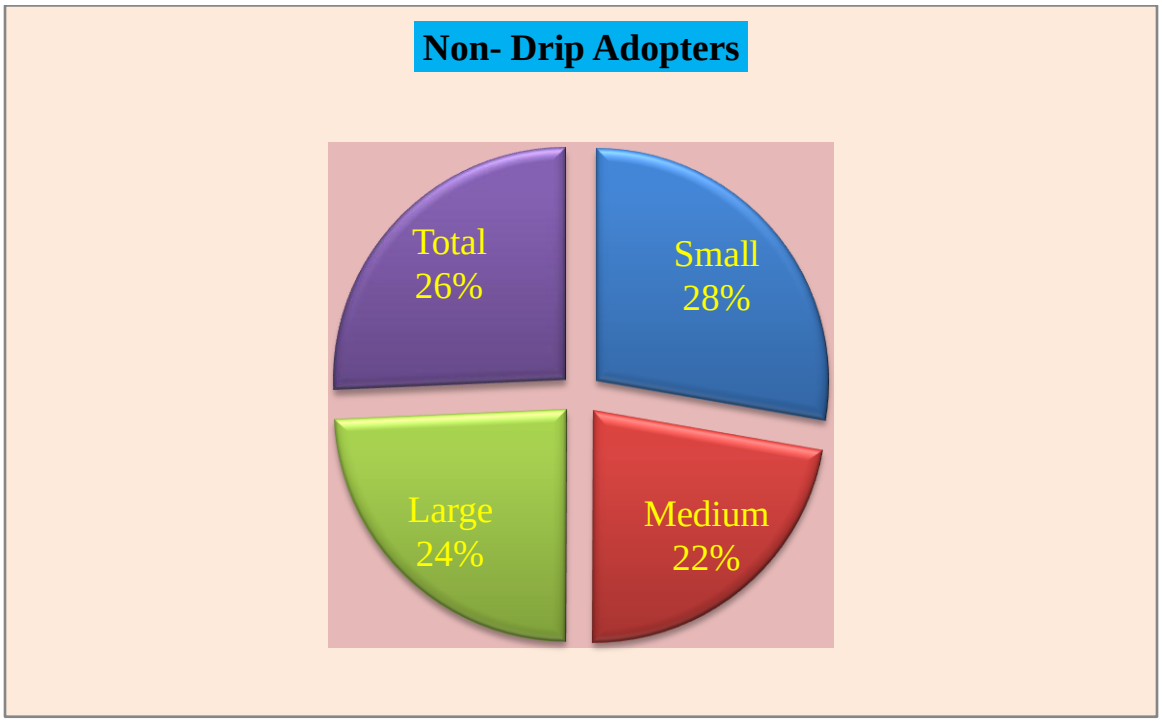


Fig 4.3: Literacy per cent of drip adopters and non-drip adopters

per cent of drip farmers and 90 per cent, 10 per cent of non-drip farmers to the total population of sample household. About 77.66 per cent and 73 per cent sample population belong to 14-60 year age group of drip and non-drip farmers respectively. The sample population of drip and non-drip-farmers below than 14 years of age group was observed to be 17.76per cent and 26 per cent while remaining of 4.56 per cent and 1.00 per cent population falls in the age group above 60 years. The overall male and female ratio was observed to be 53:46 of sample population. The farmers of study area were found to be highly educated and noticed approximately 86.30 per cent and 70.00 per cent of literacy was drip and non drip farmers among the members of sample householdsrespectively.

The occupation detail of drip and non-drip farmers among sample households indicated that 83.54 per cent and 98.38 per cent of sample households. Involved in the agriculture as a primary occupation. Agriculture was a occupation and it was varied from 77.41 to 85.00 per cent drip farmers and 85.71 to 100.00 per cent non-drip farmers among large to medium farm households. Service was the second important source of income and followed to be 11.37 per cent drip and 1.61 per cent non drip member of sample households. Other sources of income among the sample household was business in the study area.

4.1.2 Land use pattern under drip irrigation

In acquire the necessary information on the land use pattern under drip irrigation 40 respondents and conventional irrigation 20 respondent from eight selection villages namely kotani, mohlai from Durg block and kanharpuri, jatagharra from Dhamdha block in Durg district. Janglesar, mohad villages from Rajnandgaon

blocks and mchanpar, kohka villages from Dongargaon blocks in Rajnandgaon district were introduced and information regarding their land holding under drip irrigation was composed for the study. Here all the 40 farmers were exclusively drip adopters and 20 farmers non-drip adopters. Table 4.2 shows the percent wise share of land use pattern under the drip irrigation. On the bases of information gathered from the respondent farmers they were grouped according to their land holding in vegetable production under drip irrigation. After manipulation of collected information it was found that the out of total farmers, 25 farmers holds up to 5 ha, 7 farmers hold between 5 to 10 ha, 3 farmers hold between 10 to 15 ha, 2 farmers between 15 to 20 ha and only 3 farmers holds between 20 to 50 ha area under drip irrigation in the study area. From the above discussion it seems that not only large farmers but also even small farmers are also using drip irrigation vegetable production.

Table 4.2: Land use pattern of selected farmer under drip irrigation

S.No.	Average holding under drip irrigation	No. of farmers
1.	5	25
2.	5-10	7
3.	10-15	3
4.	15-20	2
5.	20-25	3

4.1.3 Change in cropping pattern with adoption of drip irrigation

In Durg and Rajnandgaon district drip irrigation are generally adopted by the farmers to irrigate the vegetable crops in their farms .Table 4.3 and Table 4.4shows the cropping pattern of the selected farmers before the adoption of drip irrigation table 4.3shows the existing cropping pattern of the selected respondents. It was observed that before adoption of drip irrigation the area under cereals and pulses covered 59.09

Table 4.3: Cropping pattern before adoption of drip irrigation of sample household

S. No.	Particulars	Drip method				Conventional method			
		Small	Medium	Large	Overall	Small	Medium	Large	Overall
(A.) (I)	Kharif season Cereals and pulses								
	a. Paddy	6.42 (22.58)	12.56 (23.61)	82.45 (20.00)	101.43 (20.53)	3.46 (17.12)	4.78 (19.36)	5.45 (20.87)	13.69 (19.27)
	b. Maize	2.25 (7.91)	5.39 (10.13)	46.32 (11.24)	53.96 (10.92)	2.43 (12.02)	2.56 (10.36)	2.76 (10.57)	7.75 (10.91)
	c. Urd	2.67 (9.39)	4.37 (8.21)	37.55 (9.11)	44.59 (9.02)	1.65 (8.16)	3.27 (13.24)	1.67 (6.39)	6.59 (9.28)
	d. Soyabean	2.98 (10.48)	2.67 (5.02)	25.46 (6.18)	31.11 (6.29)	1.78 (8.80)	1.65 (6.68)	2.27 (8.69)	5.70 (8.02)
	e. Others	1.35 (4.75)	5.82 (10.94)	53.57 (12.99)	60.74 (12.29)	2.24 (11.08)	1.98 (8.01)	2.37 (9.07)	6.59 (9.28)
	Sub- total	**15.67 (55.13)**	**30.81 (57.93)**	**245.35 (59.51)**	**291.81 (59.09)**	**11.56 (57.19)**	**14.24 (57.67)**	**14.52 (55.61)**	**40.32 (56.78)**
(II)	**Vegetables**								
	a. Tomato	2.89 (10.16)	5.47 (10.28)	45.78 (11.10)	54.14 (10.96)	2.08 (10.29)	2.23 (9.03)	3.25 (12.44)	7.56 (10.64)
	b. Brinjal	2.56 (9.00)	3.48 (6.54)	39.88 (9.67)	45.92 (9.29)	1.12 (5.54)	2.35 (9.51)	2.46 (9.42)	5.93 (8.35)
	c. Cabbage	1.47 (5.17)	2.76 (5.18)	14.68 (3.56)	18.91 (3.82)	1.15 (5.69)	1.32 (5.34)	1.24 (4.74)	3.71 (5.22)
	d. Cauliflower	1.32 (4.64)	2.87 (5.39)	12.46 (3.02)	16.65 (3.37)	1.11 (5.49)	1.12 (4.53)	1.15 (4.40)	3.38 (4.75)
	e. Okra	1.25 (4.39)	1.92 (3.61)	8.95 (2.17)	12.12 (2.45)	1.18 (5.83)	1.42 (5.75)	1.18 (4.51)	3.78 (5.32)

	f..Chilli	1.28 (4.50)	1.98 (3.72)	12.69 (3.08)	15.95 (3.22)	0.65 (3.21)	1.16 (4.69)	1.08 (4.13)	2.89 (4.06)
	g.Others	1.98 (6.96)	3.89 (7.31)	32.46 (7.87)	38.33 (7.76)	1.36 (6.72)	0.85 (3.44)	1.23 (4.71)	3.44 (4.84)
	Sub-total	**12.75 (44.86)**	**22.37 (42.06)**	**166.90 (40.49)**	**202.02 (40.90)**	**8.65 (42.80)**	**10.45 (42.32)**	**11.59 (44.38)**	**30.69 (43.21)**
	Total	**28.42 (100)**	**53.18 (100)**	**412.25 (100)**	**493.85 (100)**	**20.21 (100)**	**24.69 (100)**	**26.11 (100)**	**71.01 (100)**
(B.) (I)	**Rabi season Cereals and pulses**								
	a. Lathyrus	2.52 (8.86)	4.78 (4.98)	42.25 (10.24)	49.55 (10.03)	1.45 (7.17)	2.65 (10.73)	2.24 (8.57)	6.34 (8.92)
	b. Wheat	4.38 (15.41)	9.45 (17.76)	58.76 (14.25)	72.59 (14.69)	2.78 (13.75)	3.45 (13.97)	4.13 (15.81)	10.36 (14.58)
	c. Gram	1.95 (6.86)	4.76 (8.95)	32.41 (7.86)	39.12 (7.92)	1.25 (6.18)	2.63 (10.65)	2.09 (8.00)	5.97 (8.40)
	d. Mung	1.88 (6.61)	3.26 (6.13)	38.24 (9.27)	43.38 (8.78)	1.23 (6.08)	1.43 (5.79)	1.26 (4.82)	3.92 (5.52)
	e. Urd	1.85 (6.50)	3.28 (6.16)	26.12 (6.33)	31.25 (6.32)	1.14 (5.64)	1.18 (4.77)	1.18 (4.51)	3.50 (4.92)
	f. Others	2.95 (10.38)	4.67 (8.78)	45.22 (10.96)	52.84 (10.69)	2.38 (11.77)	1.30 (5.26)	2.26 (8.65)	5.94 (8.36)
	Sub-total	**15.53 (54.64)**	**30.20 (56.78)**	**243 (58.94)**	**288.73 (58.46)**	**10.23 (50.61)**	**12.64 (51.19)**	**13.16 (50.40)**	**36.03 (50.73)**
(II)	**Vegetables**								
	a.Tomato	2.59 (9.11)	5.25 (9.87)	42.56 (10.32)	50.40 (10.20)	2.28 (11.28)	3.08 (12.47)	3.26 (12.48)	8.62 (12.13)
	b.Brinjal	2.36 (8.30)	4.36 (8.19)	35.48 (8.60)	42.2 (8.54)	2.21 (10.93)	2.34 (9.47)	2.46 (9.42)	7.01 (9.87)

	c Cabbege	1.89 (6.65)	3.49 (6.56)	16.47 (3.99)	21.85 (4.42)	1.12 (5.54)	1.25 (5.06)	1.48 (5.66)	3.85 (5.42)
	d. Cauliflower	1.85 (6.50)	2.96 (5.56)	18.35 (4.45)	23.16 (4.68)	0.95 (4.70)	1.28 (5.18)	1.65 (6.31)	3.88 (5.46)
	e.Okra	1.35 (4.75)	2.16 (4.06)	13.46 (3.26)	16.97 (3.43)	0.85 (4.20)	1.22 (4.98)	1.24 (4.74)	3.31 (4.66)
	f. Chilli	1.67 (5.87)	2.25 (4.23)	16.48 (3.99)	20.40 (4.13)	1.18 (5.83)	1.24 (5.02)	1.32 (5.05)	3.74 (5.26)
	g.Others	1.18 (4.15)	2.51 (4.71)	26.45 (6.41)	30.14 (6.10)	1.39 (6.87)	1.64 (6.64)	1.54 (5.89)	4.57 (6.43)
	Sub-total	**12.89 (45.35)**	**22.98 (43.21)**	**169.25 (41.05)**	**205.12 (41.53)**	**9.98 (49.38)**	**12.05 (48.80)**	**12.95 (49.59)**	**34.98 (49.26)**
	Total cropped area	**72.51 (100)**	**137.17 (100)**	**1069.85 (100)**	**1279.51 (100)**	**51.98 (100)**	**63.62 (100)**	**66.74 (100)**	**182.34 (100)**
	Net cropped area	**28.42 (100)**	**53.18 (100)**	**412.25 (100)**	**493.85 (100)**	**20.21 (100)**	**24.69 (100)**	**26.11 (100)**	**71.01 (100)**
	Double cropped area	**28.42 (100)**	**53.18 (100)**	**412.25 (100)**	**493.85 (100)**	**20.21 (100)**	**24.69 (100)**	**26.11 (100)**	**71.01 (100)**
	Cropping intensity	**255.13**	**257.93**	**259.51**	**259.08**	**257.19**	**257.67**	**255.61**	**256.78**

Note: Figures in the parenthesis indicate the percentages to total cropped area.

Table 4.4: Cropping pattern after adoption of drip irrigation of sample household

S. No.	Particulars	Drip				Non-drip			
		Small	**Medium**	**Large**	**Overall**	**Small**	**Medium**	**Large**	**Overall**
(A.) (I)	**Kharif season Cereals and pulses**								
	a. Paddy	5.68 (19.98)	12.45 (23.41)	76.11 (18.46)	94.24 (19.08)	3.52 (17.41)	4.98 (20.17)	5.42 (20.75)	13.92 (19.60)
	b. Maize	2.47 (8.69)	4.35 (8.17)	42.15 (10.22)	48.97 (9.91)	2.34 (11.57)	2.47 (10.00)	2.85 (10.91)	7.66 (10.78)
	c. Urd	1.18 (4.15)	3.25 (6.11)	36.11 (8.75)	40.54 (8.20)	1.48 (7.32)	3.12 (12.63)	1.34 (5.13)	5.94 (8.36)
	d. Soyabean	1.65 (5.80)	2.21 (4.15)	24.14 (5.85)	28.00 (5.66)	1.25 (6.18)	1.35 (5.46)	1.42 (5.43)	4.02 (5.66)
	e. Others	2.78 (9.78)	4.66 (8.76)	36.05 (8.74)	43.49 (8.80)	2.19 (10.83)	1.28 (5.18)	2.44 (9.34)	5.91 (8.32)
	Sub- total	**13.76 (48.41)**	**26.92 (50.62)**	**214.56 (52.04)**	**255.24 (51.68)**	**10.78 (53.33)**	**13.20 (53.46)**	**13.47 (51.58)**	**37.45 (52.73)**
(II)	**Vegetables**								
	a. Tomato	3.47 (12.20)	5.37 (10.09)	49.53 (12.01)	58.37 (11.81)	2.12 (10.48)	2.46 (9.96)	3.18 (12.17)	7.76 (10.92)
	b. Brinjal	2.50 (8.79)	3.46 (6.50)	46.21 (11.20)	52.17 (10.56)	1.37 (6.77)	2.00 (8.10)	2.42 (9.26)	5.79 (8.15)
	c. Cabbege	1.35 (4.75)	2.32 (4.36)	12.78 (3.10)	16.45 (3.33)	1.18 (5.83)	1.83 (7.41)	1.20 (4.59)	4.21 (5.92)
	d. Cauliflower	2.45 (8.62)	4.98 (9.36)	15.46 (3.75)	22.89 (4.63)	1.04 (5.14)	1.66 (6.72)	1.00 (3.82)	3.70 (5.21)
	e. Okra	1.67 (5.87)	3.15 (5.92)	10.58 (2.56)	15.40 (3.11)	1.06 (5.24)	1.57 (6.35)	1.46 (5.59)	4.09 (5.75)

	f. Chilli	1.48 (5.20)	3.20 (6.01)	15.78 (3.82)	20.46 (4.14)	0.98 (4.84)	1.30 (5.25)	1.13 (4.32)	3.41 (4.80)
	g. Others	1.74 (6.12)	3.78 (7.10)	47.35 (11.48)	52.87 (10.70)	1.68 (8.31)	0.67 (2.71)	2.25 (8.61)	4.60 (6.47)
	Sub-total	**14.66 (51.58)**	**26.26 (49.37)**	**197.69 (47.95)**	**238.61 (48.31)**	**9.43 (46.66)**	**11.49 (46.53)**	**12.64 (48.41)**	**33.56 (47.26)**
	Total	**28.42 (100)**	**53.18 (100)**	**412.25 (100)**	**493.85 (100)**	**20.21 (100)**	**24.69 (100)**	**26.11 (100)**	**71.01 (100)**
(B.) (I)	**Rabi season Cereals and pulses**								
	a. Lathyrus	1.32 (4.64)	3.98 (7.48)	45.86 (11.12)	51.16 (10.35)	1.46 (7.22)	1.36 (5.50)	2.46 (9.42)	5.28 (7.43)
	b. Wheat	3.67 (12.91)	7.35 (13.82)	49.67 (12.04)	60.69 (12.28)	3.20 (15.83)	4.05 (16.40)	3.98 (15.24)	11.23 (15.81)
	c. Gram	1.98 (6.96)	3.49 (6.56)	32.82 (7.96)	38.29 (7.75)	1.12 (5.54)	1.47 (5.95)	1.58 (6.05)	4.17 (5.87)
	d. Mung	1.88 (6.61)	2.92 (5.49)	28.93 (7.01)	33.73 (6.83)	0.85 (4.20)	1.08 (4.37)	0.89 (3.40)	2.82 (3.97)
	e. Urd	1.96 (6.89)	2.67 (5.02)	24.98 (6.05)	29.61 (5.99)	1.17 (5.78)	1.49 (6.03)	1.06 (4.05)	3.72 (5.23)
	f. Others	1.98 (6.96)	3.89 (7.31)	20.35 (4.93)	26.22 (5.30)	1.69 (8.36)	2.43 (9.84)	2.18 (8.34)	6.30 (8.87)
	Sub-total	**12.79 (45.00)**	**24.30 (45.69)**	**202.61 (49.14)**	**239.70 (48.53)**	**9.49 (46.95)**	**11.88 (48.11)**	**12.15 (46.53)**	**33.52 (47.20)**
(II)	**Vegetables**								
	a. Tomato	3.95 (13.89)	6.36 (11.95)	42.65 (10.34)	52.96 (10.72)	2.36 (11.67)	3.15 (12.75)	2.45 (9.38)	7.96 (11.20)
	b. Brinjal	2.89 (10.16)	5.85 (11.00)	69.32 (16.81)	78.06 (15.80)	2.16 (10.68)	2.05 (8.30)	2.75 (10.53)	6.96 (9.80)
	c. Cabbege	2.5 (8.79)	4.00 (7.52)	18.14 (4.40)	24.64 (4.98)	1.08 (5.34)	1.46 (5.91)	1.59 (6.08)	4.13 (5.81)

	d. Cauliflower	2.66 (9.35)	4.40 (8.27)	23.30 (5.65)	30.36 (6.14)	1.22 (6.03)	1.85 (7.49)	1.70 (6.51)	4.77 (6.71)
	e. Okra	1.78 (6.26)	2.12 (3.98)	17.77 (4.31)	21.67 (4.38)	1.35 (6.67)	1.28 (5.18)	1.20 (4.59)	3.83 (5.39)
	f. Chilli	1.00 (3.51)	2.90 (5.45)	19.99 (4.84)	23.89 (4.83)	1.25 (6.18)	1.37 (5.54)	1.62 (6.20)	4.24 (5.97)
	g.Others	0.85 (2.99)	3.25 (6.11)	18.47 (4.48)	22.57 (4.57)	1.30 (6.43)	1.65 (6.68)	2.65 (10.14)	5.60 (7.88)
	Sub-total	**15.63 (54.99)**	**28.88 (54.30)**	**209.64 (50.85)**	**254.15 (51.46)**	**10.72 (53.04)**	**12.81 (51.88)**	**13.96 (53.46)**	**37.49 (52.79)**
	Total cropped area	**56.84**	**106.36**	**824.5**	**987.7**	**40.42**	**49.38**	**52.22**	**142.02**
	Double cropped area	**28.42**	**53.18**	**412.25**	**493.85**	**20.21**	**24.69**	**26.11**	**71.01**
	Net cropped area	**28.42 (100)**	**53.18 (100)**	**412.25 (100)**	**493.85 (100)**	**20.21 (100)**	**24.69 (100)**	**26.11 (100)**	**71.01 (100)**
	Cropping intensity	**200**	**200**	**200**	**200**	**200**	**200**	**200**	**200**

Note: Figures in the parenthesis indicate the percentages to total cropped area.

per cent kharif and 58.46 per cent rabi season in drip irrigation and 56.78 per cent kharif and 43.21 per cent rabi season in conventional irrigation. However, the vegetable contribute 40.90 per cent kharif and 41.53 per cent rabi season in drip irrigation and 43.21 per cent kharif and 34.98 per cent rabi season in conventional irrigation method.

Whereas,Table 4.4 shows after the adoption of drip irrigation the area under cereals and pulses crop cover 51.68 per cent kharif and 48.53 per cent rabi season under drip irrigation in other hand. 52.73 per cent kharif and 47.20 per cent rabi season cover in conventional method. However, the vegetable contribute 48.31 per cent kharif and 51.46 per cent rabi season in drip irrigation and 47.26 per cent kharif and 52.79 per cent rabi season in conventional irrigation method. Area under vegetable crops increases in drip irrigation i.e. 41.22 per cent up to 49.88 per cent. From the above Table it is concluded that before the adoption of drip irrigation the area under cereals and pulses crop was more while after the adoption of drip irrigation the area under vegetable crops was increases.

4.2 Economics of Drip Irrigation

4.2.1 Installation cost of drip irrigation

The information with reference to the installation cost of drip irrigation is mostly based on the secondary data collected from the Directorate of Horticulture, Chhattisgarh Government, Netafim Limited and Jain Irrigation Private Limited Raipur Chhattisgarh. The main determinants of the cost of the drip irrigation system are power sources and eventually the amounts of capital investment depend on the factors mentioning below.

1. Type of crops and soil
2. Hectares to be irrigated and frequency of application.
3. Distance from desired use, elevation and availability of water sources.

4. Existing farm equipment.

The total installation costs and the main items of drip system of irrigation for vegetable crops production are presented in the Table 4.5. The installation cost of drip irrigation mention in the table is applicable to 1 ha. block of land on flat basis. As explained in the table the general cost of investment is Rs. 80860 however such costs may vary. Generally it was observed during the investigation that the cost of investment in drip system of irrigation varies to a great extends. Table shows the variation in the drip system installation cost. It is mainly depend on the nature and the spacing at which a particulars vegetable crop has proposed to be grown. It can be concluded that the cost for drip system of irrigation is higher in case of inline system as compared to online system although both system are being used in the study area according to the investment capacity of farmers.

Table 4.5: Average cost of installation of drip irrigation system for vegetables.

S. No.	Equipment	Rs. Per hectare
1.	5.0 HP electric pump	22,000
2.	Drip Irrigation Pipe (Laterals 12”)	14,800
3.	Full Filter System	
a.	Main Pipe	5560
b.	Sub Main Pipe	3550
4.	Drippers	24050
5.	Start Connectors	1200
6.	Straight Connectors	150
7.	Stoppers	800
8.	PVC Fitting	1500
9.	Trencher	3400
10.	Sub Total	77010
11.	Installation Charges (5 per cent)	3850
12.	Total cost of installation	80860

Note: Cost may vary for drip irrigation system of varying company, type of crop and its spacing. (2011)

4.2.2 Cost of cultivation of selected vegetables

1.Tomato:

Table 4.6 clearly shows that the per hectare cost of cultivation of Tomato was higher on drip as compare to non-drip. It may be due to the fact that large drip farmers could incurred more expenditure on modern farm inputs like quality seed, fertilizer, plant protection material, hired labour etc. as a result of borrowing from different credit institutions and better economic status. The higher expenditure provides higher yield and returns on these farms as compare to other.

The average cost of cultivation per hectare of Tomato reported to Rs. 153293 in drip method and Rs. 113291 in conventional method. The cost of cultivation per hectare showed a rising trend with the rise in the size of farms as reported by the respondents.

Cost and return, yield, value of output, net income and input-output ratio of Tomato:

Table 4.7indicates that the per hectare average yield of Tomato come to 585 quintals and 293 quintals in drip and without drip farms. On an average the per hectare value of net income came to Rs. 314707 and Rs. 121109, respectively, on the sample drip farms and non-drip farms of the different sizes. The average input-output ratio in Tomato came to 1:3.05 and 1:2.06 on the sample drip and non-drip farms.

Table 4.6: Input wise cost of cultivation of Tomato on sampled house hold under drip irrigation and conventional irrigation

Rs./ha.

S.No.	Particulars	Drip Irrigation				Conventional Irrigation			
		Small	**Medium**	**Large**	**Overall**	**Small**	**Medium**	**Large**	**Overall**
1	**Human labour**								
(i)	Hired labour	82435 (57.35)	84998 (54.79)	86815 (53.93)	84749 (55.29)	56423 (56.19)	61395 (54.84)	69857 (54.78)	62558 (55.22)
(ii)	Family labour	2331 (1.62)	1865 (1.20)	1426 (0.89)	1874 (1.22)	3352 (3.34)	1645 (1.47)	1225 (0.96)	2074 (1.83)
	Sub- total	**84766 (58.97)**	**86863 (55.99)**	**88241 (54.81)**	**86623 (56.51)**	**59775 (59.53)**	**63040 (56.31)**	**71082 (55.75)**	**64632 (57.05)**
2	Machine power	11952 (8.31)	11986 (7.73)	12000 (7.45)	11979 (7.81)	11237 (11.19)	11837 (10.57)	11965 (9.38)	11680 (10.31)
3	Seed	4504 (3.13)	4495 (2.90)	4500 (2.80)	4499 (2.93)	2200 (2.19)	3960 (3.54)	4048 (3.17)	3402 (3.00)
4	Manure	6250 (4.35)	7499 (4.83)	10000 (6.21)	7916 (5.16)	2350 (2.34)	3750 (3.35)	5000 (3.92)	3700 (3.27)
5	**Fertilizer**								
(i)	N (Urea)	1425 (0.99)	1639 (1.06)	1852 (1.15)	1639 (1.07)	570 (0.57)	713 (0.64)	855 (0.67)	712 (0.63)
(ii)	P (SSP)	1275 (0.89)	1350 (0.87)	1500 (0.93)	1375 (0.90)	566 (0.56)	600 (0.54)	750 (0.59)	638 (0.56)
(iii)	K (MOP)	1898 (1.32)	2137 (1.38)	2375 (1.48)	2136 (1.39)	1425 (1.42)	1520 (1.36)	1615 (1.27)	1520 (1.34)
(iv)	Micro nutrient	3297 (2.29)	4400 (2.84)	5500 (3.42)	4399 (2.87)	1375 (1.37)	2750 (2.46)	4125 (3.23)	2750 (2.43)
6	Plant Protection	2567 (1.79)	3158 (2.04)	3172 (1.97)	2966 (1.93)	850 (0.85)	925 (0.83)	1015 (0.80)	930 (0.82)

7	Staking	16871 (11.74)	18866 (12.16)	18877 (11.73)	18205 (11.88)	14875 (14.81)	17688 (15.80)	21313 (16.71)	17958 (15.85)
8	Irrigation Charges	3359 (2.34)	6724 (4.33)	6724 (4.18)	5603 (3.66)	1284 (1.28)	816 (0.73)	798 (0.63)	966 (0.85)
	A. total	**138164 (95.12)**	**149117 (96.12)**	**154741 (96.12)**	**147340 (96.12)**	**96507 (96.11)**	**107599 (96.11)**	**122566 (96.11)**	**108888 (96.11)**
9	Miscellaneous	1381 (0.96)	1491 (0.96)	1547 (0.96)	1473 (0.96)	965 (0.96)	1075 (0.96)	1225 (0.96)	1088 (0.96)
10	Land Revenue	14.82 (0.01)	14.82 (0.01)	14.82 (0.01)	14.82 (0.01)	14.82 (0.01)	14.82 (0.01)	14.82 (0.01	14.82 (0.01)
	B. total	**139560 (97.09)**	**150623 (97.09)**	**156303 (97.09)**	**148828 (97.09)**	**97487 (97.09)**	**108689 (97.09)**	**123806 (97.09)**	**109991 (97.09)**
11	Interest on working capital	4187 (2.91)	4519 (2.91)	4689 (2.91)	4465 (2.91)	2925 (2.91)	3261 (2.91)	3714 (2.91)	3300 (2.91)
	Total input cost	**143747 (100)**	**155142 (100)**	**160992 (100)**	**153293 (100)**	**100411 (100)**	**111949 (100)**	**127520 (100)**	**113291 (100)**

Note: Fighers in parentheses indicate the per cent of total input cost

Table 4.7: Cost and return, yield, value of output, net income and input-output ratio of Tomato

(Rs./ha)

S. No.	Particulars	Drip irrigation				Conventional irrigation			
		Small	**Medium**	**Large**	**Overall**	**Small**	**Medium**	**Large**	**Overall**
1.	Input cost (Rs.)	143747	155142	160992	153293	100411	111949	127520	113291
2.	Vegetable yield (q./ha)	525	580	650	585	250	280	350	293
3.	Selling price (Rs./q)	800	800	800	800	800	800	800	800
4.	Gross income	420000	464000	520000	468000	200000	224000	280000	234400
5.	Net income	276253	308858	359008	314707	99589	112051	152480	121109
6.	Input-output Ratio	1:2.92	1:2.99	1:3.23	1:3.05	1:1.99	1:2.00	1:2.19	1:2.06

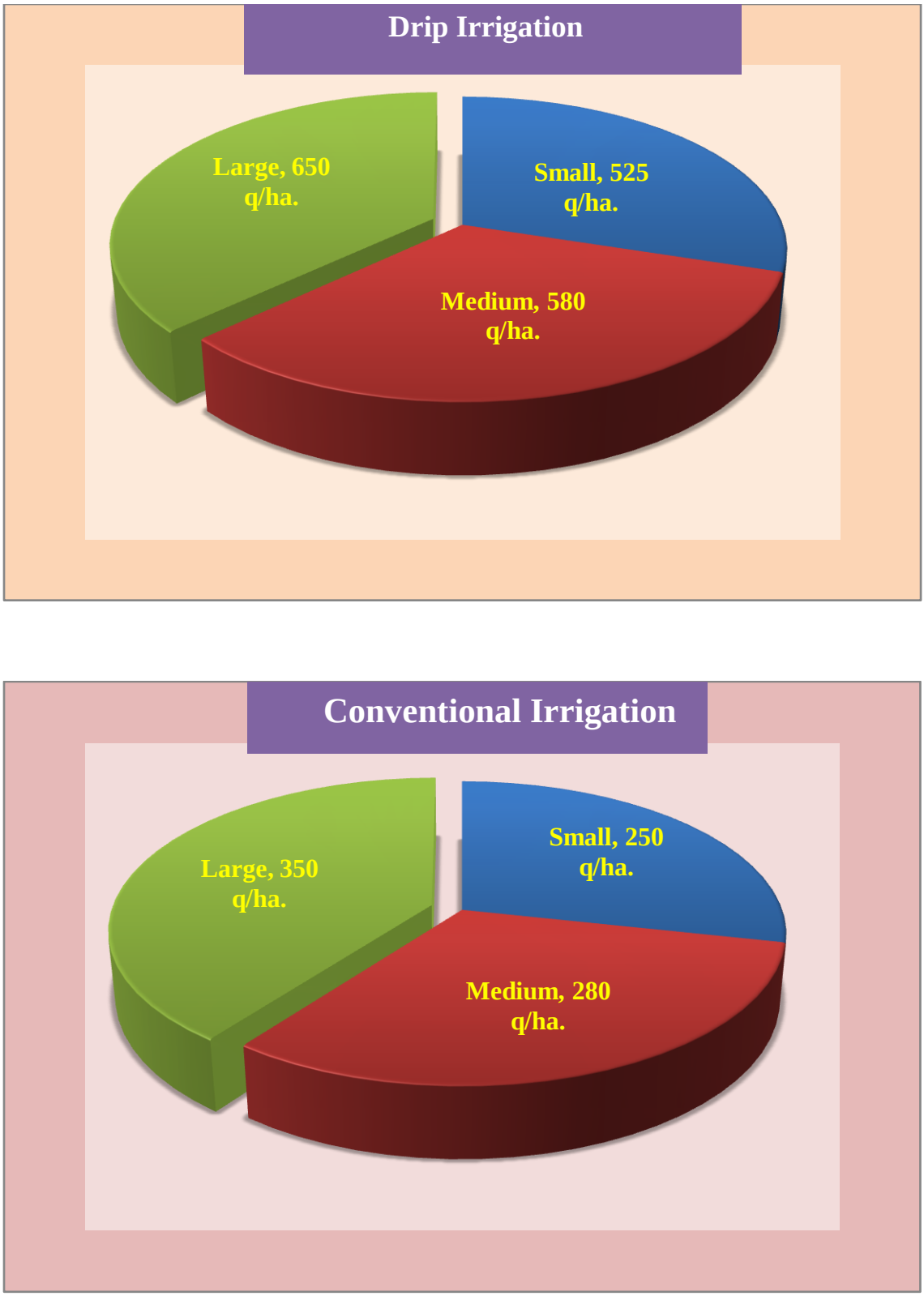
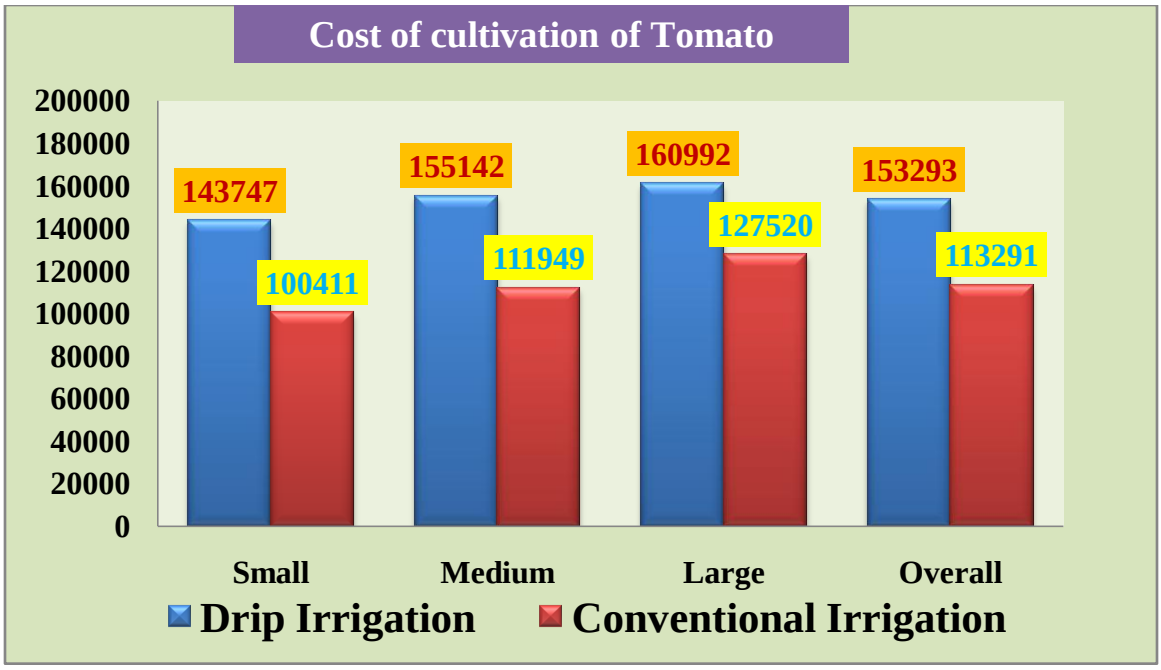


Fig. 4.4: Yield of Tomato under drip irrigation and conventional irrigation



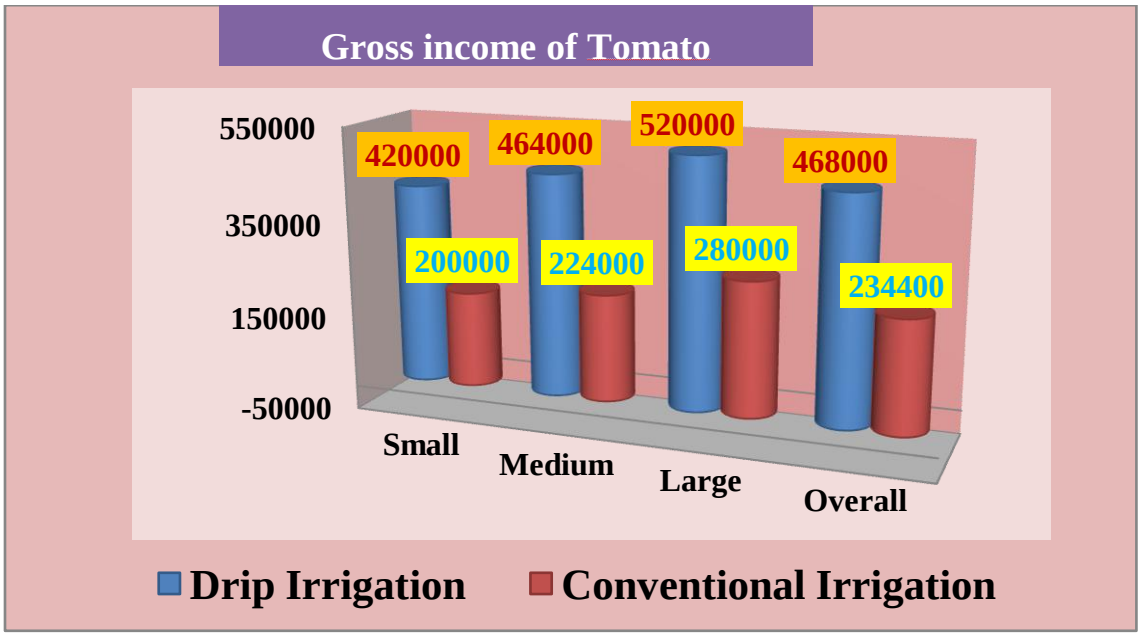
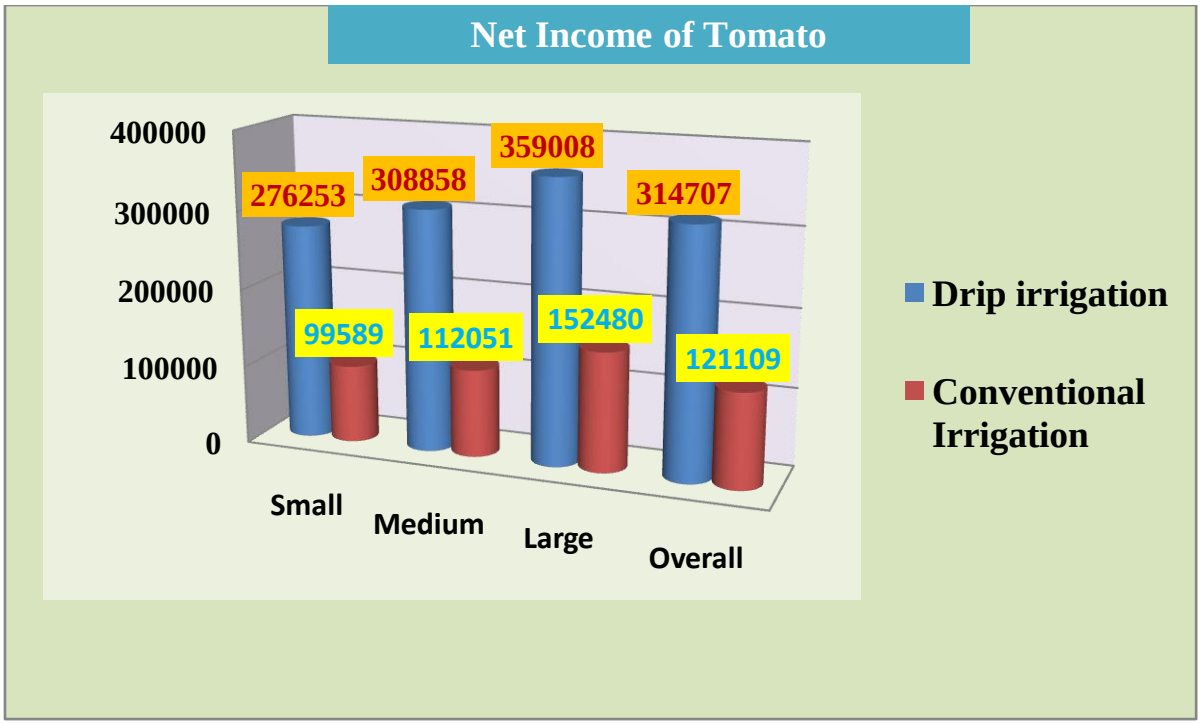


Fig.4.5: Cost of cultivation and Gross income of Tomato under drip irrigation and conventional irrigation



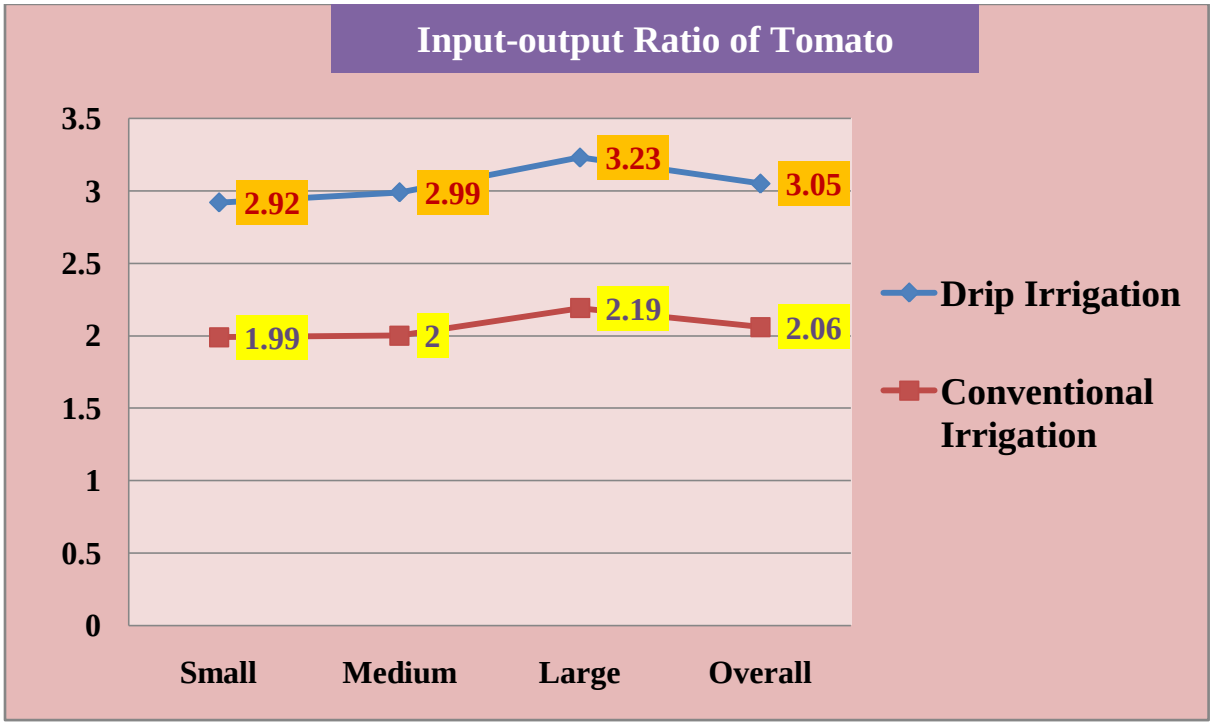


Fig.4.6: Net income and input-output ratio of Tomato under drip irrigation and conventional irrigation

2. Brinjal

Table 4.8 clearly shows that the per hectare cost of cultivation of Brinjal was higher on drip irrigation as compare to non-drip irrigation. It may be due to the fact that large drip farmers could incurred more expenditure on modern farm inputs like quality seed, fertilizer, plant protection material, hired labour etc. As a result of borrowing from different credit institutions and better economic status. The higher expenditure provides higher yield and returns on these farms as compare to other.

The average cost of cultivation per hectare of Brinjal reported to Rs. 103622 in drip method and Rs. 71869 in conventional method. The cost of cultivation per hectare showed a rising trend with the rise in the size of farms.

Cost and return, yield, value of output,net income and input-output ratio of Brinjal:

The yield, value of output,net income and input-output ratio per hectare of Brinjal on the sample drip and non-drip farms have been worked out in Table 4.9.

Table 4.9indicates that the per hectare average yield of Brinjal come to 400 quintals and 200 quintals in drip and non-drip farms. On an average the per hectare value of net income came to Rs. 176377 and Rs. 68131, respectively, on the sample drip farms and non-drip farms of the different sizes. The average input-output ratio in Brinjal came to 1:2.70 and 1:1.95 on the sample drip and non-drip farms.

Table 4.8: Input wise cost of cultivation of Brinjal on sampled house hold under drip irrigation and conventional irrigation

Rs./ha.

S.No.	Particulars	Drip Irrigation				Conventional Irrigation			
		Small	**Medium**	**Large**	**Overall**	**Small**	**Medium**	**Large**	**Overall**
1	**Human labour**								
(i)	Hired labour	49679 (58.90)	65856 (61.72)	74011 (61.77)	63182 (60.97)	39226 (58.44)	42858 (60.43)	46825 (60.37)	42970 (59.79)
(ii)	Family labour	2330 (2.76)	1540 (1.44)	1245 (1.04)	1706 (1.65)	3860 (5.75)	1245 (1.76)	925 (1.19)	2010 (2.80)
	Sub- total	**52009 (61.67)**	**67396 (63.16)**	**75256 (62.81)**	**64888 (62.62)**	**43086 (64.19)**	**44103 (62.19)**	**47750 (61.56)**	**44980 (62.59)**
2	Machine power	11892 (14.10)	11985 (11.23)	12033 (10.04)	11970 (11.55)	11585 (17.26)	11690 (16.48)	11980 (15.44)	11752 (16.35)
3	Seed	825 (0.98)	880 (0.82)	908 (0.76)	871 (0.84)	600 (0.89)	640 (0.90)	660 (0.85)	633 (0.88)
4	Manure	3750 (4.45)	4659 (4.37)	7500 (6.26)	5303 (5.12)	2500 (3.73)	3750 (5.29)	5000 (6.45)	3750 (5.22)
5	Fertilizer								
(i)	N (Urea)	1068 (1.27)	1140 (1.07)	1271 (1.06)	1160 (1.12)	765 (1.14)	855 (1.21)	1140 (1.47)	920 (1.28)
(ii)	P (SSP)	827 (0.98)	855 (0.80)	900 (0.75)	861 (0.83)	450 (0.67)	480 (0.68)	600 (0.77)	510 (0.71)
(iii)	K (MOP)	1425 (1.69)	1663 (1.56)	1900 (1.59)	1663 (1.60)	1140 (1.70)	1425 (2.01)	1520 (1.96)	1362 (1.90)
(iv)	Micro nutrient	3300 (3.91)	4400 (4.12)	5500 (4.59)	4400 (4.25)	1375 (2.05)	2750 (3.88)	4125 (5.32)	2750 (3.83)
6	Plant Protection	2601	2854	3172	2876	985	1014	1118	1039

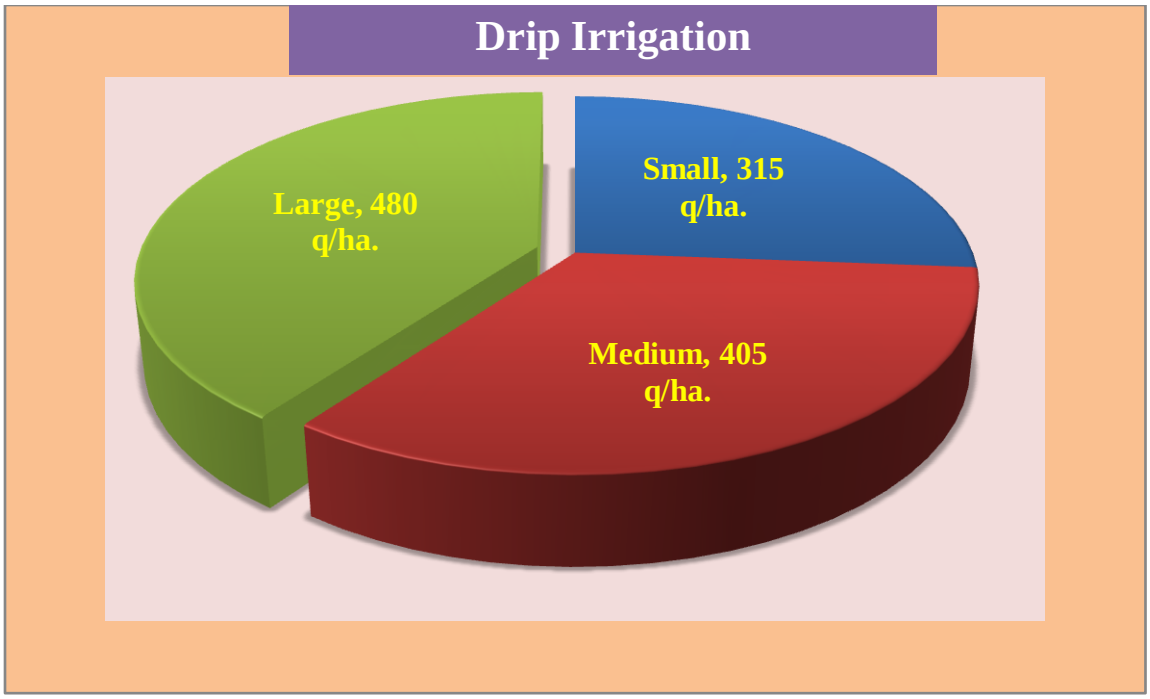
		(3.08)	(2.67)	(2.65)	(2.78)	(1.47)	(1.43)	(1.44)	(1.45)
7	Irrigation Charges	3362 (3.99)	6724 (6.30)	6724 (5.61)	5603 (5.41)	2021 (3.01)	1449 (2.04)	655 (0.84)	1375 (1.91)
	A. total	**81059 (96.11)**	**102556 (96.11)**	**115164 (96.11)**	**99595 (96.11)**	**64507 (96.10)**	**68156 (96.11)**	**74548 (96.11)**	**69071 (96.11)**
8	Miscellaneous	810 (0.96)	1025 (0.96)	1151 (0.96)	995 (0.96)	645 (0.96)	681 (0.96)	745 (0.96)	690 (0.96)
9.	Land Revenue	14.82 (0.01)	14.82 (0.01)	14.82 (0.01)	14.82 (0.01)	14.82 (0.02)	14.82 (0.02)	14.82 (0.02)	14.82 (0.02)
	B. total	**81884 (97.09)**	**103596 (97.09)**	**116330 (97.09)**	**100605 (97.09)**	**65167 (97.09)**	**68852 (97.09)**	**75308 (97.09)**	**69776 (97.09)**
10	Interest on working capital	2457 (2.91)	3108 (2.91)	3490 (2.91)	3018 (2.91)	1955 (2.91)	2066 (2.91)	2259 (2.91)	2093 (2.91)
	Total input cost	**84340 (100)**	**106703 (100)**	**119819 (100)**	**103622 (100)**	**67121 (100)**	**70917 (100)**	**77566 (100)**	**71869 (100)**

Note: Fighers in parentheses indicate the per cent of total input cost

Table 4.9: Cost and return, per hectare yield, value of output,net income and input-output ratio of Brinjal

(Rs./ha)

S. No.	Particulars	Dripirrigation				Conventional irrigation			
		Small	Medium	Large	Overall	Small	Medium	Large	Overall
1.	Input cost (Rs.)	84340	106703	119819	103622	67121	70917	77566	71869
2.	Vegetable yield (q./ha)	315	405	480	400	160	206	235	200
3.	Selling price (Rs./q)	700	700	700	700	700	700	700	700
4.	Gross income	220500	283500	336000	280000	112000	144200	164500	140000
5.	Net income	136160	176796	216180	176377	44878	73283	86933	68131
6.	Input-output Ratio	1:2.61	1:2.66	1:2.80	1:2.70	1:1.67	1:2.03	1:2.12	1:1.95



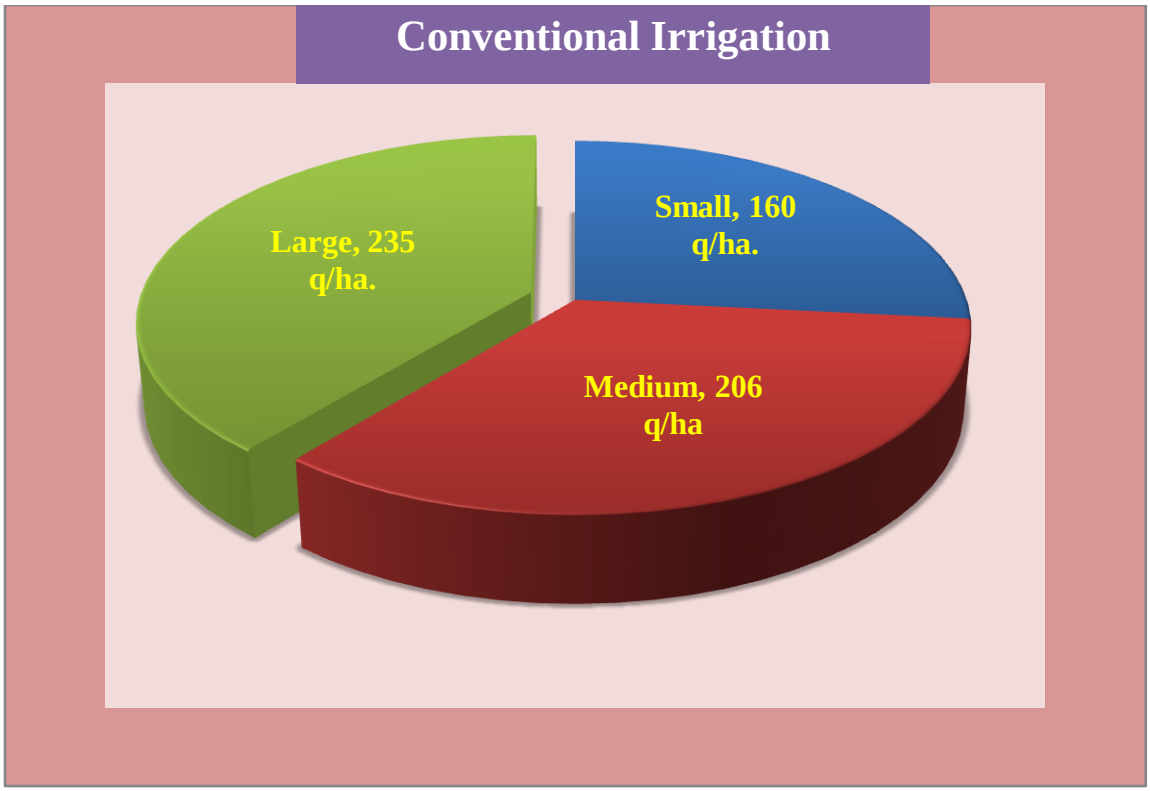
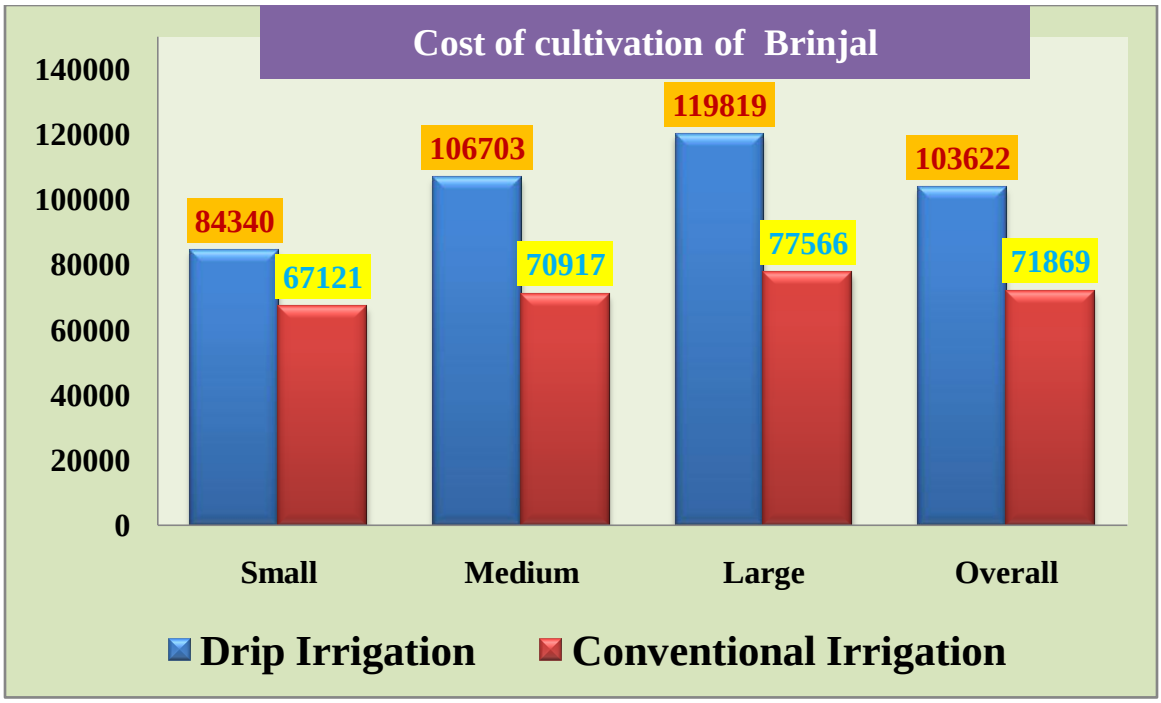


Fig.4.7: Yield of Brinjal under drip irrigation and conventional irrigation



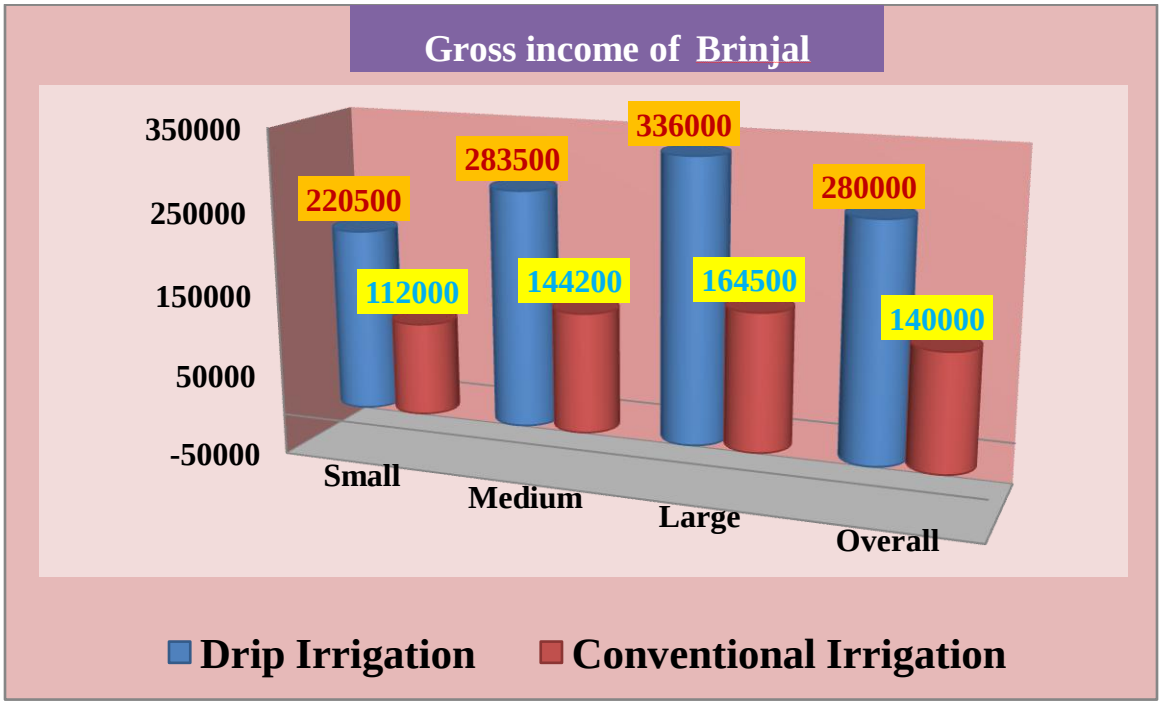


Fig.4.8: Cost of cultivation and Gross income of Brinjal under drip irrigation and conventional irrigation

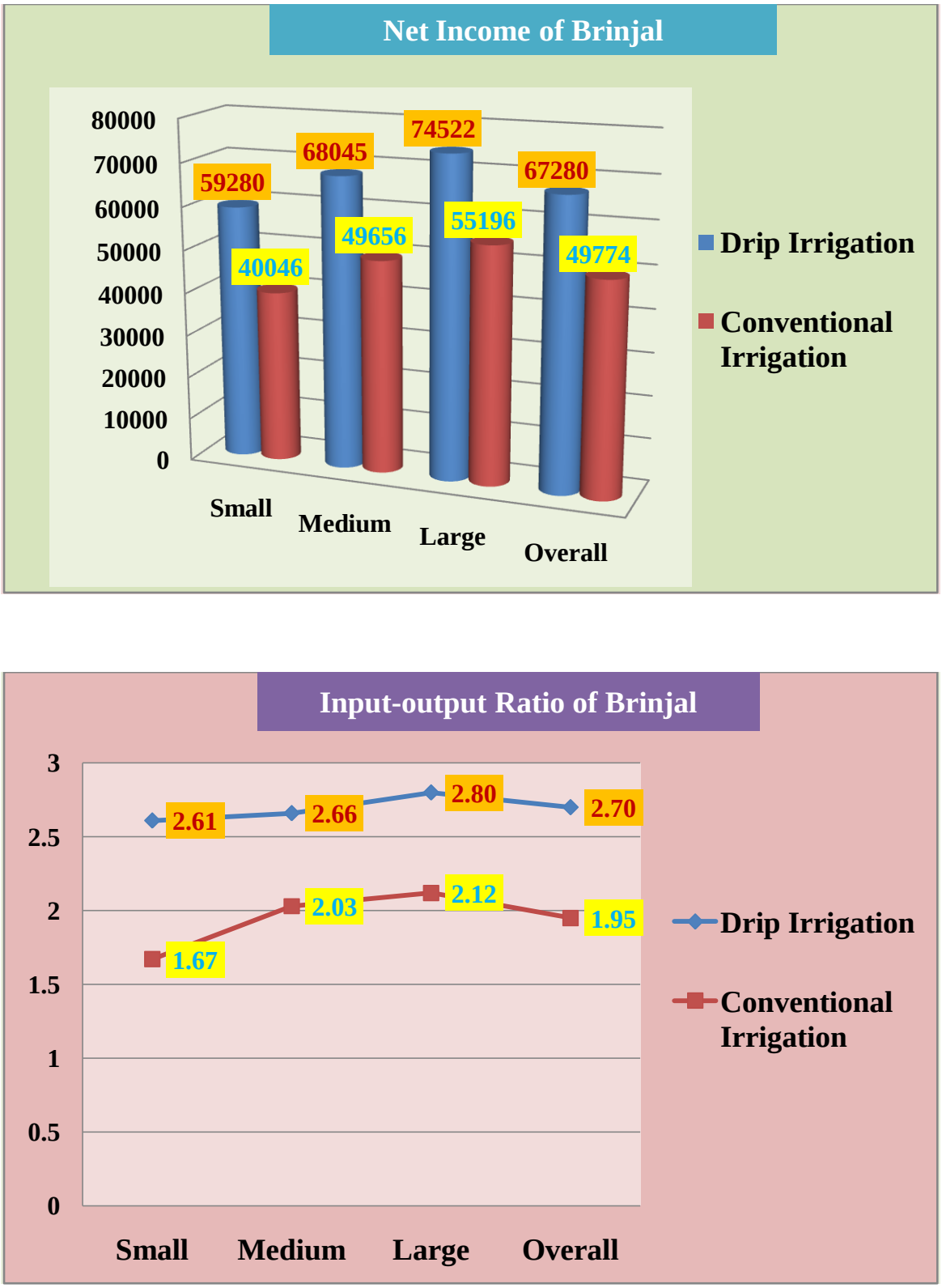


Fig.4.9: Net income and input-output ratio of Brinjal under drip irrigation and conventional irrigation

3. Okra

Table 4.10 clearly shows that the perhectare cost of cultivation of Okra was higher on drip as compare to non-drip. It may be due to the fact that large drip farmers could incurred more expenditure on modern farm inputs like quality seed, fertilizer, plant protection material, hired labour etc. as a result of borrowing from different credit institutions and better economic status. The higher expenditure provides higher yield and returns on these farms as compare to other.

The average cost of cultivation per hectare of Okra reported to Rs. 71342 in drip method and Rs. 48382 in conventional method. The cost of cultivation per hectare showed a rising trend with the rise in the size of farms as reported by the respondents.

Cost and return, yield, value of output, net income and input-output ratio of Okra

The yield, value of output per hectare and cost of production per quintal of Okra on the sample drip and non-drip farms have been worked out in Table 4.11.

Table 4.11 indicates that the per hectare average yield of Okra come to 187 quintals and 100 quintals in drip and non- drip farms. On an average the per hectare value of net income came to Rs. 106308 and Rs. 46618, respectively, on the sample drip farms and non-drip farms of the different sizes. The average input-output ratio in Okra came to 1:2.49 and 1:1.96 on the sample drip and non-drip farms.

Table 4.10: Input wise cost of cultivation of Okra on sampled house hold under drip irrigation and conventional irrigation

Rs/ha.

S.No.	Particulars	DripIrrigation				Conventional Irrigation			
		Small	**Medium**	**Large**	**Overall**	**Small**	**Medium**	**Large**	**Overall**
1	**Human labour**								
(i)	Hired labour	18897 (30.47)	20970 (29.42)	23603 (29.24)	21157 (29.66)	9548 (23.45)	16138 (32.61)	18099 (32.94)	14595 (30.17)
(ii)	Family labour	2330 (3.76)	1540 (2.16)	1245 (1.54)	1706 (2.39)	3860 (9.48)	1245 (2.52)	925 (1.68)	2010 (4.15)
	Sub- total	**21227 (34.23)**	**22510 (31.58)**	**24848 (30.78)**	**22863 (32.05)**	**13408 (32.93)**	**17383 (35.13)**	**19024 (34.62)**	**16605 (34.32)**
2	Machine power	11865 (19.13)	11970 (16.79)	12029 (14.90)	11955 (16.76)	11245 (27.62)	11650 (23.54)	11970 (21.78)	11622 (24.02)
3	Seed	11250 (18.14)	12375 (17.36)	14625 (18.12)	12750 (17.87)	6750 (16.58)	8250 (16.67)	9614 (17.50)	8205 (16.96)
4	Manure	3750 (6.05)	5000 (7.01)	7500 (9.29)	5417 (7.59)	1213 (2.98)	1486 (3.00)	1732 (3.15)	1477 (3.05)
5	**Fertilizer**								
(i)	N (Urea)	713 (1.15)	855 (1.20)	997 (1.24)	855 (1.20)	428 (1.05)	570 (1.15)	713 (1.30)	570 (1.18)
(ii)	P (SSP)	375 (0.60)	450 (0.63)	525 (0.65)	450 (0.63)	300 (0.74)	450 (0.91)	600 (1.09)	450 (0.93)
(iii)	K (MOP)	1188 (1.92)	1425 (2.00)	1663 (2.06)	1425 (2.00)	950 (2.33)	1425 (2.88)	1900 (3.46)	1425 (2.95)
(iv)	Micro nutrient	3300 (5.32)	4400 (6.17)	5500 (6.81)	4400 (6.17)	1375 (3.38)	2750 (5.56)	4125 (7.51)	2750 (5.68)
6	Plant Protection	2571 (4.15)	2794 (3.92)	3172 (3.93)	2846 (3.99)	987 (2.42)	1192 (2.41)	1396 (2.54)	1192 (2.46)
7	Irrigation Charges	3362	6724	6724	5603	2471	2394	1730	2198

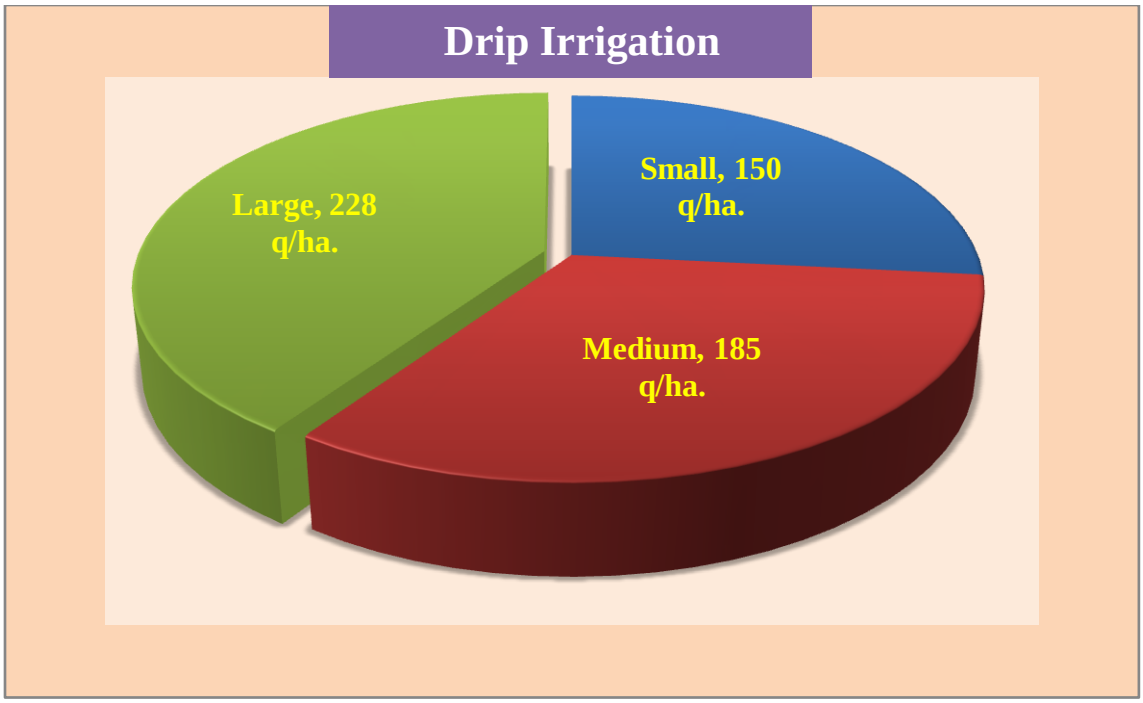
		(5.42)	(9.43)	(8.33)	(7.85)	(6.07)	(4.84)	(3.15)	(4.54)
	A. total	**59601 (96.10)**	**68503 (96.11)**	**77583 (96.11)**	**68564 (96.11)**	**39127 (96.09)**	**47550 (96.10)**	**52804 (96.10)**	**46494 (96.10)**
8	Miscellaneous	596 (0.96)	685 (0.96)	775 (0.96)	685 (0.96)	391 (0.96)	475 (0.96)	528 (0.96)	464 (0.96)
9.	Land Revenue	14.82 (0.02)	14.82 (0.02)	14.82 (0.02)	14.82 (0.02)	14.82 (0.04)	14.82 (0.03)	14.82 (0.03)	14.82 (0.03)
	B. total	**60212 (97.09)**	**69203 (97.09)**	**78373 (97.09)**	**69264 (97.09)**	**39533 (97.09)**	**48040 (97.09)**	**53347 (97.09)**	**46973 (97.09)**
10	Interest on working capital	1806 (2.91)	2076 (2.91)	2351 (2.91)	2078 (2.91)	1186 (2.91)	1441 (2.91)	1600 (2.91)	1409 (2.91)
	Total inputcost	**62018 (100)**	**71279 (100)**	**80724 (100)**	**71342 (100)**	**40719 (100)**	**49481 (100)**	**54947 (100)**	**48382 (100)**

Note: Fighers in parentheses indicate the per cent of total input cost

Table 4.11: Cost and return, per hectare yield, value of output,net income and input-output ratio of Okra

(Rs./ha)

S. No.	Particulars	DripIrrigation				Conventional Irrigation			
		Small	Medium	Large	Overall	Small	Medium	Large	Overall
1.	Input cost (Rs.)	62018	71279	80724	71342	40719	49481	54947	48382
2.	Vegetable yield (q./ha)	150	185	228	187	80	100	120	100
3.	Selling price (Rs./q)	950	950	950	950	950	950	950	950
4.	Gross income	142500	175750	216600	177650	76000	95000	114000	95000
5.	Net income	80482	104471	135876	106308	35281	45519	59053	46618
6.	Input-output Ratio	1:2.30	1:2.47	1:2.68	1:2.49	1:1.87	1:1.92	1:2.07	1:1.96



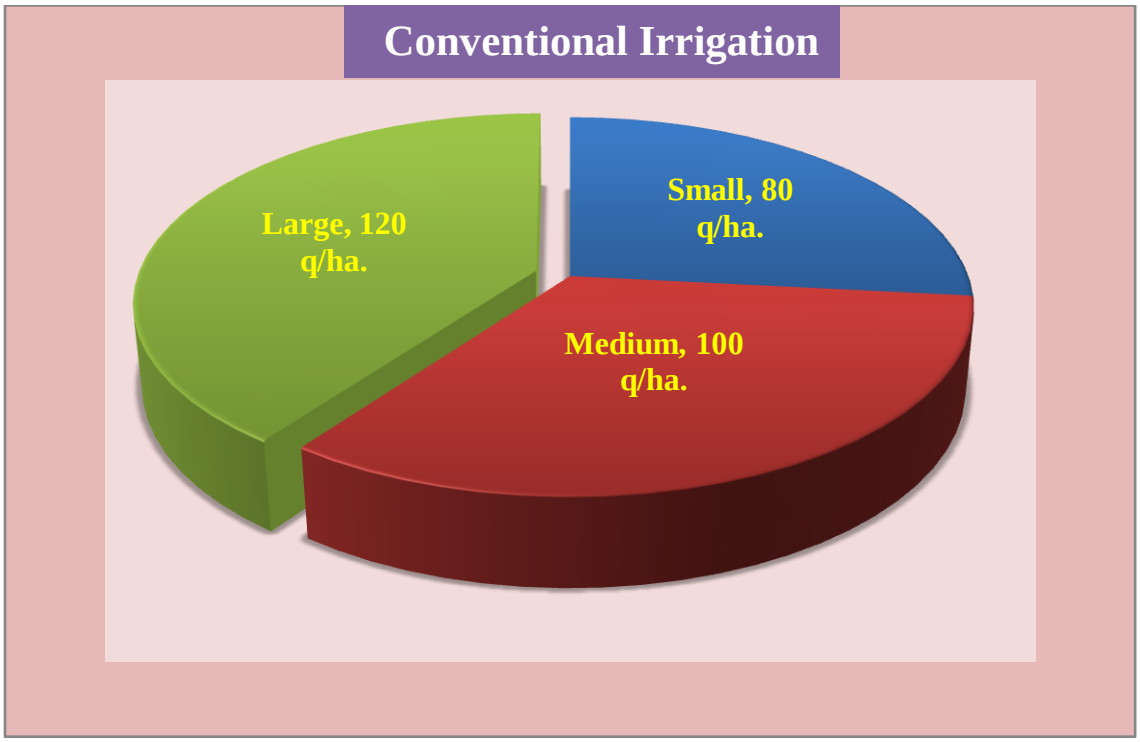
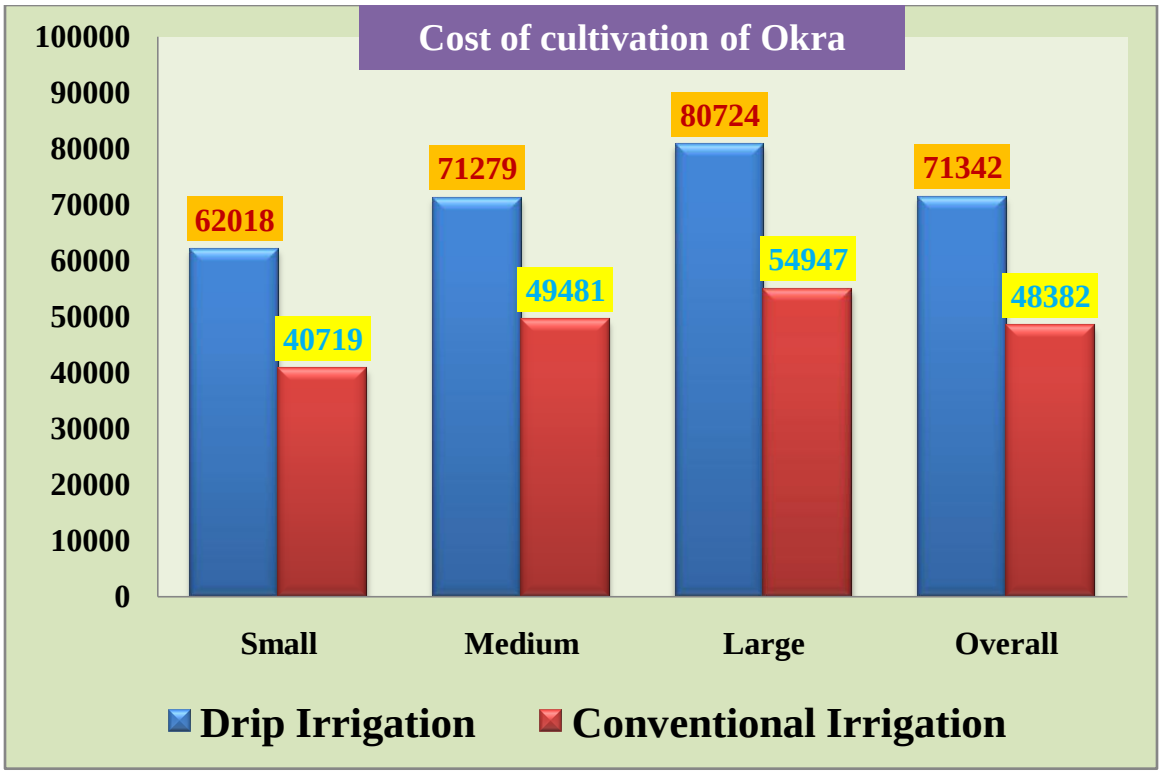


Fig.4.10: Yield of Okra under drip irrigation and conventional irrigation



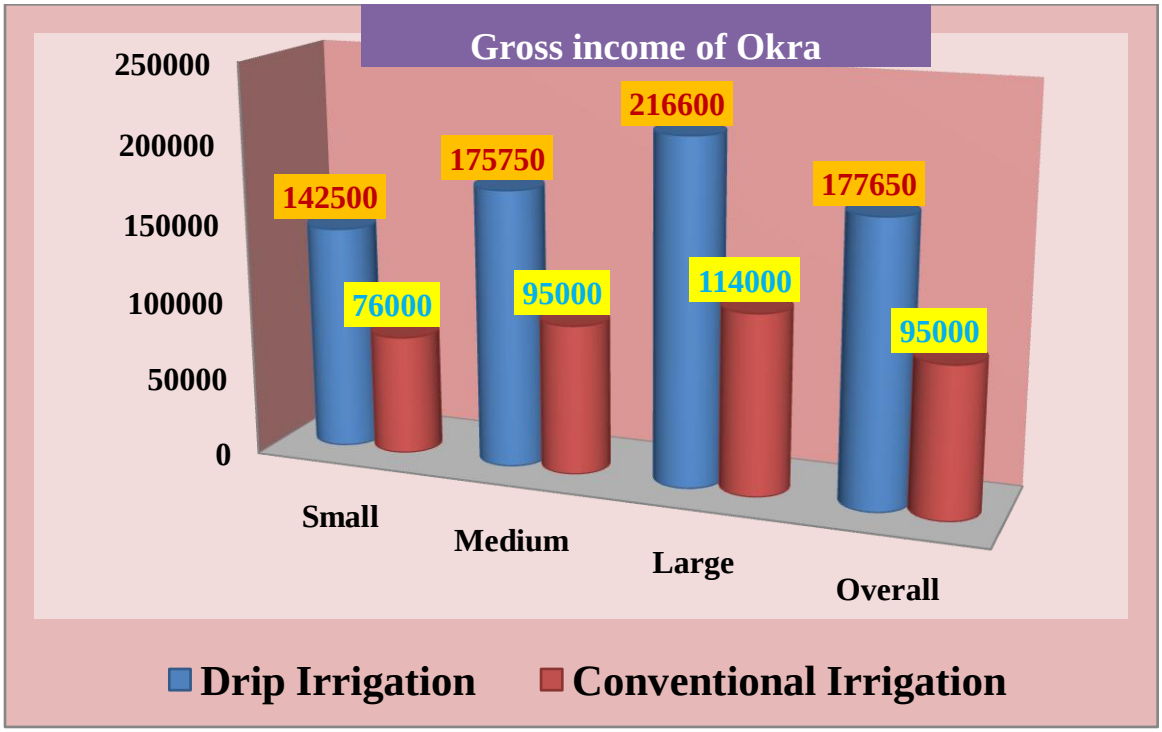


Fig.4.11: Cost of cultivation and Gross income of Okra under drip irrigation and conventional irrigation

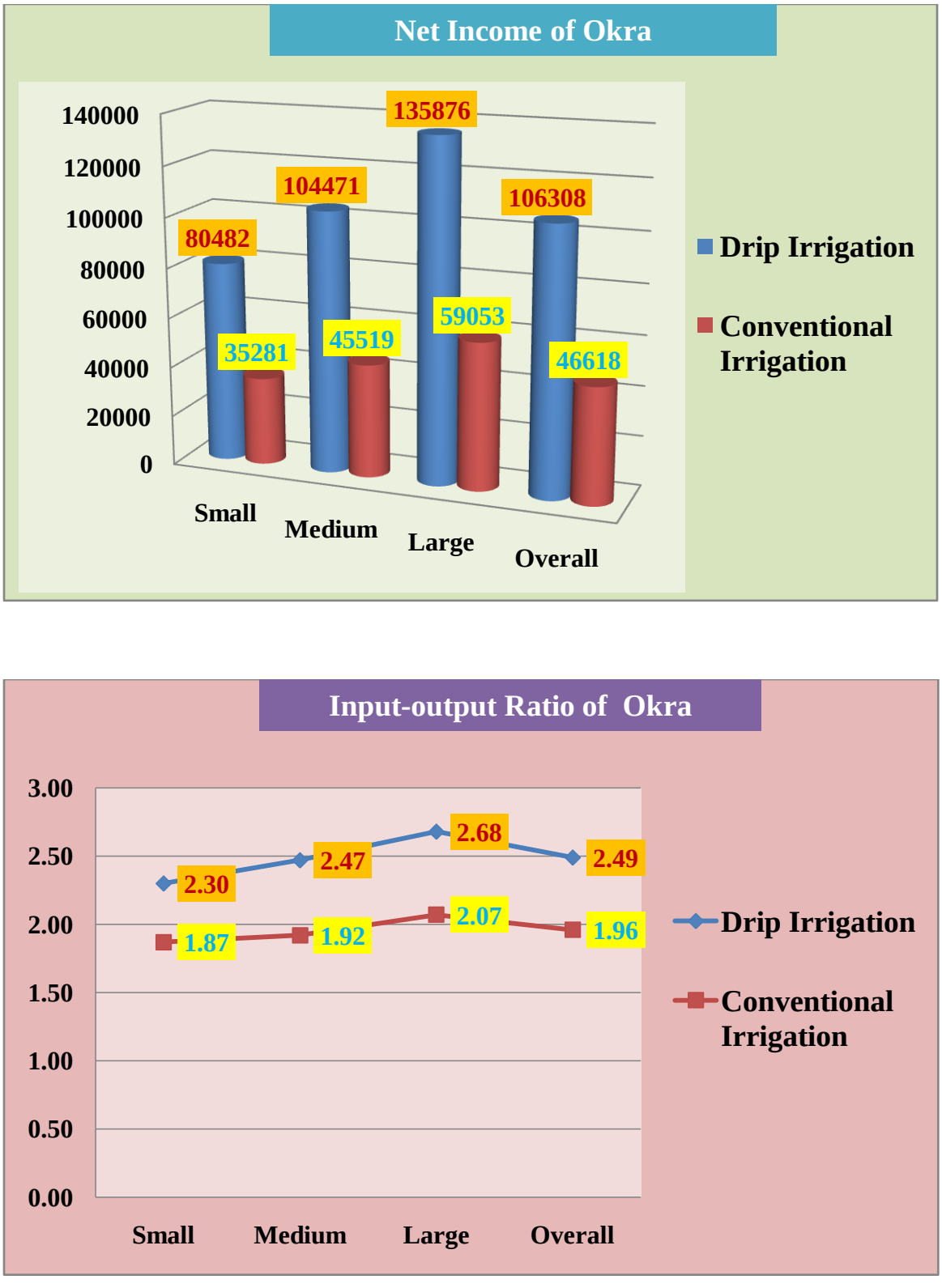


Fig.4.12: Net income and input-output ratio of Okra under drip irrigation and conventional irrigation

4. Cabbage

Table 4.12 clearly shows that the per hectare cost of cultivation of Cabbage was higher on drip as compare to non-drip. It may be due to the fact that large drip farmers could incurred more expenditure on modern farm inputs like quality seed, fertilizer, plant protection material, hired labour etc. as a result of borrowing from different credit institutions and better economic status. The higher expenditure provides higher yield and returns on these farms as compare to other.

The average cost of cultivation per hectare of Cabbage reported to Rs. 58723 in drip method and Rs. 41650 in conventional method. The cost of cultivation per hectare showed a rising trend with the rise in the size of farms.

Cost and return, yield, value of output, net income and input-output ratio of Cabbage

Table 4.13indicates that the per hectare average yield of Cabbage come to 310 quintals and 153 quintals in drip and non-drip farms. On an average the per hectare value of net income came to Rs. 96277and Rs.34850, respectively, on the sample drip farms and non-drip farms of the different sizes. The average input-output ratio in Cabbage came to 1:2.64 and 1:1.84 on the sample drip and non-drip farms.

Table 4.12: Input wise cost of cultivation of Cabbage on sampled house hold under drip irrigation and conventional irrigation

Rs./ha.

S.No.	Particulars	Drip Irrigation				Conventional Irrigation			
		Small	**Medium**	**Large**	**Overall**	**Small**	**Medium**	**Large**	**Overall**
1	**Human labour**								
(i)	Hired labour	15339 (30.48)	18128 (30.45)	21152 (31.89)	18206 (31.00)	9348 (26.17)	12858 (30.70)	16225 (34.28)	12811 (30.76)
(iI)	Family labour	2341 (4.65)	1494 (2.51)	664 (1.00)	1499 (2.55)	3660 (10.24)	1324 (3.16)	512 (1.08)	1832 (4.40)
	Sub- total	**17680 (35.14)**	**19622 (32.96)**	**21816 (32.90)**	**19705 (33.56)**	**13008 (36.41)**	**14182 (33.86)**	**16737 (35.36)**	**14643 (35.16)**
2	Machine power	11865 (23.56)	11970 (20.11)	12029 (18.14)	11955 (20.36)	11245 (31.48)	11650 (27.81)	11970 (25.29)	11622 (27.90)
3	Seed	2800 (5.57)	3040 (5.11)	3120 (4.70)	2986 (5.08)	1200 (3.36)	2800 (6.68)	3200 (6.76)	2400 (5.76)
4	Manure	3750 (7.45)	5000 (8.40)	7500 (11.31)	5416 (9.22)	2500 (7.00)	3750 (8.95)	5000 (10.56)	3750 (9.00)
5	**Fertilizer**								
(i)	N (Urea)	855 (1.70)	997 (1.67)	1140 (1.72)	997 (1.70)	570 (1.60)	684 (1.63)	741 (1.57)	665 (1.60)
(ii)	P (SSP)	600 (1.19)	900 (1.51)	1200 (1.81)	900 (1.53)	510 (1.43)	720 (1.72)	780 (1.65)	670 (1.61)
(iii)	K (MOP)	1900 (3.78)	2090 (3.51)	2185 (3.29)	2058 (3.50)	760 (2.13)	950 (2.27)	1330 (2.81)	1013 (2.43)
(iv)	Micro nutrient	3300 (6.56)	4400 (7.39)	5500 (8.30)	4400 (7.49)	1375 (3.85)	2750 (6.57)	3300 (6.97)	2475 (5.94)

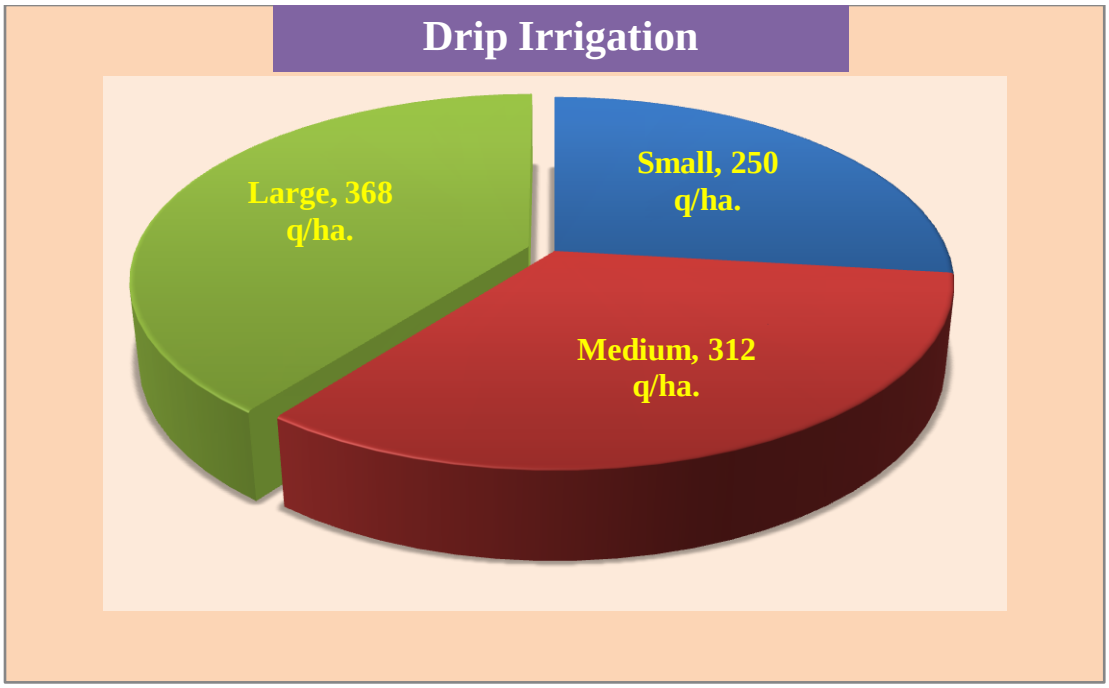
6	Plant Protection	2250 (4.47)	2470 (4.15)	2521 (3.80)	2414 (4.11)	723 (2.02)	968 (2.31)	1138 (2.41)	943 (2.26)
7	Irrigation Charges	3362 (6.68)	6724 (11.30)	6724 (10.14)	5603 (9.54)	2436 (6.82)	1798 (4.29)	1290 (2.73)	1841 (4.42)
	A. total	**48362 (96.10)**	**57213 (96.10)**	**63735 (96.13)**	**56434 (96.13)**	**34327 (96.13)**	**40252 (96.13)**	**45486 (96.13)**	**40022 (96.09)**
8	Miscellaneous	483 (0.96)	572 (0.96)	637 (0.96)	564 (0.96)	343 (0.96)	402 (0.96)	454 (0.96)	400 (0.96)
9	Land Revenue	14.82 (0.03)	14.82 (0.02)	14.82 (0.02)	14.82 (0.03)	14.82 (0.04)	14.82 (0.04)	14.82 (0.03)	14.82 (0.04)
	B. total	**48860 (97.09)**	**57800 (97.09)**	**64387 (97.09)**	**57013 (97.09)**	**34685 (97.09)**	**40669 (97.09)**	**45955 (97.09)**	**40437 (97.09)**
10	Interest on working capital	1466 (2.91)	1734 (2.91)	1932 (2.91)	1710 (2.91)	1041 (2.91)	1220 (2.91)	1379 (2.91	1213 (2.91)
	Total input cost	**50326 (100)**	**59534 (100)**	**66318 (100)**	**58723 (100)**	**35725 (100)**	**41889 (100)**	**47333 (100)**	**41650 (100)**

Note: Fighers in parentheses indicate the per cent of total input cost

Table 4.13: Cost and return, yield, value of output, net income and input-output ratio of Cabbage

(Rs./ha)

S. No.	Particulars	Drip Irrigation				Conventional Irrigation			
		Small	**Medium**	**Large**	**Overall**	**Small**	**Medium**	**Large**	**Overall**
1.	Input cost (Rs.)	**50326**	**59534**	**66318**	**58723**	**35725**	**41889**	**47333**	**41650**
2.	Vegetable yield (q./ha)	250	312	368	310	120	150	189	153
3.	Selling price (Rs./q)	500	500	500	500	500	500	500	500
4.	Gross income	125000	156000	184000	155000	60000	75000	94500	76500
5.	Net income	74674	96466	117682	96277	24275	33111	47167	34850
6.	Input-output Ratio	1:2.48	1:2.62	1:2.78	1:2.64	1:1.68	1:1.79	1:2.00	1:1.84



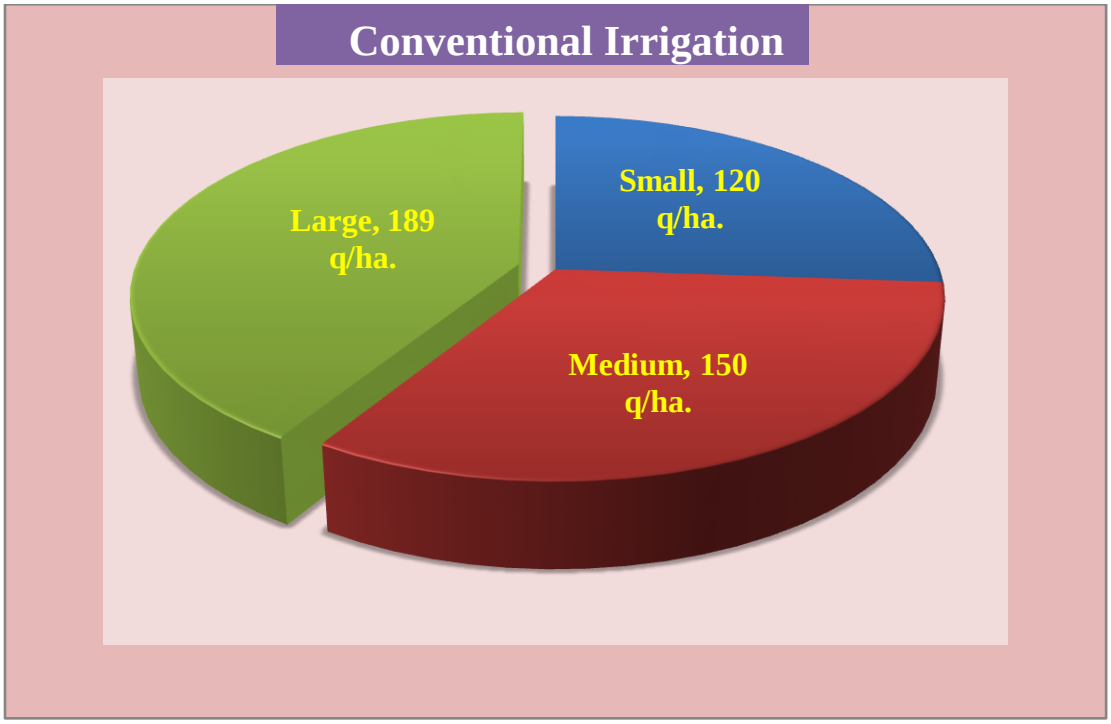
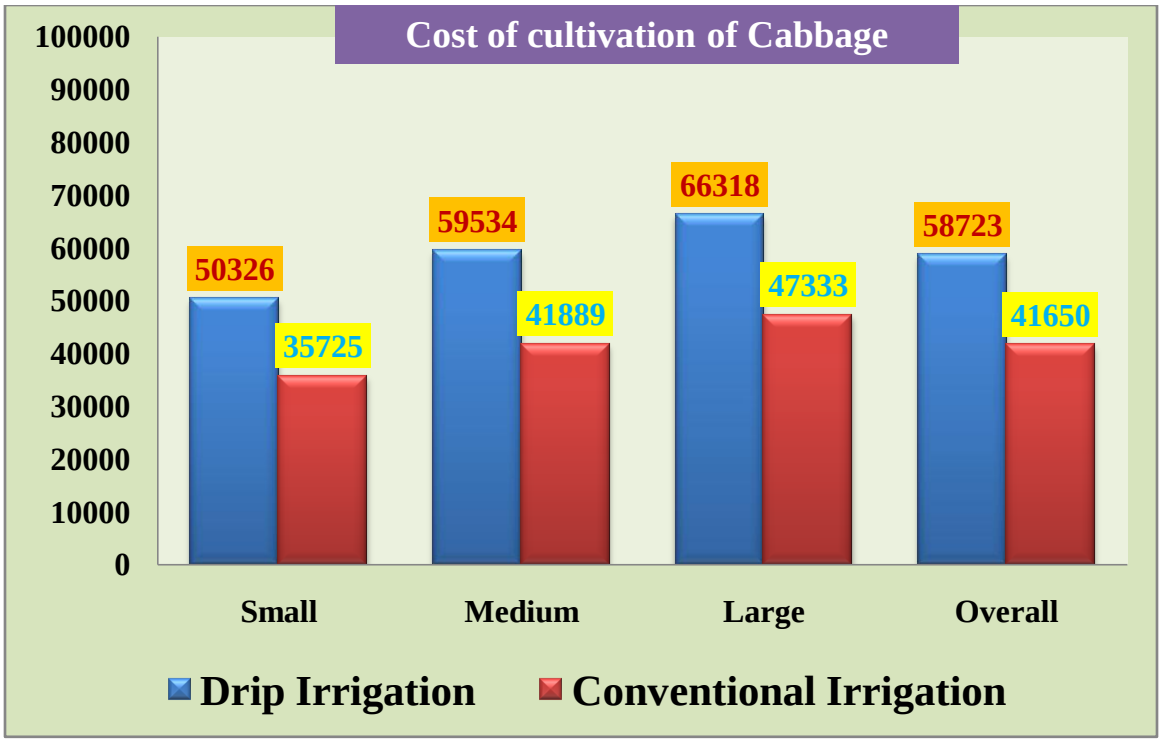


Fig.4.13: Yield of Cabbage under drip irrigation and conventional irrigation



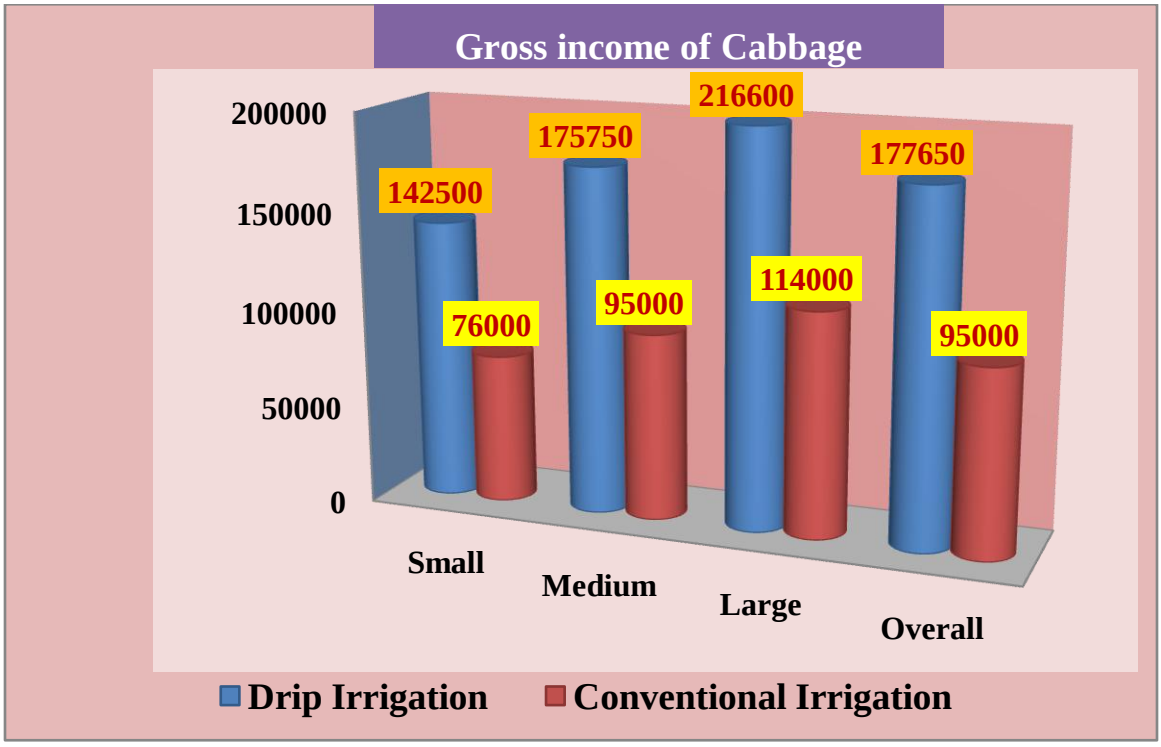
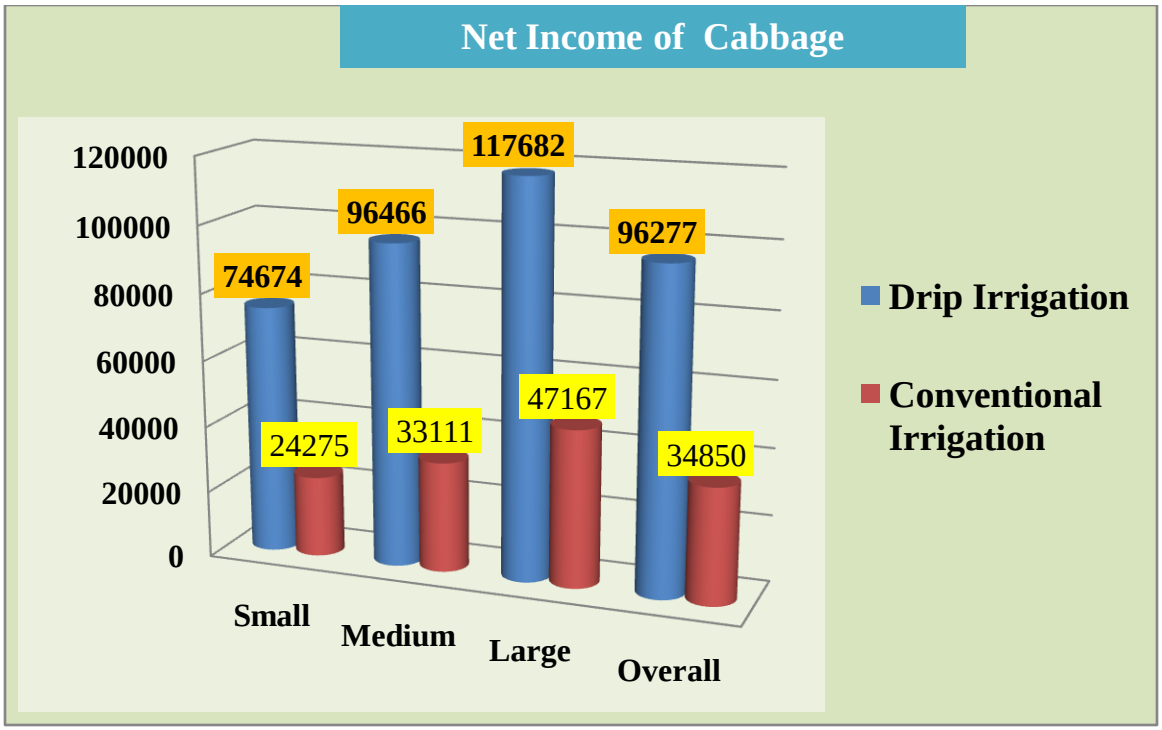


Fig.4.14: Cost of cultivation and Gross income of Cabbage under drip irrigation and conventional irrigation.



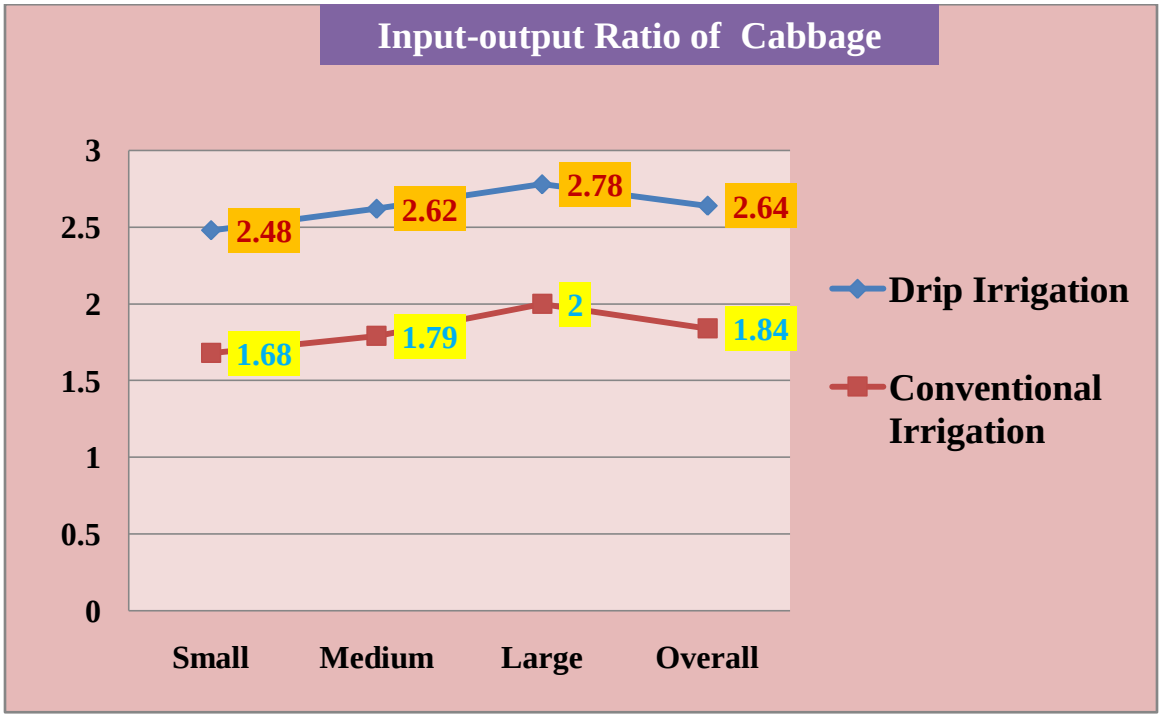


Fig.4.15: Net income and input-output ratio of Cabbage under drip irrigation and conventional irrigation

5. Chilli

Table 4.14 clearly shows that the per hectare cost of cultivation of Chilliwas higher on drip as compare to non-drip. It may be due to the fact that large drip farmers could incurred more expenditure on modern farm inputs like quality seed, fertilizer, plant protection material, hired labour etc. as a result of borrowing from different credit institutions and better economic status. The higher expenditure provides higher yield and returns on these farms as compare to other.

The average cost of cultivation per hectare of Cabbage reported to Rs. 67280in drip method and Rs. 49774 in conventional method. The cost of cultivation per hectare showed a rising trend with the rise in the size of farms.

Cost and return, yield, value of output, net income and input-output ratio of Chilli

Table 4.15 indicates that the per hectare average yield of Okra come to 266 quintals and 150 quintals in drip and non-drip farms. On an average the per hectare value of net income came to Rs. 140184 and Rs.67210, respectively, on the sample drip farms and non-drip farms of the different sizes. The average input-output ratio in Chillicame to 1:3.08 and 1:2.35 on the sample drip and non-drip farms.

Table4.14: Input wise cost of cultivation of Chilli on sampled house hold under drip irrigation and conventional irrigation

Rs./ha.

S.No.	Particulars	Drip Irrigation				Conventional Irrigation			
		Small	Medium	Large	Overall	Small	Medium	Large	Overall
1	**Human labour**								
(i)	Hired labour	20407 (34.42)	22174 (32.58)	24304 (32.61)	22295 (33.13)	10226 (25.53)	17858 (35.95)	20225 (36.63)	16103 (32.34)
(ii)	Family labour	2678 (4.52)	1841 (2.70)	1059 (1.42)	1859 (2.76)	3436 (8.58)	1465 (2.95)	945 (1.71)	1948 (3.91)
	Sub- total	**23085 (38.93)**	**24015 (35.28)**	**25363 (34.03)**	**24154 (35.89)**	**13662 (34.10)**	**19323 (38.90)**	**21170 (38.34)**	**18051 (36.25)**
2	Machine power	11892 (20.06)	11985 (17.61)	12033 (16.14)	11970 (17.79)	11585 (28.92)	11690 (23.53)	11980 (21.70)	11752 (23.60)
3	Seed	5600 (9.44)	6440 (9.46)	7000 (9.39)	6347 (9.43)	4480 (11.18)	5040 (10.15)	5600 (10.14)	5040 (10.12)
4	Manure	3750 (6.32)	5000 (7.35)	7500 (10.06)	5416 (8.05)	2500 (6.24)	3750 (7.55)	5000 (9.06)	3750 (7.53)
5	**Fertilizer**								
(i)	N (Urea)	712 (1.20)	855 (1.26)	1140 (1.53)	902 (1.34)	570 (1.42)	684 (1.38)	712 (1.29)	655 (1.32)
(ii)	P (SSP)	750 (1.26)	900 (1.32)	930 (1.25)	860 (1.28)	300 (0.75)	360 (0.72)	450 (0.82)	370 (0.74)
(iii)	K (MOP)	1900 (3.20)	2185 (3.21))	2280 (3.06))	2121 (3.15)	691 (1.72)	847 (1.71)	903 (1.64)	814 (1.63)
(iv)	Micro nutrient	3300 (5.57)	4400 (6.46)	5500 (7.38)	4400 (6.54)	1375 (3.43)	2750 (5.54)	4125 (7.47)	2750 (5.52)
6	Plant Protection	2634 (4.44)	2906 (4.27)	3166 (4.25)	2902 (4.31)	666 (1.66)	718 (1.45)	743 (1.35)	2127 (4.27)

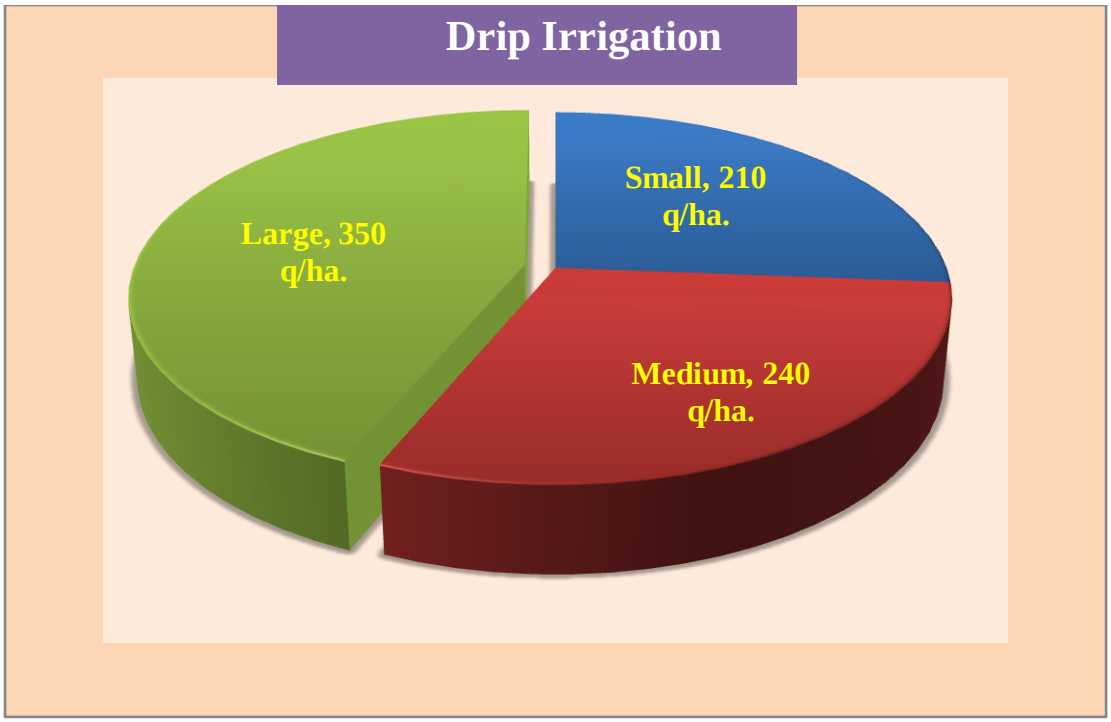
7	Irrigation Charges	3362 (5.67)	6724 (9.88)	6724 (9.02)	5603 (8.33)	2667 (6.66)	2571 (5.18)	2376 (4.30)	2538 (5.10)
	A. total	**56985** **(96.10)**	**65410** **(96.10)**	**71636** **(96.11)**	**64675** **(96.11)**	**38496** **(96.09)**	**47733** **(96.10)**	**53059** **(96.10)**	**47847** **(96.10)**
8	Miscellaneous	569 (0.96)	654 (0.96)	716 (0.96)	646 (0.96)	384 (0.96)	477 (0.96)	530 (0.96)	478 (0.96)
9	Land Revenue	14.82 (0.02)	14.82 (0.02)	14.82 (0.02)	14.82 (0.02)	14.82 (0.04)	14.82 (0.03)	14.82 (0.03)	14.82 (0.03)
	B. total	**57569** **(97.09)**	**66079** **(97.09)**	**72367** **(97.09)**	**65336** **(97.09)**	**38895** **(97.09)**	**48225** **(97.09)**	**53604** **(97.09)**	**48340** **(97.09)**
9	Interest on working capital	1727 (2.91)	1982 (2.91)	2171 (2.91)	1960 (2.91)	1167 (2.91)	1447 (2.91)	1608 (2.91)	1450 (2.91)
	Total input cost	**59280** **(100)**	**68045** **(100)**	**74522** **(100)**	**67280** **(100)**	**40046** **(100)**	**49656** **(100)**	**55196** **(100)**	**49774** **(100)**

Note: Fighers in parentheses indicate the per cent of total input cost

Table 4.15: Cost and return, yield, value of output, net income and input-output ratio of Chilli:

(Rs./ha)

S. No.	Particulars	Dripirrigation				Conventional irrigation			
		Small	**Medium**	**Large**	**Overall**	**Small**	**Medium**	**Large**	**Overall**
1.	Input cost (Rs.)	59280	68045	74522	67280	40046	49656	55196	49774
2.	Vegetable yield (q./ha)	210	240	350	266	100	150	200	150
3.	Selling price (Rs./q)	780	780	780	780	780	780	780	780
4.	Gross income	163800	187200	273000	207480	78000	117000	156000	117000
5.	Net income	104504	119139	198462	140184	37938	67328	100788	67210
6.	Input-output Ratio	1:2.76	1:2.75	1:3.66	1:3.08	1:1.95	1:2.36	1:2.83	1:2.35



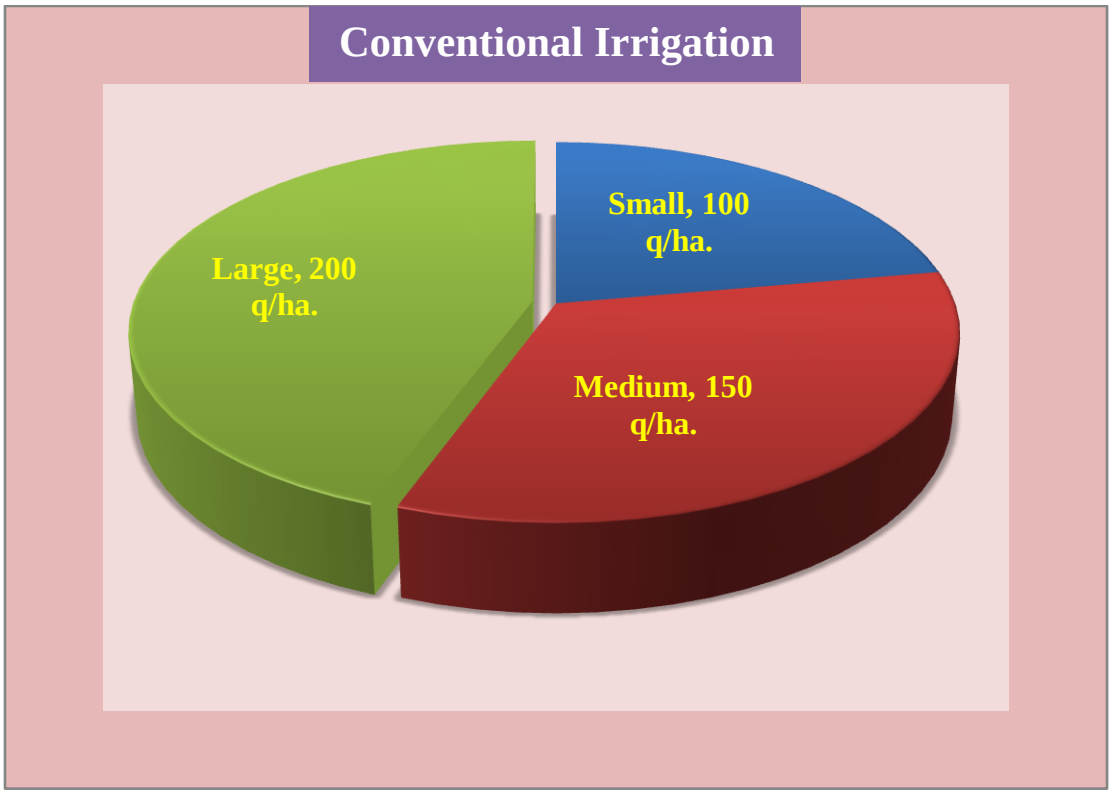
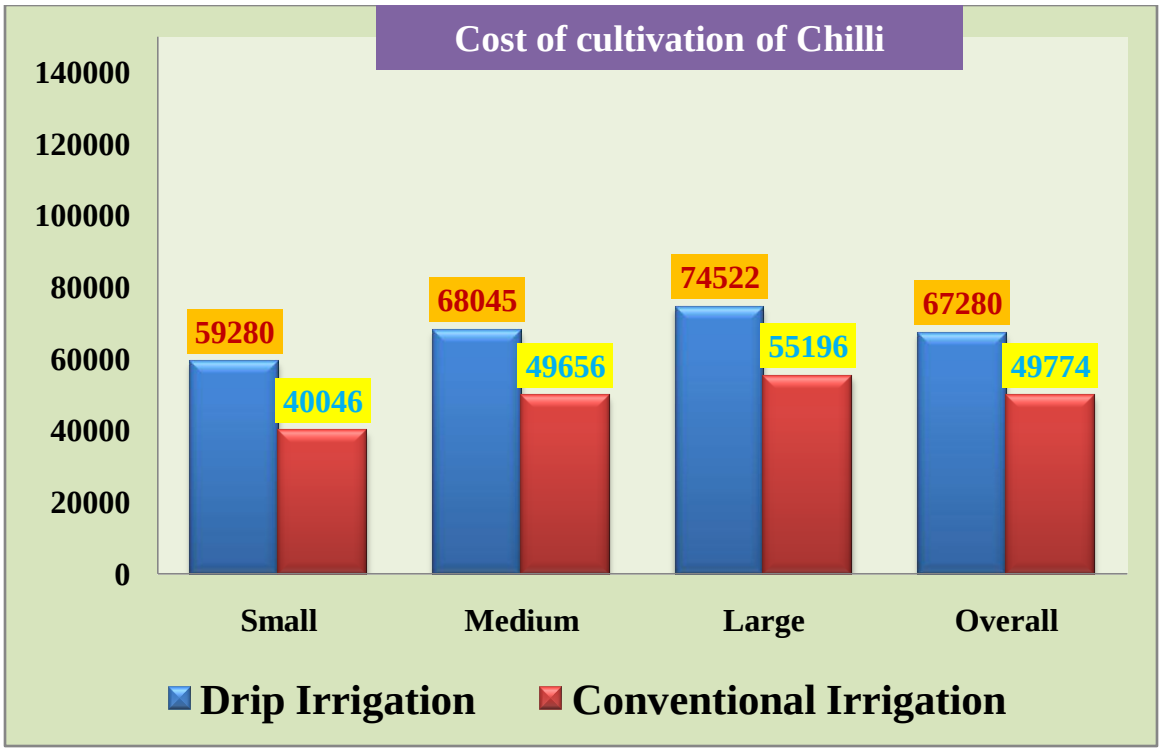


Fig.4.16: Yield of Chilli under drip irrigation and conventional irrigation



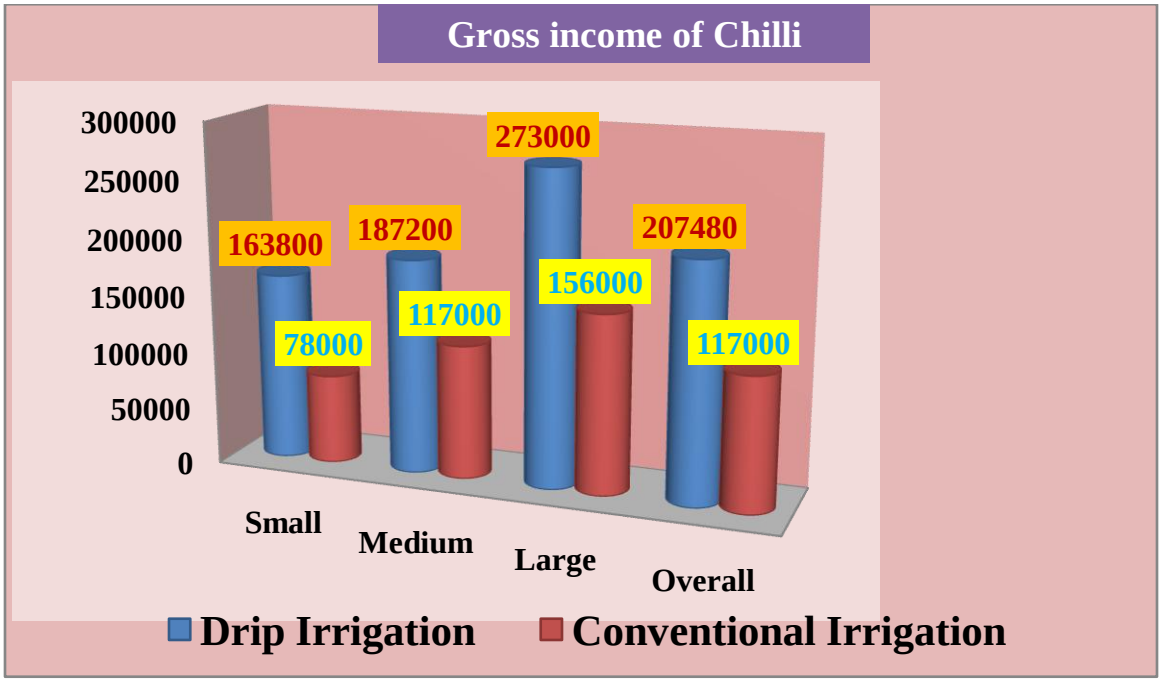


Fig.4.17: Cost of cultivation and Gross income of Chilliunder drip irrigation and conventional irrigation

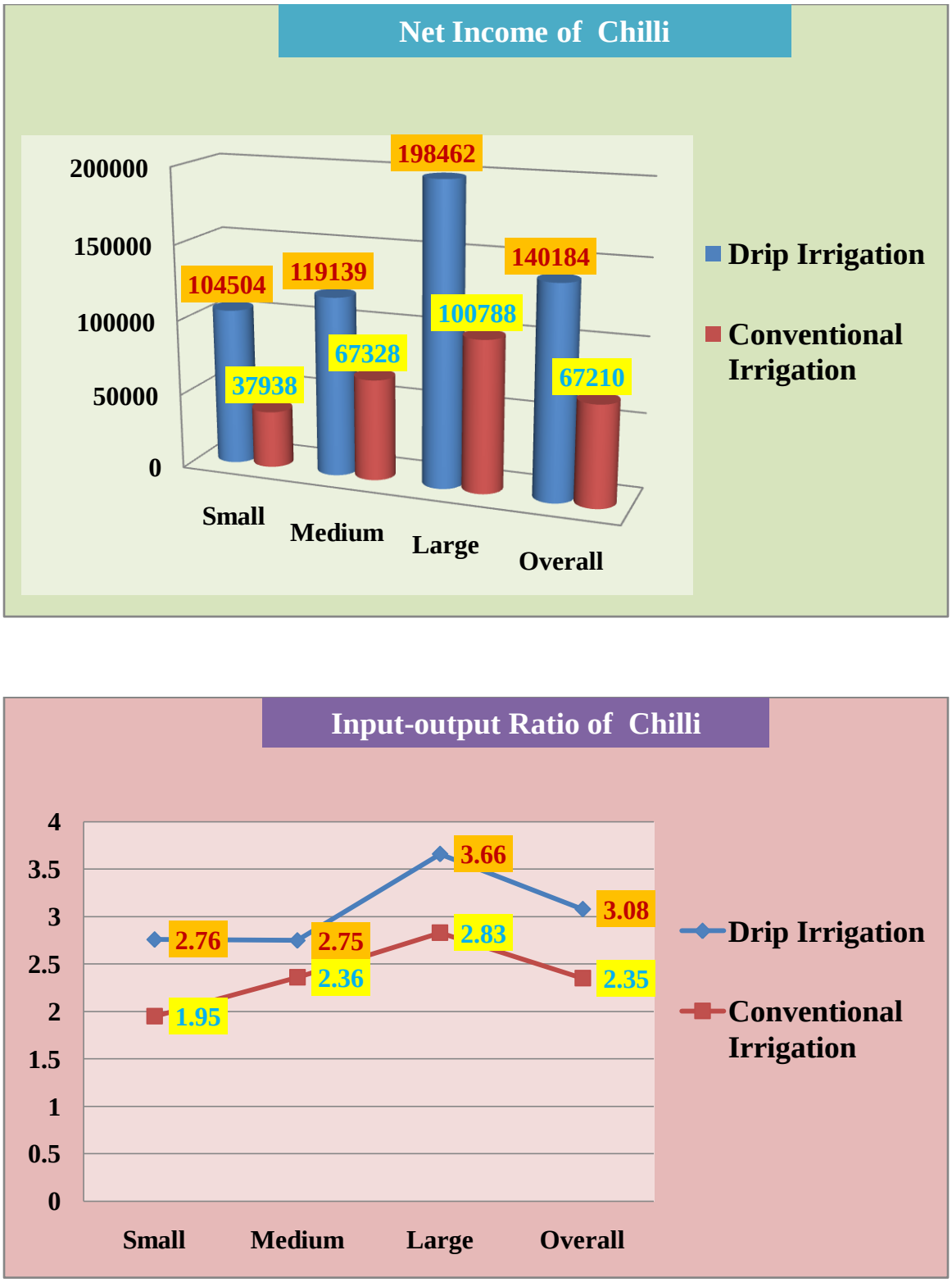


Fig. 4.18: Net income and input-output ratio of Chilliunder drip irrigation and conventional irrigation

4.2.3. Feasibility of Drip irrigation for vegetable crops

In this respect drip irrigation is assume to be costlier than the conventional method of irrigation. If other miscellaneous cost of drip irrigation is sum with total cost of cultivation. But the comprehensible advantage of drip irrigation over the conventional method of irrigation can be noticed from the Table 4.16and Fig.4.19. This table indicated the yield gap of vegetable crops under the both method of irrigation. It is clearly visible from the table that the yield of Tomato, Brinjal, Okra, Cabbage and Chilli through drip method of irrigation are 585 quintals, 400 quintals, 187 quintals, 310 quintals and 266 quintals per hectare. While the total yields of the same vegetables under conventional method of irrigation are 293 quintals, 200 quintals, 100 quintals, 153 quintals and 150 quintals, respectively. It is found that maximum yield gap 49.91 per cent in case of Tomato and minimum in case of Okra i. e. 10.21 per cent.

Table 4.16: Yield gap between drip irrigation and conventional irrigation of selected vegetables

S. No.	Vegetable crops	Observed yield (q/ha)		Yield gap (q/ha)	Per cent gap
		Drip irrigation	Conventional irrigation		
1.	Tomato	585	293	292	49.91
2.	Brinjal	400	200	200	50
3.	Okra	187	100	87	46.52
4.	Cabbege	310	153	157	50.64
5.	Chilli	266	150	116	43.60

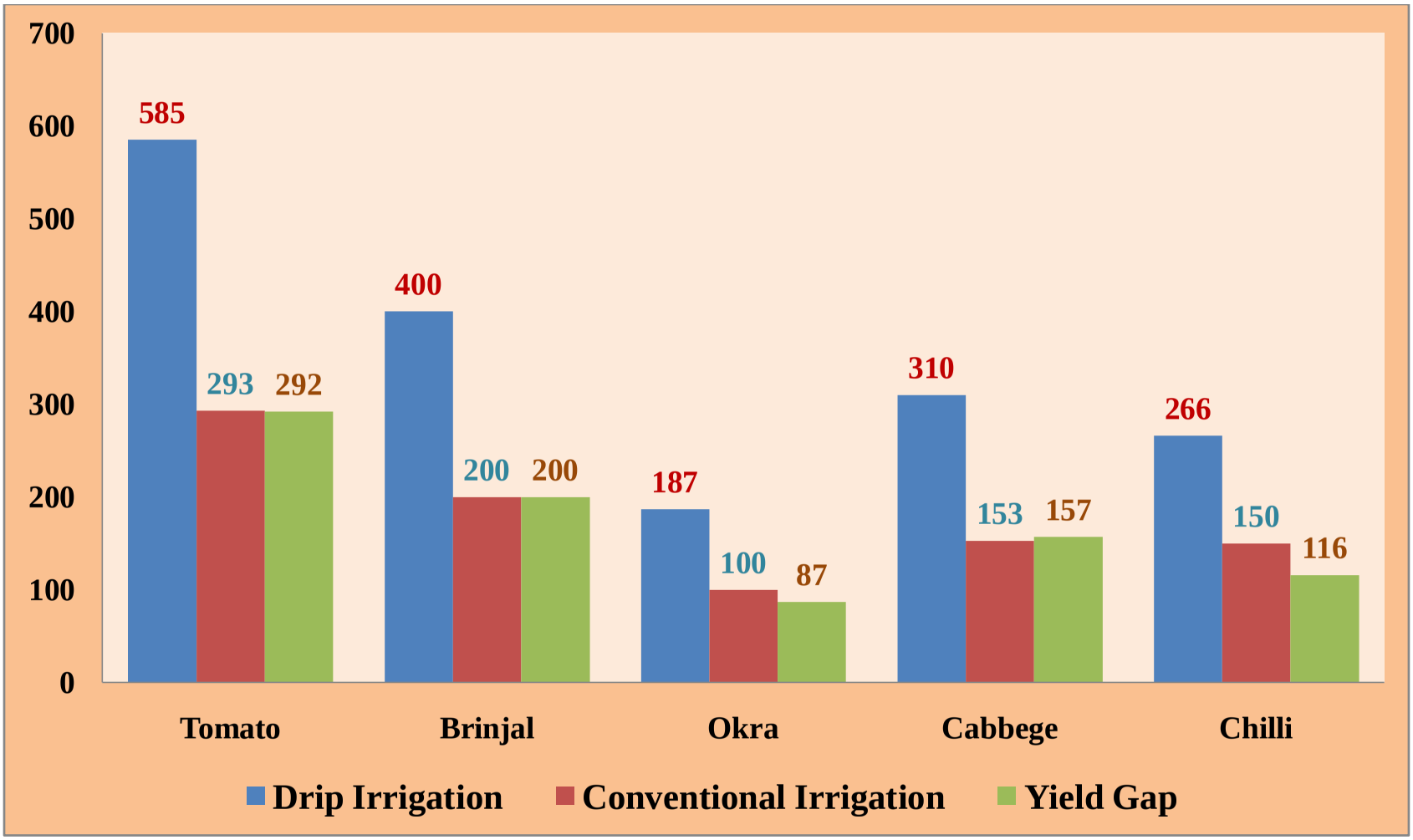


Fig.4.19: Yield comparison between drip irrigation and conventional irrigation of selected vegetable crops

Table 4.17 showsthe input-output ratio of selected vegetables in case of drip and conventional irrigation. Chilli shows the maximum output 3.08 after the investment of Rs 1.00 in drip irrigation while the minimum output after the investment of Rs 1.00 was observed in okra 2.49. In case of conventional irrigation chilli shows the maximum output (2.35) while the minimum output was observed in case of cabbage (1.84).

Table 4.17: Input-output ratio of selected vegetable crops under drip irrigation and conventional irrigation

S. No.	**Vegetable crops**	**Total cost of cultivation**	**Gross Return (Rs./ha)**	**Net return (Rs./ha)**	**Input-output ratio**
(A)	**drip irrigation**				
1.	Tomato	153293	468000	314707	1:3.05
2.	Brinjal	103622	280000	176377	1:2.70
3.	Okra	71342	177650	106308	1:2.49
4.	Cabbage	58723	155000	96277	1:2.64
5.	Chilli	67280	207480	140184	1:3.08
(B)	**conventional irrigation**				
1.	Tomato	113291	234400	121109	1:2.06
2.	Brinjal	71869	140000	68131	1:1.95
3.	Okra	48382	95000	46618	1:1.96
4.	Cabbage	41650	76500	34850	1:1.84
5.	Chilli	49774	117000	67210	1:2.35

4.3. Factors affecting for the adoption of drip irrigation

Table 4.18 illustrated the main reason for the adoption of drip irrigation in the study area. On the basis of information collected from all these farmers six main factors for adoption of drip irrigation were identified and presented. Interpretation of information shows that out of total respondent farmers, 12 Farmers (30 per cent) have used the drip irrigation because they observed that it saves the irrigation water to a significant level. Saving of production inputs has emerged as the second most important factor (27.5 per cent) for the adaptation of drip irrigation. Increases the

yield of produce has ranked third and 8 respondent farmers (20 per cent) used the drip irrigation because they thought it increase the level of production as compared to the conventional method of irrigation, besides saving the irrigation water and intake of less input. Out of the total respondents 4 (10 per cent) of them total they used the drip irrigation because it not only increases quantify but quality of produce also improves. 3 farmers (7.5 per cent) used drip irrigation for fewer problems of disease and pest. Only 2farmers used the drip irrigation because government is providing about 75 per cent subsidy for installation of drip irrigation. So it is concluded that water saving nature and less intake of production inputs are the main motivation factors (72 per cent) for the use of drip irrigation in the vegetable production .During the investigation it was found that most of respondent were financially able to use drip irrigation without any governmental assistant hence only 3 respondents has adopted the drip irrigation under financial support scheme. Table 4.18explained that it is difficult to extend the drip irrigated area through the provision of subsidy. So creating awareness about the advantage of drip irrigation may cause motivation factors and could increase the area under drip irrigation.

Table 4.18: Factor Responsible for Adoption for Drip Irrigation

S. No.	**Factors**	**No. of Respondents**	**Percentage**
1.	High yield	8	20
2.	Less inputs	11	27.5
a.	Labours in irrigation	6	15
b.	Fertilizer	3	7.5
c.	Chemical	2	5
3.	High quality of produce	4	10
4.	Less problem of disease and pest	3	7.5
5.	Saving of water	12	30
6.	Subsidy	2	5
	Total	**40**	**100**

4.4. Constraints in Implementation of Drip Irrigation programme

During the investigation the reasons behind less adoptability of drip irrigation was discussed with the respondents and result were gathered. After the investigation the various constraints to the installation of the drip irrigation system have been identified and listing as given below.

1. High initial investment require for drip irrigation particularly for the vegetable crops.
2. Fragmented land holding.
3. Irregular water supply.
4. Lack of infrastructural facilities in the farm for proper maintenance of drip irrigation instrument because it required higher investment..
5. Publicity of drip irrigation through media is poor.
6. Services after sales of drip system of irrigation are poor one and it become a problematic to maintain the system without any technical understanding.
7. There is a need to organized training programmeafter installation of drip irrigation system by the manufactures is not satisfactory.
8. Role of extension agencies could not be motivated to the farmers for adaptation of drip irrigation system.
9. Financial assistant from financing institute and other government agencies are not enough to cover large number of beneficiary.
10. Exhaustive paper work required in the government subsidy scheme and there is lots of discrimination of the farmers under subsidy scheme.
11. Drip irrigation requires expensive maintenance and managerial cost.
12. Low voltage of electricity and power.
13. Chance of theft and breakage of pipe.

14. Choking problems are also deterministic in adoption of drip irrigation.

15. Trained labours are required to operate the drip system of irrigation.

Table 4.19: Constraints in implementation of drip irrigation program

S. No.	Constraints	Small		Medium		Large	
		Yes	No	Yes	No	Yes	No
1	High initial investment for drip setup	6 (70.00)	4 (30.00)	5 (60.00)	5 (40.00)	6 (30.00)	14 (70.00)
2	Fragmented land holding	7 (70.00)	3 (30.00)	3 (30.00)	7 (70.00)	-	20 (100.00)
3	Lack of proper storage facility	9 (90.00)	1 (10.00)	7 (70.00)	3 (30.00)	12 (60.00)	8 (40.00)
4	Expensive maintenance and managerial cost	7 (70.00)	3 (30.00)	6 (60.00)	4 (40.00)	11 (55.00)	9 (45.00)
5	Lack of organized training after setup	6 (60.00)	4 (40.00)	7 (70.00)	3 (30.00)	2 (10.00)	18 (90.00)
6	Exhaustive paperwork to get government subsidy	6 (60.00)	4 (40.00)	5 (50.00)	5 (50.00)	3 (15.00)	17 (85.00)
7	Low voltage of electricity and power	3 (30.00)	7 (70.00)	2 (20.00)	8 (80.00)	2 (10.00)	18 (90.00)
8	Breakage of pipes and choking problem	7 (70.00)	3 (30.00)	6 (60.00)	4 (40.00)	13 (65.00)	7 (35.00)
9	Lack of need of trained and skilled labour	8 (80.00)	2 (20.00)	7 (70.00)	3 (30.00)	12 (60.00)	8 (40.00)

Note: Figures in parenthesis indicate percentage to total respondents.

4.5. Suggest policy alternative for enhancing the Drip irrigation

During the investigation it was realized that there is enormous possibility of drip irrigation system in Chhattisgarh state and a general perception about the drip irrigation system among the vegetable growers has developed and eventually shaping the frame for its adoption in recent future. Therefore to strike the full prospective of drip irrigation system the constraints are to be removed by appropriate policy intervention, financial assistant and technical guidance. The opinions and the problems raised by the farmers during the investigation should be taken in to account

and solvent thoroughly. In conclusion following steps should be initiation for enhancing the drip irrigation among the vegetable growers.

1. To achieve the desired area under drip irrigation, a massive awareness generation campaign concerning the importance of micro irrigation in the present scenario of agricultural, should be launched among the farmers community.
2. The training and non- training need of farmers as well as of implementing agencies should be identified and analyzed and should be trained.
3. The central government and the state government should increase in the budgetary allotment and they should release their share of fund timely and ensure the full and proper utilization of released funds.
4. The guideline released by government for drip irrigation under the subsidy scheme should be modified in view of the ground realities. The person at the helm of the affaires should be accountable for low performance.
5. Effort should be made to develop cost effective system of drip irrigation.
6. The present policy of subsidy for micro irrigation should be updated, accountable and simplified.
7. Storage facility should be created at the village level for proper storage of vegetable produced.
8. Steps should be initiated in establishment of vegetable based agro- processing unit at district level so that growers should fetch the right price for their produce.
9. The technological needs to be standardized and hence, more field oriented research are to be undertaken by the universities and institutions.

10. A strict monitoring mechanism should be developed by the drip manufacturer to ensure proper maintenance and supply of adequate parts of drip system installed in the farmer's field.
11. All financial agencies (government and non- government) should increase flow thus to provide the loan facility at concession rates to the farmers interested in installation of drip system of irrigation.

SUMMARY AND CONCLUSIONS

CHAPTER-V

SUMMARY, CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH WORK

5.1 Summary

Increasing competition with the other water users in the future would limit the water availability for expanding irrigated area. In traditional surface irrigation methods, the losses in water conveyance and application are large. These losses can be considerably reduced by adopting drip irrigation methods. Among all the irrigation methods, the drip irrigation is the most efficient and it can be practised in a large variety of crops, especially in vegetables, orchard, plantation and flowers. In drip irrigation, water is applied near the plant root through emitters or drippers, on or below the soil surface, at a low rate varying from 2 - 20 litres per hour. The soil moisture is kept at an optimum level with frequent irrigations. Drip irrigation results in a very high water application efficiency of about 90-95 per cent.

The application or injection of fertilizers and other chemicals can also be optimized through the use of drip irrigation, weed growth can be reduced, and salinity problems can be mediated. Relative to highly pressurized sprinkler irrigation systems, drip irrigation may require less energy. Drip irrigation systems also are very adaptable to difficult soil and terrain conditions.

Vegetables are very popular and have occupied important place in the daily foods of most of the Indian population for nutritional sufficiency. As a result the country has emerged as second largest producer of vegetable after china. The vegetable production in India has increasing trends. Its production has raised from 88.622 million tons with an area of 6.156 million hectare during 2001-02 to 156.3

million tons from area of 8.98 million hectare during 2011-12. The production is to be raised to 225 million tons by 2025, to cater the minimum requirement of vegetables for the ever increasing population. The huge gap between present production and future requirements necessitates enhanced vegetable production. But, urbanization, and industrialization impose constraints of decreased arable land as well as share of water to agriculture year after year. Consequently, agriculture in the future has to produce ever increasing quantities of food with decreasing quantities of water available for irrigation. Therefore, efficient utilization of water for irrigation assumes great significance. It has vast potential of application of 27 million hectare (M ha) land in India. At present, about more than 1.3 M ha land under vegetables and high value crops is being irrigated through drip irrigation in India.

According to the information as available during 2001, the area under Drip Irrigation estimated to have been increased to about 4.50 lakh hectares, which includes about 3.50 lakh hectares covered under the Government of India Schemes and 1.00 lakh hectare covered by a large number of institutions, commercial organizations, universities, large public/private sector companies, NGOs, etc.

The share of production of vegetables in Chhattisgarh is 60.8 percent of total production of vegetable in India. And it is produced by traditional irrigation system. We can enhance its production by adopting the micro irrigation techniques i.e. drip irrigation system. The vegetables produced by the drip irrigation is having good quality because plant received optimum water for its growth and development it result is more yield and due to that farmer’s get high economic value vegetables and high net return.

The total area covered by drip irrigation in Chhattisgarh is 6,360 ha and in India was 18, 97,282 ha for all the crops. The maximum area covered by drip irrigation is in

Maharashtra (6,04,440 ha) followed by Andhra Pradesh (5,05,205 ha) and Gujarat (2,26,773 ha). The total vegetables area of drip irrigation in India is 33,764 ha.

To study the economics of drip irrigation for vegetable production in the Chhattisgarh, the financial feasibility was determined by exhaustive survey done in the study area. For the economic estimation of drip irrigation in vegetable production, primary data were collected from each and every respondent through a pre-designed questionnaire. The preliminary analysis was done by calculation of input-output ratio and it has provided that the drip irrigation is profitable investment for vegetable production.

The present study has made an attempt in this direction with following specific objectives:-

- To workout the economics of major vegetables in drip irrigation system.
- To examine the changes in cropping pattern with the adoption of drip irrigation.
- To identify the factors affecting for the adoption of drip irrigation.
- To find out the problems in adoption of drip irrigation system and suggest some policy measures to overcome them.

The present study was under taken to assess the economic practicability of drip irrigation in the Durg and Rajnandgaon district where irrigation systems could be converted from conventional to drip irrigation system for vegetable production. There are 27 districts in Chhattisgarh state. Out of 27 districts Durg and Rajnandgaon district was selected purposively. From Durg district, Durg and Dhamdha blocks were selected purposively. From Rajnandgaon District, Rajnandgaon and Dongargaon were selected purposively for the present study. The purpose of present study was to compare the drip method with conventional method of irrigation for vegetable production. Farmers adopting drip irrigation system with vegetable crops were

considered as respondents. For the present study 60 vegetable growers were selected from Durg and Rajnandgaon Districts. Therefore among the major vegetable growing farmers, the farmers using drip method of irrigation were selected. In the last a sample of 40 drip adopter and 20 non drip adopter farmers having good land holding were chosen randomly as the respondents and personally interviewed to acquire useful information for representing the result of the study

5.2 Conclusions

1. The percentage of literacy of the family members was 86.3 per cent in drip and 70.00 per cent in conventional.
2. The average family size was 4.9 in drip and 5.0 in conventional.
3. Average cropping intensity was observed 200 of the selected household.
4. The total operated area among sample farms was 123.12 ha in drip and 43.51 ha in conventional.
5. On an average cost of cultivation of Tomato, Brinjal, Okra, Cabbage and Chilli was Rs. 153293, Rs. 103622, Rs. 71342, Rs. 58723 and Rs. 67280 per hectare under drip irrigation, respectively. In other hand on an average cost of cultivation of Tomato, Brinjal, Okra, Cabbage and Chilli was Rs. 113291, Rs. 71869, Rs. 48382, Rs. 41650 and Rs. 49774 per hectare under conventional irrigation, respectively. The cost of cultivation per hectare showed increasing trend with respect to the farm size of holdings.
6. On an average yield of Tomato, Brinjal, Okra, Cabbage and Chilli was observed 585 q/ha, 400 q/ha, 187 q/ha, 310 q/ha and 266q/ha under drip irrigation system and 293 q/ha, 200 q/ha, 100 q/ha, 153 q/ha and 150 q/ha under conventional irrigation, respectively.

7. On an average input-output ratio in Tomato, Brinjal, Okra, Cabbage and Chilli was 1:3.05, 1:2.7, 1:2.49, 1:2.64 and 1:3.08 under drip irrigation and 1:2.06, 1:1.95, 1:1.96, 1:1.84 and 1:2.35 under conventional irrigation, respectively.
8. Chilli is considered as the most profitable vegetable crops among the selected vegetable crops. It gives Rs. 3.08 after the expenditure of Rs. 1.00.
9. On an average net return in Tomato, Brinjal, Okra, Cabbage and Chilli cultivation was Rs. 314707, Rs. 176377, Rs. 106308, Rs. 96277 and Rs.140184 per hectare under drip irrigation, respectively and Rs. 121109, Rs. 68131, Rs. 46618, Rs. 34850 and Rs. 67210 per hectare under conventional irrigation, respectively.
10. Drip irrigation is less labour intensive method of irrigation as compared to the conventional method.
11. Before adoption of drip irrigation the area under cereals and pulses covered 59.09 per cent kharif and 58.46 per cent rabi season in drip irrigation and 56.78 per cent kharif and 50.73 per cent rabi season in conventional irrigation. However, the vegetable contribute 40.90 per cent kharif and 41.53 per cent rabi season in drip irrigation and 43.21 per cent kharif and 49.26 per cent rabi season in conventional irrigation method. After adoption of drip irrigation the area under cereals and pulses covered 51.68 per cent kharif and 48.53 per cent rabi season in drip irrigation and 52.73 per cent kharif and 47.20 per cent rabi season in conventional irrigation. However, the vegetable contribute 48.31 per cent kharif and 51.46 per cent rabi season in drip irrigation and 47.26 per cent kharif and 52.79 per cent rabi season in conventional irrigation method.

12. Before the adoption of drip irrigation the area under cereals and pulses crop was more while after the adoption of drip irrigation the area under vegetable crops was increases. From the above discussions it may be concluded that the maximum area is covered by vegetable crops and among the vegetable crops the maximum area is covered by tomato crops because it is considered to be most reliable and profitable crops interms of net income under the drip irrigation system in Chhattisgarh state.
13. Higher yield, saving of water and fewer intakes of inputs are the main reason for adoption of drip irrigation.
14. Higher installation cost and lack of trained and skilled labours are two important reasons for the less adoptability of drip irrigation.

5.3 Suggestions for future research works

On the basis of result and experience gained after the completion of investigation the following points are suggested for the future research.

1. A separate study is required for the critical analysis about the constraint responsible for less adoptability of drip irrigation for vegetable cultivation in Chhattisgarh.
2. Impact of different NGO's, Government and banks on the adoption issue of drip irrigation with especial reference to vegetable production needs to be thoroughly examined.
3. A separate study needs to be conducted to understand the inherent causes of greater adaptability of conventional irrigation for vegetable production.
4. Research should be suggested on the development of cost effective drip irrigation systems.

5. There is a need to conduct a separate study to assess the grass root status of drip irrigation in the Chhattisgarh State.
6. Study should be started to assess the impact of subsidy scheme on drip irrigation.
7. There is a need to study the role of manufacturer in adoption of drip irrigation.
8. Role of extension on the adaptability of drip irrigation need to be study separately.
9. Banking institution should provide finance/credit with less formality to meet credit requirement.
10. Market related information such as daily and weekly price of horticultural products should be disseminated among those needing this information.
11. Varieties capable of resisting insect/ pest and disease should be grown.
12. Need for the processing unit of the vegetable during peak season.
13. Vegetable growing area should facilities of transportation from going on vegetable market.
14. Horticultural crop producer's co-operative societies should be formed for better performance and achievement.
15. Government should encourage partnership between research institutions, agricultural universities, NGO's and private industries to address constraints and link vegetable farmers to markets.

ABSTRACT

AN ECONOMIC ANALYSIS OF DRIP IRRIGATION SYSTEM ON MAJOR VEGETABLES OF CHHATTISGARH PLAIN

BY

SARITA PAINKRA

ABSTRACT

The present investigation was carried out during the year 2012-13 from Durg district, Durg and Dhamdha blocks and from Rajnandgaon District, Rajnandgaon and Dongargaon were selected in Chhattisgarh state purposively for the present study. Four villages were selected on the basis of maximum area under drip irrigation. Further, on the basis of adoption of drip irrigation two categories of vegetable growers namely drip adopter and non-drip adopter were formulated. For the present study 60 vegetable growers were selected from Durg and Rajnandgaon Districts. The data were collected through personal interview and analyzed by using appropriate stastical tools.

The study conducted on economic analysis of drip irrigation for vegetable crops in Durg and Rajnandgaon district of Chhattisgarh revealed that the drip irrigation for vegetable production is profitable investment. Before the adoption of drip irrigation the area under cereals and pulses crop were more while after the adoption of drip irrigation the area under vegetable crops highest average yield, average cost of cultivation and average net return was observed in Tomato (585 q/ha, Rs. 153293 and Rs 314707/ha) under drip irrigation system as compare to other selected vegetables. Chilli gives highest input-output ratio i.e 1:3.08 as compared of other vegetable crops.

From the above discussions it may be concluded that the maximum area is covered by vegetable crops and among the vegetable crops the maximum area is

covered by tomato crops because it is considered to be most reliable and profitable crops under the drip irrigation system in Chhattisgarh state. Higher yield, saving of water and fewer intakes of inputs are the main reason for adoption of drip irrigation. Higher installation cost and lack of trained and skilled labours are two important reasons for the less adoptability of drip irrigation. A strict monitoring mechanism should be developed by the drip manufacturer to ensure proper maintenance and supply of adequate parts of drip irrigation system installed in the farmer's field. All financial agencies (government and non government) should increase fund flow thus to provide the loan facility at concession rates to the farmers interested in installation of drip irrigation system.

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APPENDICES

APPENDIX-I

DEPARTMENT OF AGRICULTURAL ECONOMICS

INDIRA GANDHI KRISHI VISHWAVIDYALAYA, RAIPUR (C.G.)

"AN ECONOMIC ANALYSIS OF DRIP IRRIGATION SYSTEM ON MAJOR VEGETABLES OF CHHATTISGARH PLAIN"

House Hold Schedule

A. General Information:

- Name of farmer ……..……2. Age……
- Education ……Categories [Gen. / OBC/ ST/ SC] ……..
- Village …… Block ……...
- District …….. State …….
- Name of market ……..Distance from market ……..
- Distance from pacca road (km)……..**.....**
- Date of interview…….

B. Details of the family

S .No.	Name of family member	Relation to head	Sex male/ female	Age	Education	Occupation	
						Main	Subsidiary
1.							
2.							
3.							
4.							
5.							
6.							

C. Land Information:

S .No.	Particular	Area (ha.)	Agriculture		Source of Irrigation	Soil type	Land quality
			Irrigated	Unirrigated			
1.	Owned land						
(i)	Cultivated						
(ii)	Home stead						
2.	Leased in						
3.	Leased out						
	Total land						

D.Source of irrigation:

S. No	Name of Source	Area (ha.)	Irrigation Charges (Rs.)
1.	Tube well		
2.	Canal		
3.	Tank		
4.	Ponds		
5.	Well (traditional)		
6.	Well (pump)		
7.	Bore well		
8.	Stop dam		
9.	Other		
10.	Total		

E. <u>Method of Irrigation</u>:

a. Drip Irrigation.

b. Conventional irrigation.

F. <u>Cropping pattern:</u>

S. No.	Particulars	Variety	Area (ha.)		Production (Quintals)	Value Rs.
			Irrigated	Unirrigated		
Ma	**Kharif** a.					
	b.					
	c.					
	d.					
	e.					
II	**Rabi** a.					
	b.					
	c.					
	d.					
	e.					
III	**Summer**					
	a.					
	b. c.					
	d.					
	e.					

G. Major Constraints

S No.	Constraints	Importance of Constraints	Severity of Constraints	Affect of Constraints in Technology Adoption	Solution of Constraints
A.	**Institutional Constraints**				
(i)	Training Facility				
(ii)	Unavailability of credit				
(iii)	Poor extension services				
B.	**Infrastructural**				
(i)	Lack of irrigation facility				
(ii)	Lack of communication facility				
(iii)	Lack of marketing facility				
(iv)	Lack of transport facility				
(v)	Lack of storage				
(vi)	Lack of electricity				
C.	**Technological**				
(i)	Lack of technical Know- how				
(ii)	Small Size of farm				

(iii)	Soil problem				
(iv)	High water table				
D.	**Personal problem**				
(i)	Lack of capital				
(ii)	others				

Table: Input wise cost of cultivation of vegetables in drip irrigation system

Rs./ha.

S.No.	Particulars	Drip Farmers					Non- Drip Farmers				
		Marginal	Small	Medium	Large	Overall	Marginal	Small	Medium	Large	Overall
1	Human labour										
(i)	Hired labour										
(ii)	Family labour										
2	Bullock labour										
3	Machine power										
4	Seed										
5	Manure										
6	Fertilizer										
	Nitrogen										
	Phosphorus										
	Potash										
	Other										
	Sub total										
7	Plant Protection										
8	Drip inputs										
9	Irrigation Charges										
10	Miscellaneous										
11	Interest on working capital										
12	Rental Value of Land										
13	Others										
14	Watching										
	Total Cost (Rs.)										

Table: Operational cost of Vegetables Production under Drip Farmers and Non- Drip Farmers

Rs,/ha.

S.NO	Particulars	Drip Farmers					Non- Drip Farmers				
		Marginal	Small	Medium	Large	Overall	Marginal	Small	Medium	Large	Overall
1	Field preparation										
2	Manure & Fertilizer										
3	Plant protection										
	IPM practices										
	Synthetic chemicals										
4	Sowing Nursery/ Transplanting										
5	Weeding/ Interculture										
6	Harvesting										
7	Transportation										
8	Miscellaneous										
9	Interest on working capital										
	Total cost										

Note**:** Figures in parentheses indicated percentage to total cost

Table:Costs and Returns of Vegetables Production under Drip Farmers and Non- Drip farmers

Rs,/ha.

S.NO	Particulars	Drip Farmers					Non- Drip Farmers				
		Marginal	Small	Medium	Large	Overall	Marginal	Small	Medium	Large	Overall
1	Input cost (Rs.)										
2	Yield (qtl./ha.)										
	a.										
	b.										
	c.										
	d.										
	e.										
	Total Yield										
3	Value of production (Rs.)										
	a.										
	b.										
	c.										
	d.										
	e.										
	Total Value of production										
4	Net return (Rs.)										
5	Additional cost over Non- Drip										
6	Additional returns over Non- Drip										
7	Additional net benefits from Drip										
8	Input- Output ratio										

APENDIX –II

COST OF CULTIVATION FOR VEGETABLES

S.No.	Particulars/Items	No. of Labours Required Day $^{-1}$		Total Expenditure	
		Conventional Irrigation	Drip Irrigation	Conventional Irrigation	Drip Irrigation
1	2	3	4	5	6
(A)	Field Preparation for Raising Nursery				
(i)	Tractor				
(ii)	Preparation of Nursery Bed (Labour @ Rs……..Day^{-1})				
(iii)					
(iv)	Spreding FYM				
(v)	Demarcation and Layout				
(vi)	Seed@				
(vii)	Rs……Kg^{-1}				
(viii)	Seed ……..……gm. Ha^{-1}				
(ix)	Sowing of seed				
(x)	Irrigation with Hazara				
(a)	Covering of Beds with -				
(b)	Paddy Straw				
(xi)	…… Removal of Grass as soon as Seed were Germinated				
(xii)	Hoeing of Nursery Beds				
(xiii)	Spraying of Pesticides				
(xiv)	Irrigation				
(xv)	Removal of Seedling from Nursery Beds				
(B)	Field Preparation for Transplanting				
(i)	Ploughing				
(ii)	Harrowing				
(iii)	Rotavator				
(iv)	Pata Leveling				
(v)	Preparation of Beds, Layout, Manuaring and Basal Application of Fertilizers				

(C) (i)	Seedling Transplanting Labours				
(D)	FYM @ Rs. ……..trolly^{-1} 12 trolly ha^{-1}				
(E) (i) (ii) (iii) (iv)	Fertilizers N Urea P SSP K MOP Application of Fertilizers				
(F) (i) (ii)	Irrigation Irrigation Frequency Labours				
(G) (a) (b)	Plant Protection Chemical use Labour				
(H) (i) (ii) (iii) (iv)	Weeding Times 1ST 2ST 3ST 4ST				
(I)	Land Revenue				
(J) (i) (ii) (iii) (iv)	Harvesting- 1ST Picking 2ST Picking 3ST Picking 4ST Picking				

APPENDIX – III

NAME OF SAMPLE HOUSEHOLDS

S. No.	Name of Respondents	Total area ha.	S. No.	Name of Respondents	Total area ha.
	Drip Adopters				
	Small				
1.	Dhruvlal patel	1.62	13	Rekhchand devangan	10.86
2.	Dulorani	1.07	14	Krishan prasad devangan	6.56
3.	Devnath sonkar	1.85	15	Pilla lal devangan	6.07
4.	Daolat ram sahu	1.31	16	Naveen parmar	4.53
5.	Bharat ram sahu	1.50	17	Manoj parmar	4.05
6.	Kaoshal chandrakar	1.25	18	Jadavjiparmar	6.18
7.	Lalji	1.62	19	Santosh kumar devangan	6.74
8.	Chaitram devangan	1.95	20	Subhash bhai	6.49
9.	Bhupendra sahu	1.54		**Total**	**209.64**
10.	Yogesh parmar	1.92		**Non-Drip Adopters**	
	Total	**15.63**		**Small**	
	Medium		1	Narsingh patel	1.21
1.	Mahendra naykar	2.83	2	Panna nishad	1.21
2.	R. Tambi	3.23	3	Dileep kumar	1.65
3.	Eshvari devangan	3.00	4	Om prakash nishad	1.25
4.	Deendyal chandrakar	2.42	5	Smt. Mamta nishad	1.80
5.	Kartik ram sahu	3.56	6	Tikam nishad	1.35
6.	Kriparam chandrakar	2.25	7	Tikam mrar	1.80
7.	Harish chandrakar	2.02	8	Kamlesh mrar	1.25
8.	Jaysuk jethwa	3.64	9	shri pitamber	1.25
9.	Anup jayswal	3.23	10	Upendra thakur	1.40
10.	Manish kumar parmar	2.42	11	Kanhaiya nishad	1.36
.	**Total**	**28.61**	12	Gopal sahu	1.21
	Large			**Total**	**16.74**
1.	Suresh patel	5.63		**Medium**	
2.	Bhuvan lal patel	4.98	1	Kishor kumar sahu	2.42
3.	Pilla ram kashyap	4.20	2	Tukaram pwar	2.50
4.	Laxmi prasad	4.39	3	Chova ram sahu	2.83
5.	Baldau shre verma	8.16	4	Agrahiz sahu	2.83
6.	Jalm singh patel	19.47	5	Mali das sahu	2.23
7.	Bhagirathi verma	18.73		**Total**	**12.81**
8.	Dharmpal verma	22.27		**Large**	
9.	Mohan yadav	20.65	1	Punam chand sonkar	4.86
10	Kantilal vateyer	12.53	2	Shankar lal sinha	4.25
11	Hemendra naykar	14.49	3	Dular ram	4.85
12	Khemlal devangan	22.66		**Total**	**13.96**