SUSTAINABLE WATER MANAGEMENT THROUGH DRIP IRRIGATION IN MADURAI DISTRICT-AN EXPLORATIVE STUDY

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Thesis submitted in part fulfillment of the requirements for the degree of MASTER OF SCIENCE (AGRICULTURE) IN AGRICULTURAL EXTENSION to the Tamil Nadu Agricultural University, Coimbatore

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CERTIFICATE

This is to certify that the thesis entitled **"Sustainable water management through drip irrigation In Madurai district-An explorative study**" submitted in part fulfillment of the requirements for the award of the degree of **MASTER OF SCIENCE (AGRICULTURE EXTENSION)** to the Tamil Nadu Agricultural University, Coimbatore is a record of *bonafide* research work carried out by **Miss. V. FLORA LAVANYA** under my supervision and guidance and that no part of the thesis has been submitted for the award of any other degree, diploma, fellowship or other similar titles or prizes and that the work has not been published in part or full in any scientific or popular journal or magazine.

Place: Madurai
Date :

Dr. T. RATHAKRISHNAN
(Chairman)

Approved

Chairman **(Dr. T. RATHAKRISHNAN)**

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Date:

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ABSTRACT

SUSTAINABLE WATER MANAGEMENT THROUGH DRIP IRRIGATION IN MADURAI DISTRICT-AN EXPLORATIVE STUDY

By

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The study entitled **"Sustainable water Management Through Drip Irrigation in Madurai District-An Explorative Study"** was conceived with assessing the profile of the respondents, various factors favouring and limiting adoption, impact of drip irrigation among the adopters were also studied and suggestions were provided to increase the adoption of drip irrigation in the study locale.

The study was taken up in Vadipatti Taluk and south Taluk of Madurai district. A sample of sixty each adopters and non adopters were taken, contributing to a total of one twenty farmers. The taluks were purposively selected and the respondents were randomly selected. Using a pretested and well structured interview schedule the necessary data were collected and statistically analysed. The Salient findings of the study are presented below.

The profile of the respondents revealed that more than half of the respondents belonged to old age category. Majority of them were educated up to secondary level. One fourth of the respondents had medium level of farming experience. Nearly one fourth of respondents possessed higher irrigation intensity. The farm power status of the respondents was found to be medium. Most of the respondents had only medium level of training participation. Majority of them had medium risk orientation nature; Lower credit orientation and economic motivation were observed with majority of the farmers. Nearly three fourth had higher innovative character. Majority, more than three fourth of the respondents had

favourable attitude towards drip irrigation technology. Comparitive study of all the characters between adopters and non adopters were carried out which represented the existence of significant difference between adopters and non adopters.

The intensity of adoption of drip irrigation among the respondents was high. The variables namely Irrigation intensity, Training participation, credit orientation, innovativeness, scientific orientation, Attitude, Perception on attributes of drip irrigation were the contributing variables for adoption intensity.

The overall impact among the respondents was high and increased income as a major impact experienced by majority of the respondents. Irrigation intensity, Innovativeness, Attitude, Perception on attributes of drip irrigation were the variables contributing for impact.

The major factors favouring adoption were water scarcity, high weed menace by conventional method of irrigation, less cost of cultivation, reduced labour requirement as reported by majority of respondents.

The constraints experienced by majority of respondents were high initial cost of investment, delay in getting loan, and salt encrustation on drippers.

Suggestions to increase adoption of drip were provision of more number of trainings and demonstrations to farmers through drip companies and department of agriculture, timely disbursement of subsidy, exposing the farmers to drip irrigation through field trips.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

India is mainly an agriculture dependent country. Our agricultural development efforts are technology driven. Focuses in the past have invariably all along been on promoting new technologies and handy products for overcoming production constraints and using market opportunities for securing immediate gains. In this approach conservation of natural resources-land and water, two basic factors of production have received limited rather inadequate attention. These natural resources have been overused in many cases to such an extent that the natural capital today stands badly depleted and environmental problems threatening our very socioeconomic fabric are surfacing at an appalling rate.

Application of farm technology of course is critical for achieving economic prosperity and welfare of the farming society and for improving standard of living and quality of life. There should not be any let up in ushering changes through developmental efforts, on the contrary there is tremendous need to accelerate technological changes since rate of growth in agriculture is rather slow. But this push forward should not in anyway be allowed to damage the natural resources – land and water that our basic life sustaining systems. How to march forward without harming our natural resource is a major challenge we face today. For sustained agricultural growth our precarious natural capital must be conserved and managed with utmost care, otherwise our future will be in peril.

Ways to conserve water

"Water" is the "Elixir of Life" and it is said to be life and blood of agriculture. With the increasing scarcity of water day by day, water management has become the need of the hour. A number of initiatives have already been taken to conserve land and water resources. States are also encouraged to promote drip and sprinkler irrigation through supply of equipments at subsidized rates. But these efforts have to be intensified.

Drip irrigation is the slow drop by drop localized application of water at a grid just above the soil surface. There are also subsurface drip systems; in which drip irrigation laterals are buried 20 to 60 centimeters below the soil surface. The

efficiency under drip irrigation has been estimated to be as high as 80 to 90 percent. Drip system also permits the use of fertilizers and other soluble nutrients along with irrigation water and is considered to be the most efficient and economical method of fertilizer application.

A slow watering process intended to deliver water and nutrient to the root area of the plant in quantities matching its evaporation requirements as closely as possible and at a rate close to what the soil will absorb is Drip irrigation defined by Tobey (1981).

This technology if accepted on a wide scale can address the problem of water scarcity. It can even out social equity issues involved in distribution of water

Present status of drip irrigation

Micro irrigation was introduced in 1980's .It could cover only 1.2 million ha in 12 states and about half acreage in Maharastra alone (45.00percent). Karnataka Tamilnadu and Andhra Pradesh are showing keen interest.

Reason for sluggish reach

The economics of drip irrigation is well established and the technology has gained commercial acceptance. However the level of technology awareness and its dissemination is very low. Among the various reasons for low dissemination of the technology; the prominent are high capital cost, distortion in subsidy disbursement mechanism, inadequate knowledge about efficient use of technology.

But still various efforts are taken by the government and Indian Agricultural Research Institute to disseminate this precious technology. One such effort was DRIP-D software for drip technology dissemination.

A user friendly and interactive software DRIP-D was developed at water technology center, Indian Agricultural Research Institute–NewDelhi.Drip-D software helps in determining the kind of drip system, operating hours, operating pressure, low economic drip system etc. For the assistance of the user, large amount of data has been provided in the software.

With this brief prelude this research study "Sustainable water Management Through Drip Irrigation in Madurai District –An Explorative study" was carried out with the following objectives.

Objectives of the study

1. To study the profile of the respondents.
2. To study the motivational factors for adoption and factors limiting adoption.
3. To document successful case studies from drip practitioners.
4. To study the impact of drip irrigation technology among the farmers.
5. To develop strategies for upscaling the drip irrigation system among the farming community.

Need and importance of the study

Irrigation is the most vital and critical input for agricultural production and productivity. The demand for irrigation water in future is destined to increase at an alarming pace. But growing competition from industry and urban use drastically reduces availability of irrigation water for agriculture. Creation of additional potential is an expensive affair, which compels one to think of water conservation practices and more efficient water application methods.

Micro irrigation is concerned about conserving the bestowed gifts of god natural resources. Through drip irrigation the use of water, which is increasing rapidly, and it is expected to be a viable and alternate irrigation method for foreseeable future.

Micro irrigation though it has varied utilities like controlled and directed water supply to root zones, fertigation and reduced labour cost, reduced evaporation rate etc,It has not been adopted very widely by the farmers this might be due to various factors. It is therefore necessary to know the extent to which this management technology has reached and adopted by the farmers.

Scope of the study

This study focuses on the intensity of adoption of drip irrigation technology by the farmers, various factors favouring adoption, constraints faced by the farmers, and relative impact of drip irrigation among the adopters and various suggestions were made to increase the adoption. These findings will help in formulating

appropriate strategy by the policy planners and development agencies to devise suitable extension strategy to motivate and convince the target groups to adopt the drip irrigation technology.

Limitations of the study

The limitation in respect of time, finance and conveyance that would normally encountered by a student researcher were met during the course of investigation.

CHAPTER II

REVIEW OF LITERATURE

Review of Literature on a topic helps the researcher to develop theoretical framework of the study and assess the nature and quantum of research studies already undertaken in the area of research. Keeping this in view an attempt was made to review the related literature. The main objective of this chapter is to portray in broad outlines the conceptual frame of references that has been used for the study, will provide a theoretical basis for the empirical investigation. It also assists in evaluating one's own research efforts by comparing them with the effort of other thesis. Research studies related to adoption of drip irrigation was very few. However, an earnest effort was made to review the available literature having direct and indirect bearing

The review has been organized in the following subheads.

2.1. Definition of drip irrigation.

2.2. Drip irrigation as an innovation.

2.3. Profile of respondents.

2.4. Intensity of adoption

2.5. Factors favouring adoption of drip irrigation technology.

2.6. Constraints in adopting drip irrigation technology

2.1 DEFINITION OF DRIP IRRIGATION

Tobey (1984) classically defined drip irrigation as a slow watering process intended to deliver water and nutrients to the root area of the plant in quantities matching its evaporation requirements as closely as possible and at a rate close to what the soil will absorb.

Breslers and Yasutomi (1990) quoted that drip irrigation as the slow application of water to the soil surface as discrete or continuous drops where in water is applied to the soil through emitters at a relatively low pressure.

Singh and Bhimawat (2003) defined drip irrigation as an advanced method of irrigation that helps to overcome various problems of water loss, besides labour, money and improper weed and water management problems.

Borake and Copergaon (2004) proclaimed drip irrigation technology as the slow drop by drop, localized application of water at a grid just, above the soil surface.

Rajput (2004) defined drip irrigation, technology as network of pipes having water emitting devices to deliver water at very low rates.

According to Chaudhary (2005) drip irrigation system as versatile management tool that can increase productivity per unit volume of water and also save up to 50.00 per cent of water in additions to other savings in farm input cost.

Srinivasulu *et al.* (2005) defined drip irrigation as localized application of water slowly drop by drop near the plant surface through small opening called drippers or emitters with variable discharge rates as per the requirement of the crop plant.

SatyaSundaram (2006) defined drip irrigation system as an advance method of applying water and fertilizer near the root zone of the crop with the help of low cost plastic pipes and emitters.

2.2. DRIP IRRIGATION AS AN INNOVATION

According to Krishnarao (1986) the drip irrigation technology was the accidental contribution of Israeli farmer Simcha Blass during the early 1940's who observed an unusual growth of a tree which was accidentally fed by a leaking metallic pipe. Later on, Hibro Agricultural University Scientists conducted research and discussed many advantages of drip irrigation, thus, it became very popular throughout Israel and spread to other countries of the world.

Rabigayen and Shankar (1990) indicated that after sustained promotional efforts during the past one and half decades, use of drip system has made a modest beginning in the country.

Rao (1993) concluded that drip irrigation was widely practiced and well established method of irrigation in western countries and slowly gaining popularity in India, as the saving of water as well as additional increase in yields has been reported to as much as 53.00 to 66.00 per cent.

According to Revathi and Rajeswari (1996) the small and large farmers in Tamil Nadu are convinced of the usefulness of the system and are introducing the system in a big way for coconut crops.

Feler (2004) revealed that India is the second country after USA to implement drip irrigation.

Chaudhary (2005) proclaimed that drip irrigation gained some momentum from 1985 onwards but not to the expected level. From a mere, 15, 00 ha in 1985, the area under drip irrigation rose to 75,000 ha in 1995 and than to 2, 85, 000 ha by 2000-01. However the expansion of area under drip irrigation is unbalanced and is limited mainly to Southern Peninsular State.

SatyaSundaram (2006) elicited that micro irrigation technology is yet to become popular in India. It was introduced in the 1980's. But, be now, it could cover only 1.2 million hectares in 12 states. About half of the acreage is in Maharashtra alone of course, Karanataka, Tamil Nadu, Andhra Pradesh, Gujarat, Madhya Pradesh and Haryana are showing keen interest.

2. 3. PROFILE OF RESPONDENTS

2.3.1. Age

Sakthivel (2000) indicated that majority of the respondents (44.17 per cent) belonged to middle age category followed by 37.11 per cent in young age group and 21.66 per cent in old age group.

Illayaraja (2002) stated that majority of the respondents (55.40 percent) falls under old age category followed by 30.00 percent and 14.10 percent under middle and young age category.

Parkavi (2003) observed that 51.66 percent of respondents under middle age category followed by 26.68 percent under old age and 21.66 percent under young age.

A Study on yield gap analysis of grape cultivars carried out by Ramani (2004) concluded that 45.00 percent of respondents belonged to old age category, 36.67 percent under middle age and only 18.33 percent under young age.

2.3.2. Educational status

Sheela (2000) indicated that 30.00 percent of the respondents were educated up to primary school level. This was followed by middle school (27.50 percent) and illiterate (25.00percent) .only a meager portion of them qualified up to secondary school, and collegiate levels.

Vijayaragavan (2001) revealed that most of the sugarcane growers were high school educated.

According to Jeyabalan (2002) considerable size of sugarcane growers (20.00 percent) had education up to primary school level followed by collegiate level (19.16 percent) and 17.50 percent of them had education up to high school level.

2.3.3. Farming experience

Mathaiya (1997) stated that nearly three-fourth (72.50 per cent) of the mango growers had medium level of experience in mango cultivation, which ranged from 10 to 24 years. This was followed by high (20.84 per cent) and low levels (6.66 per cent).

Senthilkumar (2001) found that majority of the banana growers had (43.33 per cent) medium level of experience in banana cultivation which ranged from 18 to 29 years. This was followed by high level (29.17 per cent) and low level (27.50 per cent).

According to Sujaivelu (2002) a higher percentage of mango growers had up to 10 years of total farming experience.

Sukitha (2003) in her findings indicated that nearly half (48.33 per cent) of the respondents possessed less than 18 years of farming experience, whereas nearly one-third (30.00 per cent) had medium level of farming experience. The rest (21.67 per cent) had farming experience of more than 29 years.

2.3.4. Farm power status

Ponnusamy (1993) revealed that 50.00 per cent of farmers were in the low level of farm power status followed by 36.67 per cent with medium level of farm power status. Only 13.33 per cent had high farm power status.

Subramanian (1994) in his study with wasteland farmers observed that 64.29 per cent had lower followed by 35.71 per cent in middle level of farm power status.

Kavitha (1999) reported that half of the growers (51.66 percent) had high farm power status and only 15.00 per cent had low farm power status remaining 33.34 percent had middle level farm power status.

2.3.5. Irrigation intensity

Kavitha (1999) proclaimed that majority of the respondents had higher irrigation intensity.

2.3.6. Training participation

Padma (2001) identified that majority of the respondents (62.51 percent) had medium level of participation in training programmes and 20.00 percent had medium level of participation. Only 17.00 percent of the respondents had high level of participation.

Usharani (2003) proclaimed that 70.34 percent of the respondents had low level of participation followed by medium participation which was found 30.00 percent.

Nalini (2004) revealed that majority of the respondents (60.00 percent) did not attend any training programme for the past three years. One training was attended by more than one-fifth (22.50 percentage) of the farmers. One-tenth

(10.83 percent) of them attended two trainings, meager percentage (6.67 percent) of the respondents attended more than two trainings.

2.3.7. Risk orientation

Prabaharan (2000) pointed out that most of the medicinal plant growers were under medium level of risk preference.

According to Vijayalan (2001) majority of the respondents (40.00 per cent) had medium level of risk orientation followed by low level (30.83 per cent).

Findings of Illayaraja (2002) indicated that large majority of the respondents had medium level of orientation towards risk taking ability.

Senthilvadivoo (2003) revealed that 43.33 per cent of the respondents had medium level of risk bearing nature followed by low (31.67 per cent) and high (25.00 per cent) levels.

2.3.8. Credit orientation

Priyadarshini Indira (2002) observed that three-fourth (75.00 percent) of the respondents had medium level credit orientation followed by high (22.50 percent) and low (2.50 percent) levels of credit orientation.

There were 40.00 percent of respondent who had high level of credit orientation followed by medium (32.00 percent) and low level as per Beullah (2004).

Jeyashree (2004) revealed that almost an equal proportion of the respondents were distributed under low to medium level category of credit orientation. Medium and low levels were seen among the 37.50 per cent and 36.67 per cent of respondents respectively. While one-fourth of the respondents (25.83 per cent) were found to have high level of credit orientation.

2.3.9. Economic motivation

According to Subramanian (2000) majority of the respondents had medium (54.67 percent) to high (21.33 percent) level of economic motivation.

As pointed out by Gandhikanakasaba (2002) majority of respondents (57.50 percent) had medium level of economic motivation followed by high (26.67 percent) and low (15.83percent) levels of economic motivation.

Nalini (2004) concluded in her study that majority (69.17 percent) of the respondents had medium level of economic motivation. Little more than one-tenth (12.50 percent) of the respondents had low level of economic motivation.

Vilas (2005) revealed that majority of the respondents (40.00 percent) had low level of economic motivation, whereas nearly one-third (31.67 percent) and more than one-fourth (28.33 percent) of the respondents possessed medium and high levels of economic motivation respectively.

2.3.10. Innovativeness

Sheela (2000) observed that majority of the farm women (88.33 percent) possessed medium to high level of innovativeness.

Chandra (2001) reported that 38.34 per cent of the respondents had high level of innovativeness followed by low (32.80 percent) and medium (29.16 percent) levels of innovativeness.

Jayabalan (2002) confirmed that 54.17 percent possessed medium level of innovativeness followed by 25.00 percent and 20.83 percent under high and low level of innovativeness.

Majority of the respondents had medium level of innovativeness as observed by Barathi Deepa (2003)

According to Jayashree (2004) nearly half of the respondents (47.50 percent) were found to have medium level of innovativeness. Low and high levels were found with 29.17 per cent and 23.33 per cent of the respondents respectively.

Desingurajan (2005) revealed that 37.50 per cent of the respondents had high level of innovativeness followed by medium (35.83 percent) and low (26.67 percent) levels.

2.3.11. Scientific orientation

Saravanan (2000) proclaimed that 42.50 percent of coconut planters with medium level of scientific orientation, follwed by high (35.00 percent) and low (22.50 percent) of scientific orientation.

According to Senthilkumar (2001) majority (47.50 percent) of the respondents possessed low level of scientific orientation followed by medium (37.50 percent) and high levels (15.00 percent) of scientific orientation.

Majority of the respondents (51.67 percent) had medium level of scientific orientation followed by high and low levels of scientific orientation as quoted by Kannan (2002).

Vilas (2005) revealed that 40.83 percent of the respondents possessed medium level of scientific orientation followed by 38.33 Percent and 20.83 per cent with low and high levels of scientific orientation respectively.

2.3.12. Attitude

Savithiri (1992) reported that little more than half (54.61 per cent) of the respondents were found to have less favourable attitude followed by 35.33 per cent with favourable attitude. Only a meagre percentage (10.00 per cent) of respondents possessed more favourable attitude towards water conservation technologies.

As proclaimed by Marimuthu (2001) that almost 57.14 percentage of respondents had lowlevel followed by medium (25.72 percentage) and 17.14 percentage with high level of attitude towards tribal development programme.

Parthibaraja (2004) reported in his study that nearly 54.17 percentage of farmers had less favourable and 32.50 percentage with favourable and 13.33 under more favourable attitude

2.3.13. Perception on attributes of drip irrigation technology

Sivanappan (1994) reported that perceptible advantage realized by all the farmers of the drip system were saving in water, less labour use, less of field preparation and saving in land area.

Hartz and Hochmuth (1996) quoted that fertigation through drip irrigation lines can reduce overall fertilizer application rates and minimize adverse environmental impact of vegetable production.

Findings of Kavitha (1999) proclaimed that all the drip users (100.00 per cent) felt that efficient use of water, water saving, less labour requirement, effective weed management, reduced soil erosion, and reduced cost of cultivation.

A large majority (96.67 per cent and 95.74 per cent) of the drip users in coconut and grapes felt increased yield as one of the important attributes.

Less attack of disease was perceived only by a meagre proportion (16.67 per cent) and more than one-fifth (36.17 per cent) of the drip users in coconut and grapes respectively.

Nearly an equal percentage of the drip users (35.00 per cent and 31.91 per cent) in coconut and grapes felt fertigation is possible as an attribute of drip irrigation technology.

More than 80.00 per cent of the drip users perceived the suitability of drip to all season as one of the attributes. Quality of the produce increased was perceived as one of attributes by 16.67 per cent and 85.11 per cent of the drip users for the crops coconut and grapes respectively.

All the drip users (100 percent) in both the crops felt that the parts can be easily removed as an important attribute of drip irrigation system.

It was found that the productivity and economic of sugarcane was sustained under drip irrigation technology as observed by Sundara (2003)

Jha (2004) in his experiment observed that the efficiency under drip irrigation has been estimated to be as high as 80 to 90 percent. Drip system also

permits the use of fertilizer and other soluble nutrients along with irrigation water and is considered to be most efficient method of fertilizer application.

The attributes of drip irrigation has been elicited by Rajput (2004) as drip irrigation minimizes conventional loss of water including, conveyance loss, deep percolation, runoff and evaporation.

Chaudhary (2005) reported that drip irrigation provides a very favourable high moisture level in the soil in which plants can flourish.

The findings of Arunadevi (2006) indicated that drip system of irrigation in mulberry cultivation can improve the earning of farmers over 200 percent from the present level.

Sivanappan (2006) reported that there is possibility of water saving around 40 to 50 percent and yield increase by about 30 to 40 percentage.

2.4. INTENSITY OF ADOPTION

Kavitha (1999) reported that nearly equal percentage of drip users in coconut and grapes (41.67 percentage and 42.55 percentage) had high intensity of adoption followed by 36.67 per cent and 12.77 per cent of drip users in coconut and grapes respectively with medium intensity of adoption. About 21.66 per cent and 44.48 per cent of drip users in coconut and grapes respectively had low level intensity of adoption of drip irrigation.

Singh and Bhimawat (2003) reported that 40.00 percent of respondents had medium adoption level and same percentage of respondents had high adoption remaining one-fifth (20.00 percent) respondents had poor adoption level.

2.5. FACTORS FAVOURING ADOPTION

Kumar Senthil (1995) reported that most of the farmers had adopted the drip irrigation system because of scarcity of water followed by scarcity of labour in their region for agriculture operations. The other reasons expressed by them were increase in yield, increase in area of operation and subsidy scheme for adoption of drip irrigation technology.

Kavitha (1999) revealed that water scarcity (93.34 percent and 93.62percent), less labour requirement (88.33percent and 87.23 percent), high weed menace (83.33 percent and 85.11 percent) were considered as the most influential factors by the drip users of coconut and grapes respectively for adoption of drip irrigation technology.

Srinivasulu (2005) reported that various factors favouring adoption viz., water saving, increased crop yield, water with higher salt concentration can be used for irrigation, adoption to undulated topographies, less weed infestation, low incidence of diseases, and reduced fertilizers requirement.

According to Sundaram (2006) various factors such as water is applied directly in to the plant root zone and alleviate drought, prevent soil erosion, improve water availability and increase food, fuel, fiber and fodder production on sustained basis.

2.6. CONSTRAINTS IN ADOPTING DRIP IRRIGATION TECHNOLOGY

Senthilkumar senthil (1995) found that major problem perceived by the sample farmers with respect to performance of drip system was clogging of microtubes followed by non-uniformity of discharge of water through drippers, as drip system required time to time attention for minor repairs, disconnection of laterals, main tubes and drippers and frequent cleaning of filters.

Problem with respect to materials used in the system was breakage of drippers, damage of materials due to rodents and rats and other animals, susceptibility of materials for easy salt deposition and corrosion of filters. Problem with respect to services and other facilities was poor or lack of after sales service by firm dealers followed by non- availability of spare parts.

According to Kavitha (1999) high investment cost was ranked as the major constraint by the drip users in the adoption of drip irrigation technology followed by delay in getting subsidy as the second major constraint. Cost of the drip system hiked by the company while getting it through subsidy was ranked as the third constraint by drip users in coconut whereas drip users in grapes ranked clogging of emitters as the third major constraint in the adoption of drip irrigation technology.

Ahire *et al.* (2003) proclaimed that 45.00 per cent of respondent expressed lack of knowledge on drip irrigation as constraint and 42.00 per cent of drip irrigation users experienced difficulty in intercultural operation 85.00 per cent of the farmers experienced problem in initial investment which they feel to be high and 65.00 per cent experienced delay in getting grants.

Singh and Bhimawat (2003) revealed that the problem of choking of drippers were expressed by (84.44 percent), heavy investment for the installation of drip irrigation as problem expressed by 93.33 percent, high technical competence required for operation and maintenance were expressed by (70.67 percent) problem in cleaning the laterals, filters and drippers (80.00 percent) . Irregular supply of electricity in the study area (53.33 percent), damage by rats and squirrels was expressed by 44.44 percentage of respondents.

Clogging of emitters, salt accumulation, high initial cost, rodents and insects were the major problem experienced by drip users as elicited by Borake (2004).

Jha (2004) Found that high capital cost, distortion in subsidy disbursement mechanism, inadequate knowledge about efficient use of the technology, as the main constraint.

Meena (2006) reported clogging of the emitters, moisture distribution, salt building, high initial cost, additional drawbacks such as damage of drippers by rodents and insects as the problems or constraints experienced by the respondents.

According to Sundaram (2006) initial cost of investment, lack of technical knowledge and trained human resource, lack of sufficient institutional and credit support as the major constraints experienced by the respondents.

CHAPTER - III

RESEARCH METHODOLOGY

This chapter was dealt with the details of the research methodology followed in this study under the following sub-heads.

3.1. Research design.

3.2. Locale of research.

3.3. Sampling design.

3.4. Selection, operationalisation and measurement of variables.

3.5. Methods of data collection.

3.6. Statistical tools used.

3.1. RESEARCH DESIGN

Research design is the plan structure and strategy of investigation conceived so as to obtain answers to the research questions and to control variance. The strategy includes the method to be used to gather and analyze the data. The strategy implies how the research objectives could be achieved and how the problems encountered in the research could be tackled"- (Kerlinger, 1964).

For this study, **Expost –facto research design** was followed .Singh (1986) has defined, **expost facto research** as a design that draws the inferences regarding the relationship between variables on the basis of such independent variable whose manifestation have already occurred. The researcher has no control over the independent variables because they occur much prior to their producing effect.

3.2. LOCALE OF RESEARCH

3.2.1. Selection and description of district

Madurai district was selected for the study by purposive sampling based on more area covered under micro irrigation (359.84 ha) and more number of crops irrigated under drip in Southern Part of Tamil Nadu. Apart from this there were no recent studies about adoption of drip irrigation in Madurai. Also familiarity to the

culture, local dialect and infrastructural facilities available would help the student researcher to develop good rapport with the clientele and hence this region was taken for the study.

Madurai district is centrally located in Tamil Nadu. It lies between $93^{o}1'$ and $10^{o}3'$ of North latitude and $77^{o}00'$ of east longitude. It is bounded by Dindigul district in the north, Sivagangai district in the East, Virudhunagar district in the South and Kerala State in the West. It is an inland district without coastal line. The total area of the district is 6,901.5 km^2.

3.3.1. Selection of taluk

Out of 6 taluks in Madurai district (Thirumangalam, Usilampatti, Vadipatti, Melur, Madurai South, and Madurai North). Vadipatti and Madurai South taluk were purposively selected by purposive sampling considering the maximum area under drip, maximum number of adopters and maximum number of crops cultivated under drip in these two taluks. (Appendix II)

3.3.2. Selection of block

The two blocks viz., (Allanganallur and Vadipatti) in Vadipatti taluk were selected for the study and in Madurai south taluk the only block viz., Thirupparamkuntram in Madurai south taluk was taken for the study.

3.3.3. Selection of village

The village wise list of drip users in Vadipatti and Alanganallur blocks was obtained from Department of Agricultural Engineering, Madurai. Out of 14 villages, 8 villages in Vadipatti taluk- 4 villages from each block- were selected for the study. In Madurai South taluk-7 villages were selected from the 14 villages. The villages were selected by purposive sampling based on more number of adopters in these villages. (Appendix III & IV)

3.3.4. Selection of respondents

The respondents from the villages were selected randomly. Both adopters and non-adopters were the respondents of the present study. Thirty adopters and thirty non adopters in each taluk were selected. Thus the total number of respondents selected from two taluks were 120.

3.4. SELECTIONS, OPERATIONALIZATION AND MEASUREMENT OF VARIABLES

Having discussed with Agricultural Scientist and Advisory Committee members and on perusal of literature a list of 17 variables was prepared and it was sent to fifty judges with three point continuum of most relevant, relevant and least relevant. The responses were obtained from 30 judges.

Scores of 3, 2, and 1 was assigned for most relevant, relevant and least relevant responses.

Mean score and co-efficient of variation was worked out for each variable. The variables with less co-efficient of variation and higher mean score than that of total was selected. Thirteen variables were selected and the judges suggestions were also considered.

OPERATIONALISATION OF VARIABLES

1. Age

Age was operationalised as the number of completed years of the respondents at the time of enquiry and the chronological age was taken as a measure. The respondents were categorized in to three viz, young, middle and old as followed by Jayashree (2004)

Sl .No	Category	Age group
1	Young	< 35 yrs
2	Middle	35-45 yrs
3	Old	>45 yrs

2. Educational status

Educational status was operationalized as the extent of formal education received by the respondents. Illiterate was an individual who did not know to read and write. Functionally literate are those who were educated up to fifth standard and also respondent one who knows to read and write. Middle education referred to education in school from sixth to eighth standard. Secondary education meant the education from nineth standard to plus two levels. Collegiate education referred to degree / diploma after schooling.

Sl.No	Category	score
1.	Illiterate	0
2.	Functionally literate	1
3.	Middle education	2
4.	Secondary education	3
5.	Collegiate education	4

3. Farming experience

Farming experience refer to the number of years of experience the respondent possessed in farming at the time of enquiry. The scoring procedure followed by Sukitha (2003) was used in this study. One score was assigned for each year of experience.

The categorization of respondents with regard to farming experience was done as low, moderate and high using cumulative frequency.

4. Irrigation intensity

Irrigation intensity was operationalised as the fraction of total area irrigated to size of holding.

It was quantified using the formula followed by Kavitha (1999) and this is expressed in percentage.

$$\text{Irrigation intensity} = \frac{\text{Total area under irrigation in acre}}{\text{Size of holding}} \times 100$$

5. Farm power status

This variable was operationalized as the farm materials possessed and used by the respondent's family. This variable was measured using the scoring pattern developed by Ponnusamy (1993) using cumulative frequency the respondents were categorized in to low, medium, and high in their farm power status.

6. Training participation

The variable was operationalised as the total number of training undergone by the users in drip irrigation technology. The scoring procedure was adopted based on the number of trainings underwent by the respondents on drip irrigation technology. The number of trainings was considered for scoring as such one score was given for each number of training attended by the respondents. Using cumulative frequency, the respondents were classified into low, medium, and high as followed by Nalini (2004).

7. Risk orientation

It was defined as the degree to which the respondents were oriented towards risks and uncertainty and courage to face problems.

Risk orientation was measured by the scale developed by Supe (1969) and followed by Senthilvadivoo (2003). The scale consisted of 6 statements of which one and five were negative. The rest were positive.

The scoring procedure is as follows:

Response	SA	A	UD	DA	SDA
Positive statements	7	5	4	3	1
Negative statements	1	3	4	5	7

8. Credit orientation

Credit orientation was operationalized with the help of the respondents relation to the need for the credit, difficulties encountered in securing credit. Scoring procedure followed by Jeyashree (2004) was used in this study.

Sl.No	Questions	Response	Score
1.	Do you think a farmer like you should favour money for agricultural purpose	No	1
		Yes	2
2.	In your opinion how difficult it is to secure credit for agricultural purpose	Very difficult	0
		Difficult	1
		Easy	2

		Very easy	3
3.	How is a farmer treated when he goes to secure credit for agricultural purpose	Very badly	0
		Badly	1
		Fairly	2
		Very fairly	3

9. Economic motivation

It has been operationalized in terms of profit maximization and the relative value placed by farmers on economic ends. In this study the procedure adopted by Vilas (2005) was used to measure the economic motivation.

The score consisted of six statements of which first five were positive and last one was negative. These items were rated over a five point continuum which ranged from strongly agree to strongly disagree.

The following scoring procedure was used.

Response	SA	A	UD	DA	SDA
Positive statements	7	5	4	3	1
Negative statements	1	3	4	5	7

Maximum score on this scale was 42 and minimum score was 6. The categorization was done based on Cumulative Frequency method as low, medium, high.

10. Innovativeness

Innovativeness has been defined by Rogers and Shoemaker (1971) as the degree to which an individual is relatively earlier in adopting the new idea than other members of the same social system.

In this study the innovativeness has been operationalized as the extent to which a respondent had acquired awareness on the need to innovate.

Scoring procedure followed by Desinguraja (2005) was used in this study.

Sl. No	Response	Score
1	As soon as it is brought to my knowledge	3
2.	After I have seen other farmer using it successfully	2
3.	I prefer to wait and take my ownDecision.	1

11. Scientific Orientation

Scientific orientation is the degree to which a farmer is oriented towards the use of scientific methods in farming. There were six statements in the scale of which the second statement was negative and others were positive. The response for each statement was measured on a five point continuum ranging from strongly agree to strongly disagree.Scoring procedure followed by Ganeshamoorthy (2005) was used .

Response	SA	A	UD	DA	SDA
Positive statements	7	5	4	3	1
Negative statements	1	3	4	5	7

The scores obtained for each statement by an individual respondent were summed up to obtain scientific orientation score. The maximum score could be 42 and minimum would be 6.

12. Perception on attributes of drip irrigation technology

Attributes of drip irrigation technology refers to the characteristics of drip irrigation technology as perceived by drip users. Items pertaining to relative advantage, Compatibility, simplicity, trialability, observablity and replaceability of drip irrigation system was used. The items were checked with two point continuum namely agree and disagree and percentage analysis was used. Procedure followed by Kavitha (1999) was used.

13. Attitude towards drip irrigation

Attitude is a mental and neutral state of readiness organized through experience, existing a directive and dynamic influence upon the individual response to all subjects and situations with which he is related.

Scale followed by Savithri (1992) was used with slight modification. The scale consisted of six positive and seven negative statements. Each statement is provided with 5 point continuum of strongly agree to strongly disagree with weightage of 5, 4, 3, 2, 1 respectively for positive statements, and 1, 2, 3, 4, 5 for negative statements. The maximum score was 65 and minimum was 13. The respondents were classified as more favourable, favourable and less favourable using Cumulative Frequency.

DEPENDENT VARIABLE

14. Intensity of Adoption

It refers to the extent of adoption of a given technology. Intensity of adoption has been operationalised as the ratio of actual area cultivated under drip irrigation to the total cultivated area by drip users and it is expressed in percentage.

$$\text{Intensity of adoption} = \frac{\text{Actual area under drip in acres}}{\text{Total cultivated Area}} \times 100$$

15. Impact of drip irrigation

Rogers and Shoemaker (1971) defined the consequence as the changes that occur with in a social system as a result of adoption or rejection of an innovation. They also defined the direct consequences as the changes that occur in immediate response to an innovation and indirect consequences are the changes that occur, as a result of direct consequences.

The impact was studied under direct and indirect consequences. A set of 23 statements was asked to the drip users. A dichotomous scoring of agree and disagree was used. The scores obtained for each item was totaled and percentage analysis was performed.

3.5. METHOD OF DATA COLLECTION

A well structured pretested interview schedule was used for the study to collect data regarding drip irrigation.

On the basis of variables selected, an interview schedule was prepared and it was pretested in the month of November in a non-sample area.

3.6. STATISTICAL TOOLS USED

For analyzing the data collected during the investigation, the following statistical tools were used based on the nature of data and relevance of information required.

1. Percentage analysis
2. Cumulative frequency
3. Independent ‘t’ test
4. Correlation co-efficient
5. Multiple regressions

CHAPTER IV

FINDINGS AND DISCUSSION

This Chapter presents the highlights of the results of analysis which have been clearly spelt out in methodology chapter. The discussion has also been taken up simultaneously with the results. They are given under the following sub heads.

4.1. Profile of respondents.
4.2. Intensity of Adoption.
4.3. Impact of Drip irrigation.
4.4. Relationship between characteristics of the respondents with their Intensity of adoption and Impact.
4.5. Factors favouring adoption of drip irrigation.
4.6. Constraints in adopting drip irrigation technologies

4.1.1. Age

Age was considered as an important factor since it influences a farmer to choose and adopt a particular technology. It may reveal that mental maturity of an individual to take decisions for achieving his needs. Therefore it has been included in this study.

The particulars gathered are presented in Table 2.

Table 2. Distribution of respondents according to their age

Sl. No.	Category	Adopters n = 60		Non adopters n = 60		Total n =120	
		No	%	No	%	No	%
1.	Young	3	5.00	6	10.00	9	7.50
2.	Middle	25	41.70	38	63.4 0	63	52.50
3.	Old	32	53.30	16	26.60	48	40.00

't' value = 2.931*

It could be stated that nearly 53.30 percent of adopters belonged to old age category, which was higher than the non-adopters (26.60 percent). There were 41.70 percent of adopters who belonged to middle aged category whereas 63.40 percent of non-adopters were belonged to the same category. Five percent of adopters were belonged to young age categories that were less than the non-adopters (10.00 percent).

The‘t’ value was significant which confirms that there exist difference between adopter and non-adopters with regard to their age.

It could be observed from the table 2 that majority of the respondents belonged to middle age category followed by old age and young age people. Young age sample were not involved in agriculture and most of them migrated to various places for search of better jobs. The results are inline with findings of Murukanandam (1998) and Ganesha Moorthy (2005).

4.1.2 Educational status

Educational status is considered as a crucial factor in influencing an individual while taking rational decisions for adopting technologies.

Table 3. Distribution of respondents based on their educational status

Sl. No.	Category	Adopters n = 60		Non adopters n = 60		Total n = 120	
		No	%	No	%	No	%
1.	Illiterate	0	0	0	0	0	0
2.	Functionally literate	2	3.36	5	8.33	7	6.80
3.	Middle education	5	8.35	22	36.66	27	22.50
4.	Secondary education	28	46.63	27	45.01	55	45.50
5.	Collegiate	25	41.66	6	10.00	31	25.20

t = 5.457*

Table 3 revealed that there were 46.63 percent of adopters and 45.01 percent of non-adopters had secondary education and 41.66 percent and 10.00 percent of adopters and non-adopters possessed collegiate education. Nearly 8.35 percent and 36.66 percent of adopters and non-adopters had middle education and 3.36 percent and 8.33 percent belonged to functionally literate category.

The significant‘t’ value confirmed the existence of significant difference between adopters and non-adopters with regard to their educational status. Thus the findings indicated that 100 percent of the respondents were literates and their educational level varied from functionally literate to collegiate education and secondary education was identified as predominant educational status of the respondents.

It could be inferred from the above findings, that the sample of the selected villages had adequate educational facilities either in their boundary or nearby which would make majority of the respondents in the study area as literates, number of non adopters in collegiate level is comparatively less than the adopters.

The findings derive support from that of Muthiah (1994), Robinson Albert (1997) Mathaiya (1997), Sukitha (2003) and Ramani (2004) who also concluded that majority of the respondents were literates.

4.1.3. Farming experience

Farming experience acquired over period of years may pave way for success in farming and may be a key factor in adoption or rejection of innovations. The experience in farming would have helped the farmer to take concrete and appropriate decision regarding their involvement in farm activities.

Table 4. Distribution of respondents according to their farming experience

Sl. No.	Category	Adopters n = 60		Non adopters n = 60		Total n = 120	
		No	%	No	%	No	%
1.	Low	19	31.70	18	30.00	37	30.80
2.	Moderate	20	33.30	21	35.00	41	34.10
3.	High	21	35.00	21	35.00	42	35.10

t = 2.603*

It is seen from the table 3 that 35.00 percent of each adopters and non adopters had higher experience followed by 33.30 percent of adopters and 35.00 percent of non adopters had moderate level farming experience and 31.70 percent, 30.00 percent of adopters and non-adopters had low experience in

farming. The significant' value indicates the significant difference exist between adopters and non-adopters in their experience in farming.

Table 4. indicates that most of the respondents had moderate to high level of experience in farming. This might be due to the fact that their forefathers had agriculture as their only occupation and hence the respondents were exposed to farming from their young age.

4.1.4. Irrigation Intensity

It mainly explains the sources of irrigation used by the respondents.

Table 5. Irrigation intensity of respondents

Sl.No	Category	Adopters n =60		Non adopters n = 60		Total n =120	
		No	%	No	%	No	%
1.	Low	16	26.66	24	40.00	40	33.33
2.	Medium	21	35.00	18	30.00	39	32.50
3.	High	23	38.34	18	30.00	41	34.17

t = 5.841*

It is opined from the table 5 that 38.34 percent of adopters had higher irrigation intensity, only 30.00 percent of non adopters had higher irrigation intensity followed by 35.00 percent of adopters and 30.00 percent of nonadopters with medium irrigation intensity and 40.00 percent and 26.66 percent of non adopters and adopters with low irrigation intensity (Fig.3).

The significant t value indicates there exist difference between adopters and non adopters with respect to their irrigation intensity. Higher irrigation intensity with adopters might be due to the higher economic status which made them to use various sources of irrigation.

4.1.5 Farm power status

It mainly explains various farm material possessed by the respondents. Farm power status of the respondent indicates the economic status and also the utility of various farm implements by the respondents.

Table 6. Farm power status of the respondents

Sl. No.	Category	Adopters n = 60		Non adopters n = 60		Total n = 120	
		No	%	No	%	No	%
1.	Low	17	28.40	17	28.40	34	28.34
2.	Medium	20	33.30	25	41.60	45	37.53
3.	High	23	38.30	18	30.00	41	34.13

t=3.557*

It is inferred from table 6 that 33.30 percent of adopters and 41.60 percent of non adopters possessed medium farm power status.

Nearly 38.30 percent and 30.00 percent of adopters and non-adopters possessed high farm power status and an equal proportion (28.40 percent) of both adopters and non-adopters possessed high farm power. As per't' value significant difference was observed between adopters and non-adopters. With regard to their farm power status. An analysis of farm power status seen in table 6 indicates that nearly 37.53 percent of respondents possessed medium level farm power status followed by high and low levels.

4.1.6. Training participation

Participation of respondents in various training is an educational process. It is to create a sense of awareness and involvement. It develops self reliance, self confidence, competence and managerial capacity. It enables them to discover their resources for productive purpose. Participation in trainings makes the people to be thinkers, decision makers. The extent of participation was assessed and data are presented in Table 7.

Table 7. Distribution of respondents according to their extent of participation in training

Sl. No.	Category	Adopters n = 60		Non adopters n =60		Total n =120	
		No	%	No	%	No	%
1.	Low	3	5.00	46	76.38	49	40.48
2.	Medium	40	66.70	14	23.62	54	45.26
3.	High	17	28.30	0	0	17	14.26

t = 6.354*

Medium level of participation in training programmes was observed with 66.70 percent of adopters and 23.62 percent of non-adopters. Majority of non adopters 76.38 percent and 5.00 percent of non-adopters fall under low level of training participation. High level of participation was observed with 28.30 percent of adopters (Fig.4).

Significant difference was observed between adopters and non-adopters with respect to their participation in training programmes.

Thus the findings of the table 7 indicated that 40.48 percent of the respondents had low level of participation in training programme, might be due to the lack of information regarding the place and duration of training. Also majority fall under non adopter category.

The findings are inline with the findings of Ponmani (1993), Ganapathisankaran (1997), Varghese (1998), and Nalini (2004).

4.1.7 Risk orientation

It refers to an individual's orientation towards encountering risks and uncertainties in adopting new ideas in farming. It decides his innovativeness and influences positively his adoption behaviour. The data collected on risk orientation are presented in table 8.

Table 8. Distribution of respondents according to their risk orientation nature

Sl. No.	Category	Adopters n = 60		Non adopters n = 60		Total n =120	
		No	%	No	%	No	%
1.	Low	19	31.70	16	26.70	35	29.18
2.	Medium	21	41.70	26	42.70	47	39.18
3.	High	20	26.60	18	30.60	38	31.64

t = 3.069*

A glimpse of table 8 reveals that 41.70 percent of adopters and 42.70 percent of non-adopters possessed medium level of risk orientation. Low level of risk orientation was observed among 31.70 percent of adopters and 26.70 percent of

non-adopters followed by 26.60 percent of adopters and 30.60 percent of non-adopters with high risk orientation nature.

The‘t’ value was found to be significant. The total analysis on the table indicates that 39.18 percent possessed medium risk orientation nature followed by 31.64 under high and 29.18 under low level.

Most of the respondents were educated up to secondary level and they were ready to adopt new technologies. Though drip irrigation involves higher initial investments and has some technological constraints the respondents were ready to take risk in certain needful conditions and that could be the reason for such an outcome.

The results are in accordance with findings of Priyadarshini (2002).

4.1.8. Credit orientation

Although the farmer needs credit for many purposes, his needs occupy a key position. Since agriculture has become a profitable enterprise the farmers demand for credit has increased with increasing cost of inputs. In this variable it was aimed to assess the willingness of farmers to obtain credit to carryout farming activities.

Table 9. Distribution of respondents according to their credit orientation

Sl. No.	Category	Adopters n = 60		Non adopters n = 60		Total n = 120	
		No	%	No	%	No	%
1.	Low	26	43.36	33	55.21	59	49.10
2.	Medium	14	23.33	23	38.06	37	30.80
3.	High	20	33.31	4	6.73	24	20.10

t = 2.758*

It could be discerned from table 9 that 43.36 percent of adopters and 55.21 percent of non-adopters had low level of credit orientation. Nearly 23.33 percent of adopters and 38.06 percent of non-adopters had medium level of credit orientation. High level of orientation towards credit was observed by 33.31 percent of adopters and 6.73 percent of non-adopters respectively.

Significant difference was observed between adopters and non-adopters, with regard to their credit orientation.

Majority of the respondents had less orientation towards credit this might be due to delay in getting loan and also most of the farmers were not treated properly while approaching bank officials for getting loan. Also the firms dealing with drip equipments, supplying to farmers on subsidy and the farmers also getting this through the Department of Agricultural Engineering which influenced them not to depend on credit.

4.1.9. Economic motivation

Every individual has an urge to earn money. Economic motivation is an important character for adoption of any technologies. Knowledge on the economic motivation of the farmer will give us an idea of the extent to which they would go to adopt technologies. Hence it was attempted to study this aspect. The results obtained are furnished in table 10.

Table 10. Distribution of respondents according to their economic motivation

Sl. No.	Category	Adopters n = 60		Non adopters n = 60		Total n = 120	
		No	%	No	%	No	%
1.	Low	18	30.00	25	41.60	43	35.80
2.	Medium	23	38.20	14	23.30	37	30.80
3.	High	19	31.80	21	35.10	40	33.40

t = 7.627*

As evident from the table 10 that 30.00 percent of adopters and 41.60 percent of non-adopters had low level of economic motivation.

About 38.20 percent and 23.30 percent of adopters and non-adopters possessed medium level of economic motivation.

Nearly 31.80 percent and 35.10 percent of adopters and non-adopters had high level economic motivation.

The‘t’ value shows that there exist significant difference between adopters and non-adopters.

This results are in line with findings of Sivarevathi (1996), Chandra (2001), who reported that majority of respondents were with low level of economic motivation.

4.1.10. Innovativeness

It is the degree to which an individual is relatively earlier in adopting the new ideas than other members of his social system. It shows the desire and interest of an individual to seek change.

Table 11. Distribution of respondents according to their innovativeness

Sl. No.	Category	Adopters n = 60		Non adopters n = 60		Total n = 120	
		No	%	No	%	No	%
1.	Low	9	15.00	31	51.42	40	33.34
2.	Medium	16	26.70	17	28.23	33	27.52
3.	High	35	58.30	12	20.35	47	39.14

t = 5.344 *

It could be observed from table 11 that most of the adopters possessed high level of innovativeness followed by medium 26.70 percent and low level 15.00 percent of innovativeness which entirely differs from that of non-adopters who possessed 51.42 percent of innovativeness under low level followed by 28.23 percent under middle and only 20.35 percent under high level of innovativeness (Fig.5).

The ‘t’ value also shows that there existed significant difference between adopters and non-adopters in their innovative character.

It could be concluded that majority of the respondents had high innovativeness this might be due to the fact that majority of the respondents were literates also possessed higher farming experience which had made them to aspire for the use of new technologies.

4.1.11. Scientific orientation

Scientific orientation is a forerunner of farmers innovativeness as stated by Rogers and Shoemaker (1971).Extension agencies are orienting the farmer to adopt the innovation by highlighting the scientific principles behind them. The data on scientific orientation of respondents are presented in table 12.

Table 12. Distribution of respondents according to their scientific orientation

Sl.No.	Category	Adopters n = 60		Non adopters n = 60		Total n = 120	
		No.	%	No.	%	No.	%
1.	Low	22	36.60	17	28.50	39	32.50
2.	Medium	15	25.00	27	44.90	42	35.00
3.	High	23	38.40	16	26.60	39	32.50

t =10.384*

It could be observed from the table 12 that majority of the adopters (38.40 percent) and 26.60 percent of the non adopters had high level of scientific orientation, nearly 25.00 percent and 44.90 percent of adopters and non adopters had medium level of scientific orientation and 36.60 percent and 28.50 percent of the adopters and non adopters had low level of scientific orientation respectively.

The high literacy level observed with the sample as indicated elsewhere would have made them to have inclination to scientific ideas and that could be the possible reason for such an outcome.

The findings are in agreement with the findings of Manivannan (1980) Sankaran (1987), and Ganeshamoorthy (2005).

4.1.12. Attitude towards drip irrigation

Attitude is the tendency to respond some objects, idea, situation or value knowing about their favorableness or unfavourableness associated with the individual towards any technology. Hence the results collected regarding the attitude towards drip irrigation are presented in table 13.

Table 13. Distribution of respondents according to their attitude towards drip irrigation technology

Sl. No.	Category	Adopters n = 60		Non adopters n = 60		Total n = 120	
		No	%	No	%	No	%
1.	Less favourable	19	31.70	22	35.30	41	34.13
2.	Favourable	20	33.40	20	33.30	40	33.31
3.	More favourable	21	34.90	18	31.40	39	32.56

t = 6.599*

From the table 13 could be exhibited, that 34.90 percent of adopters possessed more favourable attitude towards drip irrigation followed by 33.40 percent under favourable attitude and 31.70 percent of adopters had less favourable attitude. But 35.30 percent of non-adopters had less favourable attitude followed by 33.30 percent under favourable and 31.40 percent under more favourable attitude category (Fig.6).

Significant difference was observed between adopters and non-adopters with regard to their attitude towards drip irrigation.

Majority of the respondents had less favourable attitude towards drip irrigation technology which might be due to less exposure of the respondents to various training about drip irrigation technology as observed with the sample indicated elsewhere in this report.

4.1.13. Perception on attributes of drip irrigation technology

Any technology must posses various good attributes in order to be used up by most of the members of the society, favourable perception of attributes of the respondents would increase the adoption level.

Any technology or innovation should have the following attributes only then it could be utilized by the society such kind of attributes are Relative advantage, Compatibility, Simplicity, Trialability, Observablity, and replaceability.

Relative advantage

A perusal of Table14 revealed the following. With respect to relative advantage 70.34 percent of adopters and 16.63 percent of non adopters perceived that efficient use of water is possible with drip irrigation technology.

Water saving as an advantage was perceived by 90.00 percent of adopters and 61.66 percent of non adopters.

Adopters felt that 40 to 60 percent of water would be saved since water is delivered directly to root zone.

Effective weed management was perceived by 70.45 percent of adopters and 26.66 percent of non adopters .Since water is applied directly to the root zone the weed menace had been reduced which resulted in less labour requirement as perceived by 85.00 percent of adopters and 33.30 percent of non adopters .

Less attack of disease was perceived by only 20.00 percent and 8.33 percent of adopters and non adopters. Most of the respondents were not considered that disease incidence will be reduced due to application of water through drip.

Reduced soil erosion was perceived by 36.65 percent and 5.00 percent of adopters and non adopters. They expressed that compared to flood irrigation water is applied without any force on the soil which reduced erosion of soil in drip system.

Management of power fluctuation is possible in drip as perceived by 36.66 percent of adopters and 23.33 percent of non adopters .Adopters also stated that the yield in coconut has been increased to the extent of 1500 to 2000 nuts per hectare per year.

Reduced cost of cultivation is an attribute was perceived by 78.32 percent and 25.00 percent of adopters and non adopters. They opined that reduction in cost was observed in terms of wages provided for labourers, fertilizer application and also larger area could be irrigated through drip when compared to that of conventional irrigation.

Fertigation is an attribute was felt by 73.36 percent of adopters and 15.00 percent of non adopters.

Compatibility

Success of any agricultural technology depends on the compatible or adjustable nature of the technology with the users culture, their environment, the nature of soil, water, season, cropping pattern etc.

With respect to compatibility about 80.00 percent and 13.33 percent of adopters and non adopters respectively perceived suitability of drip to all types of soil as an attribute.

Suitable to all type of water was perceived as one of the attributes by 68.34 percent and 11.65 percent of adopters and non adopters. Similarly 55.00 percent of adopters and 15 .00 percent of non adopters felt that drip irrigation would be suitable for intercropping. Nearly 55.00 percent perceived suitability to all season as an attribute

Simplicity

Spare parts are readily available as stated by 53.33 percent and 18.33 percent. They did not come across any hurdles in getting the spares as the spares readily available with drip representatives. Easy maintenance and easy to operate were perceived as an attributes by 53.30 percent and 23.39 percent respectively and remaining sample expressed that they faced some technological constraints such as clogging of emitters, damage by rodents, leakage of pipes etc.

Trialability

The drip technology is amenable for trial in small scale as opined by 40.00 and 13.33 percent of respondents. After getting conviction on the technical feasibility and economic viability in small scale they would go for large scale adoption.

Observability

Increase in the quality of produce was perceived by 31.60 percent and 11.66 percent. Crop maturity advanced was perceived by 23.33 percent and 13.00 percent.

Replacebility

About (43.33 percent) and 18.33 percent of adopters and non adopters felt that parts can be easily removed and changed by the respondents themselves.

The foregoing discussion revealed that majority of the respondents was of the opinion that water saving, lesslabour requirement as important attributes of drip irrigation technology.

The percentage of respondents perception towards various attributes was comparatively higher in case of adopters than that of non adopters. It is quite natural that only by practicing any new ideas the attributes of the innovation could be perceived favourably.

4.2. Intensity of adoption

Intensity of adoption in the present study referred to the extent to which the drip irrigation technology was utilized by the respondents. The overall intensity of adoption by the respondents was analyzed and furnished in Table 15.

Table 15. Distribution of respondents according to their intensity of adoption

Sl. No.	Category	Adopters	
		No	%
1.	Low	20	33.33
2.	Medium	18	30.01
3.	High	22	36.66

From the table15 it could be noticed that the intensity of adoption was high with 36.66 percent followed by 33.33 percent under low and 30.01 percent under medium levels. This might be due to the fact that installation of drip system requires high initial cost and also this technology is not suitable to all types of crops. Further this technology also possesses some technological constraints such as salt encrustation, clogging of emitters etc and that could be stated as reason for one third of the samples intensity of adoption was low.

4.3.1. Impact of drip irrigation technology

It is inevitable to study the impact of any technology when it is used in the society. Hence the impacts were studied and the findings are presented in table.16 The impact was divided in two broad categories namely direct and indirect consequences.

A. Direct consequences

It is evident from the Table16 that among direct consequences increased income was observed by 51.60 percent and increased standard of living by 27.00 percent of adopters.

Increased income resulted in spending more on education for their children. Nearly (41.66Percent) of respondents expressed that prior to adoption of drip irrigation they educated their children up to primary or middle school level which has been increased to secondary level and collegiate level after adoption of drip. .

Majority of respondents got increased income due to adoption of drip technology which might be due to the less cost of cultivation, reduced labour requirement, fertigation, less weed infestation due to which increased income was obtained which in turn led to increased standard of living.

Indirect consequences

Contact with their peer groups outside their village has been increased according to 58.30 percent of the sample adopters.

Consultation with fellow farmers had been increased as reported by 38.33 percent of adopters followed by 41.66 percent of adopters who indicated the increased rate of exposure to media, and 40.00 percent reported that they had gained social recognition due to the increased yield and income by adopting the drip technology.

It is further evident from the table that majority of them widened their contact outside their village namely with drip users, drip companies representatives, in order to know information regarding drip technology or to clear their doubts regarding the operation and maintenance of drip system.

Due to non availability of service in their villages the adopters seek the company representatives to get their system serviced. Adoption of drip system also influenced the farmers to consult or share their experience with the fellow farmers.

Family living conditions

Nearly one fourth of the adopters reported that the income obtained after installation of drip has been utilized for clearing their debts in banks. Only meager percent of adopters reported that the income from drip system was utilized for purchase of household articles and conducting ceremonies.

Social impact

Increased participation in farmers forum, Farm science club was experienced by 45.00 percent of adopters of drip irrigation technology .Increased leadership quality was reported by 28.33 percent.

Economic impact

Nearly 21.66 percent of adopters reported that they had purchased additional land by adopting drip technology. Nearly 30.00 percent of adopters felt that drip irrigation technology influenced to purchase agricultural implements and invest money in farming.

4.3.2. Overall impact

Table 17. Distribution of respondents according to the overall impact of drip irrigation

Sl.No	Category	No	%
1.	Low	19	31.66
2.	Medium	19	31.66
3.	High	22	36.68

Table.17 indicates drip irrigation created good impact viz., medium to high level as stated by 68.34 percent of sample adopters.

4.4. RELATIONSHIP BETWEEN THE CHARACTERISTICS OF THE RESPONDENTS WITH INTENSITY OF ADOPTION AND IMPACT

This part deals with association and contribution of selected independent variables with dependent variable. Correlation, multiple regression were performed to study the relationship, contribution of independent variables respectively.

4.4.1. Correlation

Correlation analysis was performed to find out the association of characteristics towards intensity of adoption and impact of drip irrigation on the respondents.

Table 18. Correlation analysis of characteristics with adoption and impact

Sl. No.	Variable	'r' value	
		Intensity of adoption	Impact
X_1	Age	0.233*	0.236*
X_2	Educational status	0.367**	0.397**
X_3	Farming experience	0.268**	0.212**
X_4	Irrigation intensity	0.455**	0.456**
X_5	Farm power status	0.298**	0.269**
X_6	Training participation	0.366**	0.252**
X_7	Risk orientation	0.282**	0.288**
X_8	Credit orientation	0.314**	0.243**
X_9	Economic motivation	0.540**	0.518**
X_{10}	Innovativeness	0.416**	0.422**
X_{11}	Scientific orientation	0.672**	0.649**
X_{12}	Attitude towards drip irrigation	0.491**	0.496**
X_{13}	Perception on attributes of drip irrigation	0.555**	0.591**

** Significant at one percent level of significance
* Significant at five percent level of significance
NS – Non significant

4.4.1.1. Association of characteristics with intensity of adoption

It could be seen from the table 18 that out of 13 variables studied, the variables viz., Educational Status, (X_2) Farming Experience (X_3), Irrigation intensity (X_4), Farm power status (X_5), Training participation (X_6), Risk orientation (X_7), Credit Orientation (X_8), Economic motivation (X_9), Innovativeness (X_{10}), Scientific Orientation (X_{11}), Attitude (X_{12}), Perception on attributes of attitude (X_{13}), exhibited a positive and significant association with intensity of adoption at one percent level of significance, Age (X_1) exhibited a positive and significant association with adoption at five percent level of significance .

It could be inferred that the Intensity of adoption was the function of respondents educational status; farming experience, farm power status, irrigation intensity, training participation, risk orientation, credit orientation, economic motivation, innovativeness, scientific orientation, attitude and perception on attributes of drip irrigation.

4.4.1.2. Association of characteristics with impact

It could be seen from the table 18 that out of 13 variables studied ten variables namely Educational Status (X_2) Farm power Status (X_5), Training Participation (X_6), Risk Orientation (X_7), Credit Orientation (X_8), Economic Motivation (X_9), Innovativeness (X_{10}), Scientific Orientation (X_{11}), Attitude (X_{12}), Perception on attributes of drip irrigation (X_{13}) had a positive and significant association with impact at one percent level of significance. Age (X_1) and farming experience (X_3), Irrigation intensity (X_4) were found to have positive and significant association at five percent level of significance.

4.4.2. Multiple regression analysis

The multiple regression analysis was performed to find out the extent of contribution of profile character towards adoption intensity of drip irrigation technology; the results are presented in Table.19.

Table 19. Multiple regression of independent variable with intensity of adoption

Variable No.	Variable	Regression Co-efficient	Standard error	't' value
X_1	Age	1.065	3.004	0.355^{NS}
X_2	Educational status	1.205	2.651	0.455^{NS}
X_3	Farming experience	0.047	0.317	0.149^{NS}
X_4	Irrigation intensity	0.242	0.114	2.122^{*}
X_5	Farm power status	0.403	0.658	0.613^{NS}
X_6	Training participation	8.380	3.349	2.502**
X_7	Risk orientation	0.157	0.373	0.420^{NS}
X_8	Credit orientation	5.963	2.151	2.772**
X_9	Economic motivation	0.659	0.365	1.804^{NS}
X_{10}	Innovativeness	4.496	2.158	2.083*
X_{11}	Scientific orientation	1.164	0.312	3.725**
X_{12}	Attitude towards drip irrigation	0.314	0.149	2.106*
X_{13}	Perception on attributes of drip irrigation	0.568	0.257	2.210*

R^2 = 0.679 'F' value = 17.229^{**}

** Significant at one percent level of significance

* Significant at five percent level of significance

NS – Non significant

4.4.2.1. Contribution of characteristics of respondents towards adoption intensity

It could be discerned from table 19 that the 'F' value was found to be highly significant at one percent level of significance. The R^2 value indicated that the thirteen variables put together accounted for 67.90 percent of variation in the dependent variable of intensity of adoption.

Above table indicates that variables namely training participations, (X_6) credit orientation (X_8), Scientific orientation (X_{11}) were found to have positive significant influence on adoption at one percent level of significance and Irrigation intensity (X_4), innovativeness (X_{10}) , attitude (X_{12}), perception on attributes of drip irrigation (X_{13}) were found to have positive significant influence on adoption at five percent level of significance. The remaining variables showed non-significant contribution towards adoption.

The strength of variables can be explained as an unit increase, in **ceteris paribus** in irrigation intensity (X4) training participation (X_6), credit orientation

(X_8), innovativeness (X_{10}), scientific orientation (X_{11}), attitude (X_{12}), perception on attributes of drip irrigation (X_{13}) would bring increase of 0.242, 8.380, 5.963, 4.496, 1.164, 0.314 and 0.568 units in adoption intensity of the respondents respectively.

Higher irrigation intensity achieved through more number of bore wells would have facilitated the installation of drip system.

Most of the respondents were exposed to medium to high level of training which would have made them to obtain skill in operating, maintaining, and repairing the drip irrigation system and would have contributed two third of the respondents to possess medium to high level intensity of adoption. Most of the respondents had medium to high level of scientific orientation which might be due to the higher literacy rate and this would have made the respondents to have inclination towards drip irrigation technology. Favourable attitude towards drip irrigation would have been created through exposure of the respondents through field trips, trainings, etc.The drip company representatives and department of agriculture also contributed to create favourable attitude which would have made the respondents to have higher intensity of adoption. Favourable perception on various attributes of drip technology would have created to the respondents through various trainings and consultation with fellow farmers and after realizing the impact in their own farm they would have extended area under drip irrigation.

Table 20. Multiple regression of independent variable with impact

Variable No.	Variable	Regression Co-efficient	Standard error	't' value
X_1	Age	0.095	0.651	0.147^{NS}
X_2	Educational status	0.993	0.574	1.730^{NS}
X_3	Farming experience	-0.045	0.069	-0.650^{NS}
X_4	Irrigation intensity	0.060	0.025	2.440*
X_5	Farm power status	0.095	0.143	0.664^{NS}
X_6	Training participation	0.167	0.726	0.230^{NS}
X_7	Risk orientation	0.080	0.081	0.995^{NS}
X_8	Credit orientation	0.800	0.466	1.717^{NS}
X_9	Economic motivation	0.087	0.079	1.098^{NS}
X_{10}	Innovativeness	0.969	0.468	2.072*
X_{11}	Scientific orientation	0.191	0.068	2.825**
X_{12}	Attitude towards drip irrigation	0.076	0.032	2.343*
X_{13}	Perception on attributes of drip irrigation	0.184	0.056	3.296**

R^2 = 0.647 'F' value = 14.944^{**}

** Significant at one percent level of significance.

* Significant at five percent level of significance.

NS – Non significant

4.4.2.2. Contribution of characteristics of respondents towards Impact

Regarding impact, R^2 value was 0.647. It could be observed from table 20 that thirteen independent variables exerted their influence to the extent of 64.70 percent on impact.

The variables namely scientific orientation (X_{11}) and perception on attributes of drip irrigation (X_{13}) had shown positive and significant influence on impact at one percent level of significance. The variables namely irrigation intensity, innovativeness (X_{10}), attitude, had shown positive and significant influence on impact at five percent level of significance.

The strength of contribution of these variables could be explained as a unit increase in, irrigation intensity, innovativeness, scientific orientation, attitude; perception on attributes of drip irrigation would bring increase of 0.060, 0.969, 0.191, 0.076 and 0.184 units in impact respectively.

Higher irrigation intensity, higher innovativeness, medium to high level of scientific orientation, Favourable attitude towards drip irrigation technology, and higher perception on various attributes of drip irrigation as presented elsewhere would have contributed to achieve higher intensity of adoption of drip irrigation and in turn would have contributed to achieve higher impact.

4.5. Factors favouring adoption of drip irrigation technology

Table 21. Distribution of respondents according to their acceptance towards various factors favouring adoption

Sl.No	Factors	No	%
A.	**Situational Factors**		
1.	Low water holding capacity of the soil	5	8.33
2.	Water scarcity	56	93.34
3.	Saline water	4	6.67
4.	High weed menace	50	83.34
5.	More disease incidence	5	8.33
6.	Undulating landscape	6	10.00
7.	Power fluctuation	18	30.00
8.	Heavy conveyance loss	45	75.00

B.	**Economic factors**		
9.	Yield increase	34	56.67
10.	Increased profit	29	48.33
11.	Less cost of cultivation	48	80.00
12.	Less labour requirement	53	88.33
13.	Savings in time	12	20.00
14.	Savings in fertilizer	12	20.00
15.	Availability of subsidy	30	50.00
16.	Availability of loan	15	25.00
17.	Increase in area under irrigation	20	33.33
C.	**External factors**		
18.	Officials of agricultural department	4	6.66
19.	Officials of agricultural engineering department	16	26.66
20.	Drip manufacturers	2	3.33
21.	Company representatives	22	36.67
D.	**Social factors**		
22.	To become an innovator	4	6.67
23.	To be role model	3	5.00
24.	Influenced by successful drip users	28	46.67
25.	Pressure from peers	18	30.00
26.	Prestige	2	3.33

Factors favouring adoption of drip irrigation technology

There are various factors which favour the adoption of drip irrigation technology by the farmers

A. Situational factors

Among the situational factors water scarcity, (93.34 percent), high weed infestation (83.34 percent) and heavy conveyance loss (75.00 percent) were expressed as major factors served as favourable for adoption of drip The other factors viz., low water holding capacity of the soil, saline water, power fluctuation, more disease incidence, undulating landscape, heavy conveyance loss were not expressed by majority of the sample despite served as favourable causes for adoption.

B. Economic factors

Less labour requirement influenced majority 88.33 percent of drip users More than three- fourth of the drip users (80.00percent) said that through drip irrigation cost of cultivation of the crops get reduced which facilitated them to adopt drip irrigation technology. More than half of drip users (56.67 percent) expressed that yield was increased to a considerable extent in drip irrigation.

Availability of subsidy was influenced nearly 50.00 percent of drip users to adopt drip irrigation. Half of drip users (48.33 percent) expressed that drip irrigation increased their profit and hence they adopted this technology.

Availability of bank loan, time saving (20.00 percent), saving in fertilizer (20.00 percent) were the other factors which influenced them to adopt drip irrigation.

C. External factors

Representatives of drip companies (36.67 percent), Officials of agricultural engineering department (26.66 percent) were the important factors for adoption of drip irrigation.

D. Social factors

About 46.67 Percent of adopters were motivated by successful drip users to adopt this technology. More than one fourth of the drip users expressed that they were influenced by their peer group members to adopt drip irrigation technology. A very meager proportion expressed that they want to be an innovator, want to be a role model (5.00) percent, and for the sake of prestige (3.33 percent) as the factors that influenced them to adopt drip irrigation technology.

On the whole, Water scarcity, less labour requirement, and high weed menace were considered as the most influential factors by the drip users.

4.6. Constraints faced by the respondents

Table 22. Distribution of respondents according to the constraints faced by them in adopting drip technology

Sl.No	Constraints	Adopters n = 60		Non adopters n = 60	
		No	%	No	%
A.	**Economic constraints**				
1.	High investment cost	47	78.33	60	100.00
2.	Delay in getting subsidy	30	50.00	43	73.00
3.	Meet different officials for getting loan	29	46.20	40	68.00
4.	Cost of drip system hiked by the company representatives	32	53.36	22	36.60
5.	Difficulty in getting subsidy	26	43.66	37	61.31
6.	Difficulty in getting loan	25	41.22	46	76.84
B.	**Technological constraints**				
7.	Clogging of emitters	46	76.00	37	61.53
8.	Salt encrustation	52	83.78	46	76.00
9.	Quality of the material not good	17	26.74	13	21.60
10.	Damage due to rats and rodents	27	44.44	16	26.61
11.	Difficulty in taking up intercultural operations	26	43.11	35	58.36
12.	Damage of laterals, microtubes due to falling of nuts and leaves	19	33.21	12	20.18
13.	Frequent cleaning of filters	49	82.35	34	57.67
14.	Poor service by dealers	31	51.56	44	73.30

c.	**General constraints**				
15.	Hard to operate the system by illiterate people	18	28.15	36	66.87
16.	Irregular supply of electricity in these areas	12	20.80	11	18.21
17.	Not suitable to all type of crops	44	74.31	48	80.10

Economic constraints

High investment cost was reported as major constraint by 78.33 percent and 100.00 percent of adopters and non adopters followed by delay in getting subsidy 50 .00percent and 73.00 percent of adopters and non adopters respectively.

About 46.20 and 68.00 percent of respondents found it difficult to meet different officials for getting loan. Difficulty in getting loan was expressed by 41.22 percent and 76.84 percent of adopters and non adopters. About 43.66 percent of adopters and 61.31 percent of non adopters indicated that cost of the drip system was raised by the company while realizing or issuing the subsidy.

Technological constraints

Clogging of emitters as a constraint was reported by 76.00 and 61.53 percent of adopters and non adopters. Salt encrustation as a constraint was expressed by 83.78 percent and 76.00 percent of adopters and non adopters respectively this was due to the salty nature of irrigation water and the adopters proclaimed they used to overcome this problem by acid treatment.

Poor quality of the drip material was listed as a constraint only by 26.74 percent and 21.60 percent of adopter and non adopters respectively. Which the non adopters came to know on interacting with the adopters. Majority of the drip users they use to get high quality drip system from very familiar drip irrigation companies.

Damage by rodents was one of the constraints of 44.44 percent and 26.61 percent of adopters and non adopters. The adopters overcome this problem by keeping their field clean without much weed infestation.

For coconut growers damage of lateral due to falling of nuts was reported by minimum percent of respondents.

Frequent cleaning of filters as a constraint was experienced by 82.34 percent and 57.67 percent of respondent

Poor service of dealers was felt as a constraint by 51.56 and 73.70 percent of farmers.

General constraints

Hard to operate the system by illiterate people was reported by 28.15 percent of adopters and 66.87 percent of non adopters

Not suitable for all crop as constraint reported by 74.31 percent and 80.10 percent of adopters and non adopters respectively.

It is interpreted from the above finding that majority of the non adopters reported high initial cost as major constraint

Table14. Distribution of respondents according to their perception on attributes of drip irrigation technology

Sl.N0	Attributes	Adopters n = 60		Non Adopters n = 60	
		No	%	No	%
A	**Relative Advantage**				
1.	Efficient use of water	42	70.00	10	16.66
2.	Water Saving	54	90.00	20	33.36
3.	Less labour requirement	51	85.00	37	61.66
4.	Effective weed management	42	70.00	16	26.66
5.	Less disease attack	12	20.00	5	8.33
6.	Reduced soil erosion	22	36.66	3	5.00
7.	Power fluctuation managed	22	36.66	14	23.33
8.	Increased yield	49	81.66	10	16.66
9.	Reduced cost of cultivation	47	78.33	15	25.00
10.	Fertigation is possible	44	73.33	9	15.00
B	**Compatibility**				
11.	Suitable to all type of water	41	68.33	7	11.66
12.	Suitable to all type of soil	48	80.00	8	13.33
13.	Suitable to all season	33	55.00	9	15.00
14.	Suitable for intercropping	39	65.00	7	11.66
15.	Suitable to different types of land	24	40.00	9	15.00
16.	Easy intercultural operations	30	50.00	3	5.00
C.	**Simplicity**				
17.	Readily available	32	53.33	11	18.33
18.	Convenient to operate	26	43.33	10	16.66
19.	Easy maintenance	32	53.33	14	23.33

D.	**Trialability**				
20.	Trialable in small scale	24	40.00	8	13.33
E.	**Observability**				
21.	Quality of the produce increased	19	31.66	7	11.66
22.	Crop maturity advanced	14	23.33	8	13.33
F.	**Replaceability**				
23.	Parts can be replaced	26	43.33	11	18.33

Table 16. Distribution of respondents according to the impact experienced by the drip users

Sl.No	Consequences	No	%
A.	**Direct Consequences**		
1.	Increased income	31	50.11
2.	Increased standard of living	27	45.00
3.	Increased pattern of education	25	41.66
4.	Increased investment on other enterprises	27	45.00
B.	**Indirect Consequences**		
I	**Personal impact**		
5.	Increased outside contact	19	31.66
6.	Increased opportunity to know more about development activities	28	46.62
7.	Increased the rate of media exposure	25	41.66
8.	Increased consultation with fellow farmers	23	38.33
9.	Got social recognition from others due to high yield, high income	24	40.00
II	**Family living condition**	21	35.00
10.	Purchased household articles		
11.	Spending more on ceremonies	18	30.00
12.	Cleared debts	20	33.33
III	**Social impact**		
13.	Political participation	13	21.66
14	Increased organizational participation like Farm science club ,Farmers forum etc.	27	45.00
15.	Increased leadership quality	17	28.33
IV	**Economic impact**		
16.	purchased or constructed new houses or improved the existing one	13	21.66
17.	Purchased additional land	19	31.66
18.	Purchased agricultural implements	18	30.00
19.	More money invested in farming	18	30.00
20.	Invested money in agriculture and other activities	15	25.00
21.	Investment in saving	25	41.66
22.	Increased livelihood security	15	25.00
23.	Repaid debts	28	46.66

CHAPTER V

SUMMARY AND CONCLUSION

Water" is the "Elixir of Life" and it is said to be life and blood of agriculture. With the increasing scarcity of water day by day, water management has become the need of the hour. A number of initiatives have already been taken to conserve land and water resources. States are also encouraged to promote drip and sprinkler irrigation through supply of equipments at subsidized rates. But these efforts have to be intensified.

For sustained agricultural growth our precarious natural capital must be conserved and managed with utmost care, otherwise our future will be in peril. With this prelude the study "Sustainable Water Management through Drip Irrigation in Madurai district-An Explorative Study" had taken up with the following objectives

Objectives of the study

1. To study the profile of the respondents in the study locale.
2. To study the motivational factors for adoption and factors limiting adoption.
3. To document successful case studies from drip practioners.
4. To study the impact of drip irrigation technology among the farmers.
5. To develop strategies for upscaling the drip irrigation system among the farming community.

Madurai district was selected for the study based on higher area covered under micro irrigation and higher number of crops irrigated under drip in Southern Part of Tamil Nadu. A well structured and pretested interview schedule was used for data collection.

For analyzing the data collected during the investigation, Percentage analysis, Cumulative frequency, Independent't' test, Correlation co-efficient, Multiple regression analysis were performed.

5.1. CHARACTERISTICS OF RESPONDENTS

1. It could be stated that nearly 53.30 percent of adopters belonged to old age category, which was higher than the non-adopters (26.60 percent). There were 41.70 percent of adopters who belonged to middle aged category whereas 63.40 percent of non-adopters were belonged to the same category. Five percent of adopters were belonged to young age categories that were less than the non-adopters (10 .00 percent).

2. There were 46.63 percent of adopters and 45.01 percent of non-adopters had secondary education followed by 41.66 percent and 10.00 percent of adopters and non-adopters who possessed collegiate education. Nearly 8.35 percent and 36.66 percent of adopters and non-adopters had middle education and 3.36 percent and 8.33 percent who belonged to functionally literate category.

3. Nearly 35.00 percent of adopters had higher experience in farming also the same percent of non adopters had higher experience in farming followed by 33.30 percent of adopters and 35.00 percent of non adopters had moderate level farming experience and 31.70 percent, 30.00 percent of adopters and non-adopters had low experience in farming. The significant‘t’ value indicates the significant difference exist between adopters and non-adopters in their experience in farming.

4. Majority 38.34 percent of adopters had higher irrigation intensity, only 30.00 percent non adopters had higher irrigation intensity followed by 35.00 percent of adopters and 30.00 percent of nonadopters with medium irrigation intensity and 40.00 percent and 26.66 percent of non adopters and adopters with low irrigation intensity.

5. The significant t value indicates there exist difference between adopters and non adopters with respect to their irrigation intensity. Higher irrigation intensity with adopters might be due to the higher economic status followed by high and low levels.

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6. Medium level of participation in training programmes related to drip irrigation was observed with 66.70 percent of adopters and 23.62 percent of

non-adopters. Majority of non adopters 76.38 percent and 5.00 percent of non-adopters fall under low level of training participation. High level of participation was observed with 28.30 percent of adopters.

Significant difference was observed between adopters and non-adopters with respect to their participation in training programmes

7. Majority (41.70 percent) of adopters and 42.70 percent of non-adopters possessed medium level of risk orientation. Low level of risk orientation was observed among 31.70 percent of adopters and 26.70 percent of non-adopters followed by 26.60 percent of adopters and 30.60 percent of non-adopters with high risk orientation nature. The‘t’ value was found to be significant.

8. Nearly 43.36 percent of adopters and 55.21 percent of non-adopters had low level of credit orientation. Nearly 23.33 percent of adopters and 38.06 percent of non-adopters had medium level of credit orientation. High level of orientation towards credit was observed by 33.31 percent of adopters and 6.73 percent of non-adopters respectively.

Significant difference was observed between adopters and non-adopters, with regard to their credit orientation.

9. About 30.00 percent of adopters and 41.63 percent of non-adopters had low level of economic motivation followed by 38.20 percent and 23.35 percent of adopters and non-adopters possessed medium level of economic motivation.

10. Most of the adopters possessed high level of innovativeness followed by medium 26.70 percent and low level 15.00 percent of innovativeness which entirely differs from that of non-adopters who possessed 51.42 percent of innovativeness under low level followed by 28.23 percent under middle and only 20.35 percent under high level of innovativeness.

11. Majority of the adopters (38.40 percent) and 26.60 percent of the non adopters had high level of scientific orientation, nearly 25.00 percent and 44.90 percent of adopters and non adopters had medium level of economic motivation and 36.60 percent and 28.50 percent of the adopters and non adopters had low level of scientific orientation respectively

12. Majority (34.90 percent) of adopters possessed more favourable attitude towards drip irrigation followed by 33.40 percent under favourable attitude and 31.70 percent of adopters had less favourable attitude. But 35.30 percent of non-adopters had less favourable attitude followed by 33.30 percent under favourable and 31.40 percent under more favourable attitude category.

13. Effective weed management was perceived by 70.45 percent of adopters and 26.66 percent of non adopters. They felt since water is applied directly to root zone the weed menace had been reduced because of which the labour requirement was also reduced as perceived by 85.00 percent of adopters and 33.30 percent of non adopters felt by utilizing drip irrigation technology

14. Less attack of disease was perceived by only 20.13 percent and 8.30 percent of adopters and non adopters .Most of the respondents felt that the disease incidence does not get reduced due to application of water through drip.

15. Reduced soil erosion was perceived by 36.65 percent and 5.00 percent of adopters and non adopters they felt when compared to flood irrigation in drip irrigation water was applied with less force on the soil which reduced erosion of soil.

16. Managing the power fluctuation was an attribute perceived by 81.66 percent of adopters and 16.65 percent non adopters. Adopters felt that the yield in coconut has been increased to the extent of 1500 to 2000 nuts per hectare per year.

17. Reduced cost of cultivation as an attribute was perceived by 78.32 percent and 25.00 percent of adopters and non adopters. They felt that reduction in cost was observed in terms of wages provided for labours, fertilizer application and also larger area could be irrigated through drip when compared to that of flood irrigation.

18. Fertigation as an attribute was felt by 73.36 percent of adopters and 15.00 percent of non adopters.

19. Success of any agricultural technology depends on the compatible or adjustable nature of the technology with the users' culture, their environment, the nature of soil, water, season, cropping pattern etc.

20. With respect to compatibility about 80.00 percent and 13.33 percent of adopters and non adopters perceived suitability of drip to all types of soil as an attribute.

21. Suitable to all type of water was perceived as one of the attribute by 68.33 percent and 11.66 percent of adopters and non adopters. Similarly 55.00percent of adopters and 15.00 percent of non adopters felt that drip irrigation would be suitable for intercropping. Nearly 55 percent perceived suitability to all season as an attribute

22. Readily available spare parts was perceived by 53.12 and 18.33 percent when the drip system had any technical defects the spare parts were readily available with drip representatives which the adopters had purchased from them. Easy maintenance was perceived as an attribute by 53.30 percent and 23.39 percent it is easy to operate and maintained by them and remaining percent felt that there were some technological constraints such as clogging of emmiters, damage by rodents, leakage of pipes etc.

23. Trialable in small scale as an attribute was felt by 40.00 and 13.30 percent of respondents many felt that drip users after getting convinced of technical feasibility and economic viability in small scale would go for large scale adoption

24. Good quality of produce increased was perceived only by 31.60 percent and 11.66 percent. Crop maturity advanced was perceived only by 23.33 percent and13.33 percent. Minimum percent of the respondent felt that application of water through drip has increased the size of the produce most of the respondents perceived that the size of the produce does not increased.

25. Nearly 43.33 percent and 18.33 percent of adopters and non adopters felt that parts can be easily removed and changed by the respondents themselves.

26. It could be observed that majority of the respondents perceived the water saving, lesslabour requirement as important attributes of drip irrigation technology. The percentages of respondents perception towards various attributes were comparatively higher in case of adopters than that of non adopters.

5.2. INTENSITY OF ADOPTION

One fourth 36.66 percent of adopters had high intensity of adoption followed by 33.33 percent under low and 30.01 percent under medium intensity of adoption. This might be due to the fact that installation of drip system requires high cost and also this technology is not suitable to all types of crops, further this technology also possess some technological constraints such as salt encrustation, clogging of emitters etc.

It could be inferred that the adoption intensity was the function of respondents educational status; farming experience, farm power status, training participation, risk orientation, credit orientation, economic motivation, innovativeness, scientific orientation, attitude and perception on attributes of drip irrigation.

5.3. IMPACT OF DRIP IRRIGATION AMONG ADOPTERS

Over all impact reveals that 22.00 percent of adopter had high level of impact followed by medium and low with similar level.

5.4. FACTORS FAVOURING ADOPTION

27. A very meagre proportion of drip users felt salinity of water (6.67 percent), high disease incidence (8.33 percent), undulating landscape (10.00 percent), and low water holding capacity of the soil (8.33percent) as factors for adopting drip irrigation.

28. Nearly (83.36 percentage) of drip users felt that less labour requirement influenced them to adopt drip irrigation. They expressed that in drip irrigation,labour is saved in operations like irrigation,weeding,etc.More than three fourth of the drip users (80.00 percent) felt that through drip irrigation cost of cultivation of the crops get reduced which facilitated them to adopt

drip irrigation technology. They said that less labour requirement was the main cause for decreased cost of cultivation. More than half of drip users (56.67) percent expressed that yield increased to a considerable extent in drip irrigation influenced them to adopt this technology

29. Nearly 50.00 percent of drip users expressed that availability of subsidy influenced them to adopt drip irrigation. Less than half of drip users expressed that drip irrigation increased their profit and hence they adopted this technology.

30. About one fourth of drip users expressed that availability of bank loan, saving in time (20.00percent), saving in fertilizer (20.00 percent) were the other factors which influenced them to adopt drip irrigation technology.

31. Representatives of drip companies (36.67 percent), Officials of agricultural engineering department (26.66 percent) were the important factors for adoption of drip irrigation.

32. Nearly 46.67 Percent of adopters were influenced by successful drip users to adopt this technology. More than one fourth of the drip users expressed that they were influenced by their peer group members to adopt drip irrigation technology. A very meagre proportion (6.67 percent) expressed that they wanted to be an innovator, wanted to be a role model (5.00 percent), and prestige (3.33percent) as the factors that influenced them to adopt drip irrigation technology.

On the whole, Water scarcity, less labour requirement, and high weed menace were considered as the most influential factors by the drip users.

5.5. Constraints as reported by adopters and non adopters

33. High investment cost was reported as major constraints by 78.33 percent and 100.00 percent of adopters and non adopters delay in getting subsidy was reported by 50.00 percent and 73.00 percent of adopters and non adopters

34. About 46.20 and 68.00 percent of respondents felt that it was difficult for them to meet different officials for getting loan. Difficulty in getting loan was expressed by 41.22 percent and 76.84 percent of adopters and non adopters. About 43.66 percent of adopters and 61.31 percent of adopters felt that cost of the drip system was hiked by the company while getting subsidy

35. Clogging of emitters as a constraint was reported by 76.00 and 61.53 percent of adopters and non adopters. Salt encrustation as a constraint was expressed by 83.78 percent and 76.00 percent of adopters and non adopters respectively. This was due to more salt content in the irrigation water and the adopters proclaimed they used to overcome this problem by acid treatment.

36. Poor quality of the material was listed as a constraint only by 26.74 percent and 21.60 percent of adopters and non adopters respectively. Majority of the drip users they used to get high quality drip system from very familiar drip irrigation companies.

37. Damage by rodents was felt as constraint by 44.44 percent and 26.61 percent of adopters and non adopters. They adopters overcome this problem by keeping their field clear without weed infestation.

38. Damage of lateral due to falling of nuts was reported only by minimum percent of respondents.

39. Frequent cleaning of filters as a constraint was experienced by 82.34 percent and 57.67 percent of respondent

40. Dealers after service poor were felt as a constraint by 51.56 and 73.70 percent of farmers.

41. Hard to operate by illiterate people was reported by 28.15 percent of adopters and 66.87 percent of non adopters

42. Not suitable for all crops as constraint reported by 74.31 percent and 80.10 percent of adopters and non adopters respectively.

5.6. IMPLICATIONS OF THE STUDY

Based on the findings the implications of the present study that may be useful for further development of drip irrigation technology are presented below.

1. The findings on profile would help the disseminating agencies in understanding the farmers and to workout suitable strategies to increase adoption of drip irrigation technology.

2. Majority of the farmers were educated and they would be able to understand or operate the system well so when exposure to drip technology if provided through the extension personnel or some drip manufacturing companies the adoption level would be increased.

3. A vast majority of the respondents had attended only less number of training so in order to increase the adoption farmer's skill should be improved towards the use of any new technology so more number of trainings and demonstrations should be arranged by drip manufacturing companies through Department of Agriculture.

4. Most of the respondents had only medium level of risk bearing ability so only when the farmer gains conviction on the technology the adoption rate will be more exposure to various successful drip users could influence the other members of the social system.

5. The findings on perceived attributes of drip irrigation technology revealed that most of the drip users had perceived favourably about the drip irrigation technology. Hence extension personnel should utilize the drip users to motivate the non adopters.

6. Most of the non adopters had only less favourable attitude towards drip irrigation technology so they should made known about the positive attributes of drip irrigation technology through various training programmes and increasing contact with various drip manufacturing companies, KVKs etc.

7. One third of the samples intensity of adoption was low due to high cost of installation, which could be met through provision of timely subsidy and the availability of such benefits is to be popularized so that everyone to be motivated to follow the technology .

8. Findings on factors favouring adoption of drip technology would help the change agents of public and private sector to popularize drip technology.

9. The findings revealed that high initial cost of installation, delay in getting subsidy and salt encrustation as main constraints which could be overcome through design of low-cost drip system. Government should take keen interest in disbursement of subsidy in right time, ways to overcome the technological constraints should me made known to the farmers, services should be provided by the drip companies which will enable the users to gain satisfaction.

Suggestions for future research

- A comprehensive study with large sample size on the same line may be conducted for in-depth probing.
- Reinventions made by farmers on the system could be studied in the intensive adoption areas.
- Performance of extension personnel and drip manufacturing companies in dissemination of technologies could be compared and studied.

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Table 1. List of variables with their measurement procedure

Sl.No	Variables	Measurement
A.	**Independent variable**	
1.	Age	Scoring procedure followed by Jeyashree(2004)
2.	Educational Status	Scoring procedure followed by Ramani (2004) modified for the study
3.	Farming experience	Scoring procedure followed by Sukitha (2003)
4.	Irrigation Intensity	Scoring procedure followed by Kavitha (1999)
5.	Farm power Status	Scoring procedure followed by Ponnusamy(1993)
6.	Training Participation	Scoring procedure followed by Nalini
7.	Risk Orientation	Scoring procedure followed by senthilvadivoo (2003)
8.	Credit orientation	Scoring procedure followed by Jayashree (2004)
9.	Economic Motivation	Scoring procedure followed by Vilas (2005)
10.	Innovativeness	Scoring procedure followed by Desinguraja (2005)
11.	Scientific Orientation	Scoring procedure followed by senthilkumar (2001)
12.	Attitude towards drip irrigation	Scoring procedure developed by Savithri (1992) modified for the study
13	Perception on attributes of drip irrigation	Scoring procedure developed by Kavitha (1999)
B	**Dependent Variable**	
14.	Intensity of adoption	Scoring procedure followed by Kavitha (1999)
15.	Impact of drip irrigation	Developed for the study

APPENDIX-I

State wise area covered under drip irrigation

Sl.No	States	Area in million ha	Percentage
1.	Andhra Pradesh	0.144	12.00
2.	Gujarat	0.036	3.00
3.	Karnataka	0.188	15.00
4.	Kerala	0.024	2.00
5.	Maharastra	0.54	45.00
6.	Tamil Nadu	0.144	12.00
7.	Rajasthan	0.132	11.00

Source: Meena (2006)

APPENDIX II

Taluk wise details on drip irrigation in Madurai district

Sl. No.	Taluk	No. of farmers	Total area cultivated under drip in ha	Different types of crops grown under drip
1.	Thirumangalam	7	9.94	5
2.	Usilampatti	9	37.54	5
3.	Vadipatti	65	127.25	8
4.	Melur	46	72.92	6
5.	Madurai South	53	88.21	7
6.	Madurai North	19	23.98	3

Source: Department of Agricultural Engineering, Madurai

APPENDIX III

Village wise distribution of respondents in Vadipatti taluk

Sl.No	Villages	Number of respondents
1.	Palamedu	8
2.	Kulasekaran Kottai	12
3.	Katchakatti	8
4.	Rajakalpatti	5
5.	Poochampatti	1
6.	Mullipallam	1
7.	Kudladampatti	1
8.	Thatampatti	4
9.	Athanur	6
10.	Viralipatti	2
11.	Vaikasipatti	6
12.	A.Kovilpatti	6
13.	T.Andipatti	6
14.	Vavidamaruthur	1

Source: Department of Agricultural Engineering, Madurai

APPENDIX IV

Village wise distribution of respondents in Madurai south Taluk

Sl.No	Village	Number of drip users
1.	Vadapalanchi	1
.2	Viradhanur	2
3.	Kosavankondu	7
4.	Nilayur	8
5.	Nallur	5
6.	Vedarpuliankulam	1
7.	Thuvarian	2
8.	Kodimangalam	4
9.	Cholankuruni	5
10.	Isalani	2
11.	Karadipatti	8
12.	Anadhamangalam	3
13.	Majanpatti	1
14.	Perungudi	5

Source: Department of Agricultural Engineering, Madurai

APPENDIX V

TAMILNADU AGRICULTURAL UNIVERSITY
DEPARTMENT OF AGRICULTURAL EXTENSION AND RURAL SOCIOLOGY
AGRICULTURAL COLLEGE AND RESEARCH INSTITUTE
MADURAI-625104

Dr. T. Rathakrishnan, Ph.D. **Phone No : 0452-2422956**
Professor and Head **FAX :0452-2422785**

Dated: 18.07.2006

Dear Sir/Madam,

Sub: PG. Education-research-judges opinion-Regarding.

* * * *

My student Miss. V. Flora Lavanya has taken up a thesis project on "Sustainable Water Management Through Drip Irrigation in Madurai District – An Explorative Study" for her M.Sc. (Ag.) degree programme.

The specific objectives of this study are

1. To study the profile of the respondents
2. To study various motivational factors and factors limiting adoption
3. To document successful case studies.
4. To study the impact of drip irrigation at the study locale.
5. To suggest strategy for upscaling drip irrigation

For this purpose the student researcher has listed out a number of socio-personal and psychological variables. In this context I request you to kindly rate the listed variables for their relevance by ticking in the appropriate column. Although utmost care has been taken to make the list exhaustive, still there may be scope for addition of items. Please do if you feel it is necessary. Kindly return your rating in the enclosed self-address stamped envelop at your earliest convenience.

Thanking you for your co-operation.

Yours sincerely,

Encl:

1. List of variables

2. Self addressed stamped envelope

SUSTAINABLE WATER MANAGEMENT THROUGH DRIP IRRIGATION IN MADURAI DISTRICT – AN EXPLORATIVE STUDY

Dependent Variable : Adoption

Non Adoption

Sl. No.	Independent variables	Relevance		
		Most relevant	Relevant	Lest relevant
1.	Age			
2.	Educational status			
3.	Occupational status			
4.	Farming experience			
5.	Area cultivated under drip irrigation			
6.	Irrigation intensity			
7.	Extent of water saved			
8.	Yield increase			
9.	Water use efficiency			
10.	Period of availability of water			
11.	Increased annual income through drip irrigation			
12.	Social participation			
13.	Economic status			
14.	Extension agency contact			
15.	Training participation			
16.	Information sharing behaviour			
17.	Mass media exposure			
18.	Risk orientation			
19.	Credit orientation			
20.	Economic motivation			
21.	Scientific orientation			
22.	Innovativeness			
23.	Progressiveness			
24.	Level of aspiration			
25.	Achievement motivation			
26.	Attitude towards drip irrigation			
27.	Others, if any			