CONSTRAINTS IDENTIFICATION OF DRIP IRRIGATION FOR SUGARCANE IN AHMEDNAGAR DISTRICT

By

Dharam Nilesh Jalindar

(Reg. No. 09/237)

A Thesis submitted to the
MAHATMA PHULE KRISHI VIDYAPEETH,
RAHURI - 413 722, DIST.AHMEDNAGAR,
MAHARASHTRA, INDIA

in partial fulfilment of the requirements for the degree

of

MASTER OF SCIENCE (AGRICULTURE)

in

IRRIGATION WATER MANAGEMENT

INTERFACULTY DEPARTMENT OF IRRIGATION WATER MANAGEMENT

POST GRADUATE INSTITUTE
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APPROVED BY

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INTERFACULTY DEPARTMENT OF IRRIGATION WATER MANAGEMENT

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This is to certify that the thesis entitled, **"CONSTRAINTS IDENTIFICATION OF DRIP IRRIGATION FOR SUGARCANE IN AHMEDNAGAR DISTRICT"**, submitted to the Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar, Maharashtra, India in partial fulfilment of the requirements for the award of the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **IRRIGATION WATER MANAGEMENT**, embodies the results of a *bona fide* research work carried out by **SHRI. DHARAM NILESH JALINDAR,** under my guidance and supervision and that no part of the thesis has been submitted for any other Degree or Diploma in any other form.

Place : M.P.K.V., Rahuri
Date : / /2012.

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Date : / /2012.

ACKNOWLEDGEMENTS

I avail this golden opportunity to express my sincere and humble indebtedness and deep sense of gratitude towards Dr. D.D. Pawar, Head, Interfaculty Department of Irrigation Water Management, M.P.K.V., Rahuri as my research guide as well as chairman of advisory committee to gave encouragement, constructive advice and parentally treatment throughout the investigation

I sincerely express my gratitude and indebtedness to Dr. R.S. Patil, Associate Dean, Post Graduate Institute M.P.K.V., Rahuri for providing me necessary facilities during my study. I take this opportunity to express my depth of respect and heart full gratitude to Dr. S.U. Bhoite, Assistant Professor, Dr. M.G. Shinde, Assistant Professor, Interfaculty Department of Irrigation Water Management, Dr. M.C. Ahire, Professor, Department Extension Education, M.P.K.V., Rahuri, who were members of my advisory committee for their constant inspiration and helpful discussions and advice at each step during the course of investigation

I express my sincere gratitude to Dr. R.M. Gethe, Prof. S.K. Dingre, Prof. R.R. Hasure, Prof. K.D. Kale for their valuable guidance and for their kind co operation. I am highly obliged to all staff of Interfaculty Department of Irrigation Water Management, M.P.K.V., Rahuri for their valuable guidance gentle gesture and wholehearted cooperation during my research.

I express my deep sense of appreciation towards my batch mates Gorakh, Sagar, Ranjit, Avinash, Datta, Rohidas, Miss. Gouri and Miss. Sarikha for their moral support and ever ending friendship during the entire investigation. I express special thanks stomy friends Sangram,Sachin Kanif, Ganesh, Rahul, Avinash, Vishal, Ravindra, Annasaheb, Vishal, Prashant, Prathmeh, Satyjit for their joyous company and all my friends for their enthusiastic company and cooperation

My head goes down before My Father Shri. Jalindar Dharam, mother Smt. Neeta Dharam and sisters Rashmi, Priyanka, Sonali and Grand father, Grandmother whose loves and blessings made me work fruitful at this stage of my life I find no words to express my indebtedness to them and their desire still inspiring me to work in any situation.

While travelling on this path of education many hands push me fourth, learned hearts put me on the right track enlightened by their knowledge and experience. I ever rest Thanks to all of them.

Place : M.P.K.V., Rahuri (N.J. Dharam)
Date : / /2012

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List of Abbreviations

Mm	:	Millimeter
cm	:	Centimeter
kg/cm²	:	Kilogram per centimeter square
m/ha	:	Million hector
lph	:	Litre per hour
m/sec	:	Meter per second
ml	:	Milli litre
min	:	Minute
DMI	:	Drip method of irrigation
FMI	:	Flood method of irrigation
EU	:	Emission Uniformity
C	:	Constant
D	:	Diameter
L	:	Length
TFC	:	Total Fixed Cost
Cu.m	:	Cubic meter
Ha	:	Hector
B:C	:	Benefit:Cost
WUE	:	Water Use Efficiency
Q/ha	:	Quintal per hector
>	:	Greater than
%	:	Percentage
M.S.	:	Maharashtra state
i.e.	:	That is

ABSTRACT

CONSTRAINTS IDENTIFICATION OF DRIP IRRIGATION FOR SUGARCANE IN AHMEDNAGAR DISTRICT

By

NILESH JALINDAR DHARAM

A candidate for the degree
of
MASTER OF SCIENCE (AGRICULTURE)
in
IRRIGATION WATER MANAGEMENT
2012

Research Guide	:	Dr. D.D. Pawar
Department	:	Interfaculty Department of Irrigation Water Management

The experiment entitled “Constraints identification of drip irrigation for sugarcane in Ahmednagar district” was conducted in six tahsils i.e. Rahata, Kopargoan, Shrirampur, Rahuri, Newasa and Sangamner of Ahmednagar district of Maharashtra state. This study has been carried out to find out the reasons for the slow adoption of drip irrigation method for sugarcane in Ahmednagar district as well as its impact on various parameters

The socio-economic study was carried out through questionnaires prepared for this study. The test for drip hydraulic as per land holding and education were performed on the farms to know i) emission uniformity (%), ii) average discharge variation (%), iii) lateral head loss reduction and iv) manifold head loss reduction (%). These tests were also helpful for finding out the technical

constraints and to know the drip hydraulics influenced due to land holding and education. The parameters worked out were i) fixed cost, ii) cost of cultivation, iii) seasonal total cost, iv) water used, v) yield of produce, vi) income from produce, vii) additional area, viii) gross cost, ix) B:C ratio, x) net extra income, xi) water use efficiency, xii) pay back period. Constraints and suggestion were reported as per the responses obtained from the farmer.

From this study, it was observed that large proportion of drip irrigation system users had moderate to higher education and majority of drip irrigation users had small to medium farms. It was found that more than 85 per cent of drip systems users had EU above 85 per cent. Average discharge variation was reported to be more than 20 per cent in 46 users, which is not desirable. Majority of drip system users had lateral head loss below 10 per cent, which is within acceptable range. Hundred per cent users had manifold head loss less than 20 per cent which is acceptable. All the above four parameters of drip hydraulics were categorised and analysed as per land holding and education level of farmer.

From the data collected during the experiment it was revealed that there was linear increase in B:C ratio as per land holding whereas there was linear decrease in B:C ratio as per education. It was found that maximum i.e. 9.39 q/ha-cm water use

efficiency was reported in marginal farmers, whereas 9.98 q/ha-cm water use efficiency was reported in users having education upto degree. The minimum pay back period i.e. 1.08 years was reported in medium farmers and 1.03 years were reported in users having secondary education.

The major economic constraints were high initial investment of drip system and high cost of spare parts. Technical constrains reported by farmers were improper design, clogging and lateral breakage. Improper demonstration on field, irregular guidance and supervision were some extension constraints. The other constraints were irregular electrical supply and problem of rodents.

The economic suggestions, technical suggestions, extension suggestions and other suggestions were invited from the respondents to overcome the above mentioned constraints.

1. INTRODUCTION

The on-farm irrigation efficiency of properly designed and managed drip irrigation system is estimated to be about 90 per cent, while the same is only about 35 to 40 per cent for surface method of irrigation. The development of drip method of irrigation has a long history. While, the basic experiment was started way back in 1860s and an important break through was achieved during 1920 in Germany when perforated pipe drip irrigation was introduced. Due to various promotional schemes introduced by the Government of India and Government of Maharashtra, the area under drip irrigation increased from 1500 ha (1985-1986) to 6.95 lakh ha (Anonymous, 2011).

At present developed total irrigation in India is 93.7 M ha as against the ultimate potential of 139 M ha. Whereas, in Maharashtra, only 18 per cent of total cultivable area is under irrigation having an ultimate potential of 50 per cent.

In Maharashtra, total micro-irrigation potential is 27.14 lakh ha and actual area under micro-irrigation is 9.94 lakh ha. In that actual area under drip irrigation system is 6.95 lakh ha and total drip irrigation potential is 11.16 lakh ha. Actual area under sprinkler system is 2.99 lakh ha and total potential is 15.98 lakh ha (Anonymous, 2011).

Recognizing the fast decline of irrigation water potential, a number of demand curtailing strategies have been introduced to increase the water use efficiency. One of the technical means introduced recently in Indian agriculture is to improve water use

efficiency through drip method of irrigation. Unlike the flood irrigation method, under drip irrigation, water is directly supplied to the root zone of the crops through a network of pipes using drippers/ emitters. The direct supply of water through the pipe network reduces the substantial amount of water losses.

Reduction in water consumption due to drip method of irrigation over the surface method of irrigation varies from 30 to 70 per cent for different crops. According to data available from research stations, productivity gain due to drip method of irrigation is estimated to be in the range of 20 to 90 per cent for different crops. While increasing the productivity of crops, it also reduces the cost of cultivation substantially especially in labour-intensive operations. The reduction in water consumption in drip method of irrigation also reduces the energy use (electricity) that is required to lift the water from irrigation wells.

Maharashtra state alone accounted for nearly 50 per cent of the India's total drip irrigated area followed by Karnataka, Tamilnadu and Andhra Pradesh. Though drip method of irrigation has good potential for various crops in water scarce countries like India, the coverage of area under drip irrigation is very limited.

While studies have been carried out to find out the reasons for the slow growth of drip irrigation method as well as its impact on various parameters, most of the studies available in Indian context are either based on experimental data or individual farmer case study. It has been corroborated by various studies carried out across different countries including India that irrigation

plays a paramount role in increasing the use of yield increasing inputs and enhancing cropping intensity as well as productivity of crops. Apart from benefiting the farmers, irrigation development also helps to increase the employment opportunities and wage rate of the agricultural landless labourers.

Over the last ten years a few studies have been carried out focusing on the impact of drip method of irrigation on various parameters in different crops. However, it focused mainly on the impact of drip method of irrigation on water saving including water use efficiency, productivity of crops and cost of cultivation. While some have studied the impact of drip on electricity saving, others have studied its economic viability in different crops, using both experimental and field survey data. Results of experimental data reported in INCID show that water saving in drip over the surface irrigation method is 65 per cent in sugarcane (Narayanmoorthy, 2006). Similar to experimental data, studies carried out using field level data in Maharashtra also shows that the water saving due to drip is about 44 per cent in sugarcane. Studies based on experimental data suggest that the productivity of crops cultivated under drip can be increased by 40 to 50 per cent over the crops cultivated under convention. Through the analysis of experimental data, studies have found a substantial water saving and productivity gains due to drip method of irrigation in sugarcane cultivation. Single cane weight, cane girth, cane length, number of internodes, leaf length and leaf breadth were also found to be higher with sugarcane cultivated under drip method of irrigation when compared to the flood method of irrigation. Because of less

moisture stress under drip, the recovery rate of sugarcane cultivated under drip was found to be higher when compared to the crop cultivated using conventional method of irrigation.

Though drip irrigation increases the crop productivity and save substantial amount of water, it requires relatively larger fixed investment to install the system in the field. Therefore, some studies have attempted to find out whether the investment in drip irrigation is economically viable or not in different crops. While some have estimated benefit-cost ratio including water saving as well as excluding water saving, others have estimated benefit cost ratio and net present worth under with and without subsidy condition. Among the various reasons for the slow progress of adoption of this new technology, its capital-intensive nature seems to be one of the main deterrent factors. Second, most of the studies available on drip irrigation in India is based on experimental data collected from different regions, which generally do not present the field level position. Some of the studies have shown that the results derived from research station data are substantially different from that of survey to bring out the impact of drip method of irrigation on different economical parameters including economic viability using both secondary (experimental data) and field level data/information. Some studies also estimated the constraints in adoption of drip irrigation such as problem in the design of drip irrigation, improper technical knowledge of drip irrigation and other constraint such as rodent problem, technical problem such as clogging of emitter etc. In the absence of reliable field studies, it is

difficult to judge the actual economic viability of drip method of irrigation.

In this context, an attempt is made in this detailed study using data collected through properly designed survey for making firm conclusions about water use efficiency, productivities and hydrolic parameters. The other issue of drip irrigation is related to its economic viability. Keeping in view the limitation or constraints an attempt is also made to study the constraints, identification of drip irrigation for sugarcane in Ahmednagar district on different parameter. Following objectives were conducted in the study.

i. Techno-socio economic survey of farmers adopting drip irrigation for sugarcane.
ii. To study the constraints in uniform application of water through drip irrigation in sugarcane.
iii. To identify constraints faced by the sugarcane growers in adoption of drip irrigation system for sugarcane in Ahmednagar district.
iv. To obtain suggestions of respondents to overcome these constraints.

2. REVIEW OF LITERATURE

This chapter consists of research findings as result of the review of literature relevant to the present study. The references directly or indirectly related to the subjects are reviewed in the following sections.

2.1 Socio-economic characteristics of drip irrigation:

2.1.1 Personal aspects for drip irrigation

2.1.1.1 Education

Patil (2002) conducted survey in Sangli district and observed that considerable number of drip adopters (42.22 per cent) received primary education followed by secondary (30.00 per cent), higher secondary (11.11 per cent) and college education (7.77 per cent).

Chavan *et al.* (2003) conducted survey in Rahuri tahsil and observed that a majority (84.00 per cent) of drip owners received secondary education.

Desai (2005) conducted survey in Jalgaon district and revealed that 40 per cent of drip irrigation system adopters had secondary education.

Bannapure (2007) observed that 45.45 per cent of the drip irrigation system adopters had secondary education.

2.1.1.2 Experience

Ahire *et al.* (1999) found that the average experience in the irrigated farming of the farmer using drip method of irrigation was 16.73 years that of flood method of irrigation was 22.87 years.

Kale (2000) found that most of the respondents had 4 to 5 years of experience in grapes cultivation under drip irrigation.

2.1.2 Socio-economic aspects for drip irrigation

2.1.2.1 Land holding

Nagare (1989) reported that size of land holding had significant negative relationship with farmers level of knowledge about the drip irrigation. Annual income of the farmers had no significance relationship with knowledge level of drip irrigation.

Patel (2003) reported that, there was relationship between size of land holding of farmers with knowledge. The annual income of farmers showed positive and significant co-relation with their knowledge of drip irrigation system.

Patil (2007) in a comparative study of users and non-user of drip irrigation system by grapes grower indicated that a large portion of the respondents had medium sized area under drip for grape orchards.

2.2 Hydraulics of drip irrigation

2.2.1 Drip hydraulics

2.2.1.1 Emission uniformity (%)

Keller and Karmeli (1974) suggested the emission uniformity as the criteria for design of drip irrigation laterals, which should be around 90% for practical purpose

Wu and Gitlin (1974) presented design of drip irrigation based on uniformity. Their study showed that the friction drop was of exponential function with respect to the length of lateral, whereas the discharge decreased with increase in length of lateral.

Chaugule (2002) reported that the emission uniformity of in-built emitter lines was excellent (>95 per cent) due to use of optimum lengths of lateral lines at all combinations of operating pressures, land slopes and emitter spacing. He also reported that for in built emitters, the emitter discharge was increased from 3.18 to 4.53, 3.42 to 4.82 and 3.74 to 5.36 lph with increase in pressure from 0.6 to 1.2 kg/cm^2, respectively, for 60, 75 and 100 cm emitters spacing.

2.2.1.2 Average discharge variation (%)

Wu and Gitlin (1974) presented design of drip irrigation based on uniformity. Their study showed that the friction drop was of exponential function with respect to the length of lateral, whereas the discharge decreased with increase in length of lateral. He also showed that average discharge variation (%) in lateral is less than 10 per cent acceptable range and for manifold and main it is suitable when it is less than 20 per cent.

Keller and Blisner (1990) found that discharge variation should be less than 10 per cent for sensitive and can be upto 20 per cent for sturdy crop like sugarcane.

2.2.2 Cost of cultivation for drip irrigation

2.2.2.1 Seasonal income influenced by land holding

Dhawan (2000) reported that total capital cost for drip irrigation in sugarcane as Rs.31492 and benefit cost ratio was 1.31 and 2.74 for without and with saving of water, respectively.

Malik and Luhach (2002) demonstrated that the benefit-cost ratio of grapes, ber and citrus (kinnow) orchards was 1.737, 1.949 and 2.570 for drip set, respectively. The B:C ratio greater

than unity in all three crops revealed that investment in drip system is economically viable and sound.

Sarkar and Hanamashetti (2002) conducted a comparative analysis of the financial and economic viability of the cultivation of sugarcane and grapes under drip-irrigation and non-drip-irrigation conditions in Ahmednagar and Nashik districts, Maharashtra, India. Data were obtained from a sample of 52 farmers (40 drip irrigation adopters and 12 non-adopters). Costs of cultivation, productivity, water and electricity consumption/ savings and incomes/returns were examined.

Srivastava *et al.* (2003) demonstrated that the investment decision for shifting to drip irrigation will depend upon many factors such as cost of cultivation, productivity, yield gain factor, cost of produce, electricity charges, depth of groundwater and irrigation requirement.

Narayanamoorthy (2006) had investigated that benefit cost ratio for DMI in sugarcane was 2.66 while for FMI it was 2.21.

2.2.2.2 Total income influenced by land holding

Hapse *et al.* (1993) conducted a study to find out the impact of drip irrigation on sugarcane cultivation, The main conclusions of the study were, (a) water saving under DMI varied from 32 to 49 per cent under different trials over the method of FMI; (b) yield increase varied from 22 to 30 per cent under DMI over the method of flood irrigation, and (c) the benefit-cost ratio (BCR) of drip investment varied from 2.79 to 2.81 under different discount rates.

Narayanamoorthy (2006) investigated that net seasonal cost for DMI and FMI is 32855 and 21025, respectively and net profit per mm of water used for DMI and FMI is 34.95 and 9.78, respectively. Water use efficiency per ha mm was reported as 180.85 and 59.53 DMI and FMI, respectively in sugarcane.

2.2.2.3 Water used and water saving

Shinde and Jadhav (2000) conducted an experiment at Vasantdada Sugar Institute, Pune from 1996-97 to 1998-99 for studying the field performance of pressure compensating, non-pressure compensating and inline drip irrigation systems in sugarcane agriculture. The results revealed that pressure compensating and inline drip irrigation systems were effective to save irrigation water to the tune of 50 % along with 17 to 20 % increase in cane yield and 2.46 times more water-use-efficiency, compared with furrow irrigation.

Malik and Luhach (2002) demonstrated that the extent of water saving is substantial higher i.e. 39.80 per cent for drought tolerant crops like ber and kinnow in comparison to grapes and about an additional area upto 0.54 to 0.66 hectare irrigated by adopting DMI is also considered indicator for evaluating water use efficiency.

Chavai *et al.* (2003) conducted a study in Rahuri tahsil at Ahmednagar District, Maharashtra, India, during 1992-2000 to evaluate the opinions of the farmers adopting drip irrigation system on the nature and extent of benefits of this system in sugarcane production. A total of 102 sugarcane farmers from 20 villages adopting drip irrigation for sugarcane were selected. The major benefits accrued and reported by majority of the farmers were, savings in water ranging from 20 to 60 %, in labour and fertilizer, reduction in weed intensity and increase in sugarcane yield.

Narayanamoorthy (2006) reported that water used (mm) in DMI and FMI for sugarcane was 940 and 2150 mm, respectively.

2.3 Constraints in adoption of drip irrigation for sugarcane

Ingale and Sagane (1992) reported that the important technical constrains as experienced by most of the drip adopters were clogging of drippers and micro tubes (78.98 per cent), inferior quality spare parts (56.63 per cent), pipe joint leakage (36.84 per cent) and in-adequacy of perfect information about drip irrigation system.

Puranik *et al.* (1992) revealed that drip irrigation was very costly as responded by 60 per cent drip farmers. Farmer did not get spare parts locally at reasonable rate. A large majority of farmers (94.00 %) also said that drip irrigation sets required frequent cleaning of mains, submains and laterals microtubes, drippers. Forty five farmers found problem as regards to required water pressure for proper working of drip irrigation system.

Kalasariya *et al.* (1993) revealed that major economic constraints face by the drip farmers were high initial cost for installing drip sets and for maintaining adequate pressure, a tank is required to be made at high altitude, un-even distribution of water due to uneven pressure and clogging due to other impurities

Sundara (2005) gave an account of research results in micro-irrigation and some constraints in adopting micro-irrigation systems for sugarcane production in Coimbatore, Tamil Nadu, India.

2.4 Suggestions of respondents to overcome constraints

Mandalia (1990) suggested that campaign should be started by extension agencies all over the India to convince the farmers about drip method and to motivate them to adopt the same, use of mass media and natural demonstration program on drip irrigation method should be started, farmer should be trained about

the drip irrigation method at farmer training centre and also officers should be oriented and due importance should be given to this method in their propaganda drive.

Ingale and Sagane (1992) reported the important technical constrains as experienced by most of the drip users. He suggested that intensive guidance and training should be given to farmers so that they will be able to repair the faults in the system the dealer should continuously guide the farmers at least once in complete season, the damage due to rodents leakages chocking etc. should be minimized, a good quality material is made available. It was also suggested that some of the material such as filters could be fabricated at village level and if some of the farmers started doing the problems of raw material need to be solved.

Phadtare *et al.* (1992) reported major suggestions made by the farmers for increasing area under drip irrigation. It included that propaganda should be made about drip irrigation through Shibirs (farmer's rallies and film shows). At least five years guarantee should be provided by the manufactures/company agent for drip irrigation system, subsidy should be given equal to all farmers in time, technical guidance and sufficient loan should be provided to the farmers.

Puranik *et al.* (1992) suggested that subsidies should be made available easily and timely to the farmers, technical know how be given through demonstration and field visits the spare parts such as micro tube, drippers etc should be made readily available at reasonable rates to both small and large type of farmers and there should be prompt service from dealer.

3. MATERIAL AND METHODS

The scientific study requires adoption of appropriate methods and procedures in order to reach reliable, unbiased and specific conclusions. This chapter describes in detail the general information about the research site, selection of respondents, designing of interview schedule, techniques followed in measurement of concepts, analysis and interpretation of data.

In short this chapter deals with where and how the research was carried out and the methods which were used for statistical analysis.

3.1 Research site

3.1.1 Selection of research area

Maharashtra is one of the state having large area under pressurized irrigation systems especially under drip irrigation system for sugarcane.

For the present investigation 100 farmers adopting drip irrigation for sugarcane from six talukas in Ahmednagar district of Maharashtra were selected as these talukas has less variation in climate, soil and these six talukas come under same agro climatic zone (scarcity zone). The details are given in Table 3.1.

Table 3.1. Selection of research area

Sr. No.	Taluka	Number of farmer
1.	Kopargoan	19
2.	Rahata	19
3.	Srirampur	16
4.	Newase	16
5.	Rahuri	14
6.	Sangamneer	16
		100

3.1.2 Location map of Research Area

The research area consists of six talukas which are located in various parts of Ahmednagar district. All the tahasils Kopargoan, Rahata, Srirampur, Rahuri, Sangamneer and Newase are located in the north of Ahmednagar district of Maharashtra. The location map of selected area is given in Fig.3.1.

Fig. 3.1. AHMEDNAGAR DISTRICT

3.1.3 Area and Population of Research Site

The total population of Ahmednagar district is 40,88,077. The details regarding area and population of selected area are given in Table 3.2.

Table 3.2 Salient feature of selected tahsil

Sr. No.	Particulars	Kopargoan	Rahata	Srirampur	Rahuri	Sangamneer	Newase
1.	Geographical area (km^2)	725.16	759.19	569.87	1035.11	1705.06	1343.43
2.	Total population	277170	288279	256458	294924	441439	326698
3.	Male population	143650	148784	131604	152464	226952	168624
4.	Female population	133520	139495	124854	142460	214487	158074

(Anonymous, 2009)

3.1.4 Climate and Rainfall

Climate and rainfall of six talukas does not vary much as the area belonging to same agro climatic zone. The climate of all talukas is dry except in monsoon. These zones receive less rainfall with 80 per cent of rainfall received in monsoon season.

3.1.5 Irrigation Facility

In 2009-10, the gross irrigated area accounted nearly 20.25 per cent of the area under cultivation in the district. Irrigation facilities are mainly used for sugarcane as well as for fruits and vegetables. The details are given in Table 3.3.

Table 3.3 Irrigation sources and irrigated area in selected tahsil (Area:ha)

Sr. No.	Particulars	Kopargoan	Rahata	Srirampur	Rahuri	Sangamneer	Newase
1.	Bore wells/ wells irrigated area	20648	51834	26463	33107	10115	96632
2.	Net irrigated area	33140	57544	30900	45808	11770	129041
3.	Gross irrigated area	33140	57544	30900	45808	11770	127661
4.	Total area under cultivation	62193	57744	45886	68761	111965	129041
5.	Percentage of irrigated land to total area	53.29	100	67.34	66.32	10.51	98.93

(Anonymous, 2009)

3.1.6 Land Utilization Pattern

The land utilization pattern of selected tahsils of Ahmednagar district are presented in Table 3.4.

Table 3.4 The land utilization pattern of selected tahsils of Ahmednagar district (Area:ha)

Sr. No.	Particulars	Kopargoan	Rahata	Srirampur	Rahuri	Sangamner	Newase
1.	Total geographical area	70613	68786	50602	101685	135780	129204
2.	Area under forest	0	0	0	15706	1140	1459
3.	Land not available for cultivation						
	a) Land under non agriculture	1689	822	1024	507	110	780
	b) Barren and uncultivable land	2940	1581	2569	13041	20770	15058
4.	Land not under cultivation (other than permanent fallow)	4022	9845	0	1065	5900	0
5.	Current fallow	6499	4992	5625	2926	2600	3570
6.	Other fallow land	3966	883	4390	5790	2920	271
7.	Net area sown	51498	50665	36994	62650	102340	108066
8.	Gross cropped area	10695	6893	8892	6111	9625	9625

(Anonymous, 2009)

3.2 Sampling Procedure

3.2.1 Selection of villages and respondents

The farmers adopting drip irrigation systems for sugarcane were selected from six talukas of Ahmednagar district of Maharashtra for this study. These selected six tahsils for present investigation have most of the sugar factories and maximum area under sugarcane. The complete list of farmers from these sampled tahsils having drip irrigation system for sugarcane was obtained from Superindent Agriculture Officer, Ahmednagar and furthermore, 100 users of drip irrigation system for sugarcane were

taken from 100 villages of these six tahsils by random sampling. Thus, 100 users of drip irrigation system for sugarcane were selected, from these six tahsils making a total sample size of 100.

3.3 Designing of interview schedule

On the basis of objectives of the study and the variables, the interview schedule was developed for the collection of the data. The interview was taken in mother tongue i.e. in Marathi, for the convenience of the respondents and to have accurate response from them for collection of data. The schedule was prepared in such a manner that the dual meaning questions and contradictory statements were avoided. The language of questions was simple and easy for understanding of the respondents.

Questions related to socio-economic and hydraulic aspects of drip irrigation system having possible correlation with knowledge of owners of that system were designed. The questions leading to understand their constraints and obtaining suggestions were also included in the study.

3.4 Pretesting of interview schedule

Pretesting of interview schedule was carried out to test its accuracy and suitability. It is also important to find out whether the schedule designed for data collection gave required information for the study. The farmers who were used as respondents for pretest of an interview schedule were different from those of the respondents under study. However, the socio-economic and situational factors of these farmers were similar to the selected farmers who were respondents of the study. After pretesting of the schedule, necessary improvements were made in the draft schedule

and then sufficient numbers of copies were prepared of the refined schedule. The questionary prepared for the study is given in Appendix B.

3.5 Collection of data

With the help of interview schedule designed for the purpose of this study, the data were collected by contacting farmers adopting drip irrigation system for sugarcane. The help of village leaders, Agricultural Assistants and Gramsevak were taken only for contacting the respondents. The respondents were contacted during the time which was convenient to them and in a friendly and informal manner. Observations regarding drip hydraulic were recorded (Plate 1 and 2) and layout and design of drip in existing condition was prepared on plot. This facilitated free and natural response from them to the various questions included in the schedule. The replies of the respondents were recorded while the interview was in progress.

3.6 Compilation of data

The collected information was compiled according to the objectives, nature, concepts and variables of the study for drip irrigation systems for sugarcane. The information collected through interviews and readings were transferred from the schedule to the primary and then to the secondary tables. Whenever necessary by using the appropriate scoring methods, the collected qualitative data were converted into quantitative forms. Quantified form of data was used to find out the nature of relationship between independent and dependent variables. The classification and tabulation of data for grouping or categorizing process were

prepared. The relevant relationship was obtained by feeding the data to the computer which facilitated accurate and easy analysis. This process helped to establish the significance of the results and put out the constraints and suggestion in the use of drip irrigation for sugarcane.

3.7 Variables and their measurements

The personal aspects for drip irrigation, socio-economic aspects for drip irrigation, and hydraulics of drip irrigation of the respondents were studied. In the present study, following characteristics of the respondents were studied as independent variables.

3.7.1 Socio-economic characteristics of drip irrigation:

3.7.1.1 Personal aspects for drip irrigation:

1. Education

Formal schooling of the farmers was considered to know education level of the respondent. It was classified into five categories as under.

Table 3.5 Classification based on education

Sr. No.	Category	Particulars
1	Illiterate	Having no formal education
2	Primary school	Education up to 4th standard
3	Secondary school	Between 5th and 10th standard
4	Higher secondary	Higher secondary and diploma
5	Degree	Graduation and above

3.7.1.2 Socio-Economic aspects for drip irrigation

1. Taluka wise classification of farmer

For the present investigation six talukas were selected of north Ahmednagar district. The farmers from six talukas selected

such that the compact area of villages of each taluka having highest drip irrigation systems under sugarcane were considered for study. For these study 100 villages were selected by random sampling. In all villages, 100 user of drip irrigation system for sugarcane were selected from these six talukas making a total sample size of 100.

Table 3.6 Taluka wise classification of farmer

Sr. No.	Name of taluka	Number of Farmer
1	Kopargoan	19
2	Rahata	19
3	Srirampur	15
4	Newasa	16
5	Rahuri	15
6	Sangamner	16
	Total	100

2. Farmers classification as per landholding

For the present study, the farmers were categorised according their size of land holding as marginal farmer, small farmer, medium farmer, large farmer. The criteria used for the classification is given below.

Table 3.7 Farmers classification as per landholding

Sr. No.	Category	Particulars
1	Marginal farmer	No. of farmers having land holding less than 1 ha
2	Small farmer	No. of farmers having land holding between 1 ha to 2 ha
3	Medium farmer	No. of farmers having land holding between 2 ha to 10 ha
4	Large farmer	No. of farmers having land holding above 10 ha

3.7.2 Hydraulics of drip irrigation

3.7.2.1 Drip hydraulics

1. Emission uniformity (%)

The head loss due to pipe friction in laterals and changes in ground surface causes variation in emitter discharge. For that purpose determination of EU is most important. The EU (%) is the measure of the uniformity of emitters discharge from all the emitters of drip irrigation system. The field emission uniformity is defined as the ratio of the average lowest one-forth of the emitter discharges readings and the average of all emitters discharge of drip irrigation system. The EU% is calculated by following formula (Keller and Karmeli, 1974).

$$EU\ (\%) = \frac{Qmin\ (lph)}{Qavg\ (lph)} \times 100 \qquad \text{.....(1)}$$

In which,

Qmin = Average of lowest one fourth emitters discharge rate in the system, lph

Qavg = Average emitters discharge rate in the system, lph

The farmers selected for this survey were categorised on the basis of Emission Uniformity using following criteria.

EU> 90%....Excellent

EU< 90%....Undesirable

2. Average discharge variation (%)

Average discharge of emitter (Qavg) is the rate of flow for sub unit or system divided by the number of emitter in operation in sub unit or system. Average discharge variation is taken as

difference between designed discharge and average discharge. Average discharge variation indicate the portion of farm getting required amount of water. The categorisation based on average discharge variation was done as per the following criteria.

Table 3.8 Categorisation based on average discharge variation

Sr. No.	Range of average variation	Particulars
1	More than 5	No. of farmers having average discharge variation of drip irrigation more than 5 %
2	More than 10	No. of farmers having average discharge variation of drip irrigation more than 10 %
3	More than 15	No. of farmers having average discharge variation of drip irrigation more than 15 %
4	More than 20	No. of farmers having average discharge variation of drip irrigation more than 20 %
5	More than 25	No. of farmers having average discharge variation of drip irrigation more than 25 %
6	30 and above	No. of farmers having average discharge variation of drip irrigation above 30%

3. Lateral head loss reduction (%)

The frictional head loss occurs in emitters, laterals, submains and main of system. A particular length of path is permissible for required loss of head for a known discharge. The permissible head loss /variation due to friction is permissible as 10% in lateral and 20% in submain and main. The Hazen-William equation used for determining the head loss due to friction is given below :

$$J = 1.526 \times 10^{4} \times (Q/C)^{1.852} \times D^{-4.87} \times (L + Le) \times F \quad .....(2)$$

In which,

J = Head loss due to friction, m
Q = Flow rate, m^3/hr

C = Constant, depends upon pipes materials
D = Inside pipe diameter, cm
L = Length of pipe, m
Le = Increase in length of pipe due to emitter connection, m
F = Reduction coefficient, dimensionless

For classification of the farmers based on head loss in lateral, the following criteria was adopted

Table 3.9 Classification of the farmers based on head loss in lateral

Sr. No.	Range of lateral head loss (%)	Particulars
1	Less than 5	No. of farmers having range of lateral head loss of drip irrigation less than 5 %
2	More than 5	No. of farmers having range of lateral head loss of drip irrigation more than 5 %
3	More than 10	No. of farmers having range of lateral head loss of drip irrigation more than 10 %
4	More than 15	No. of farmers having range of lateral head loss of drip irrigation more than 15 %
5	More than 20	No. of farmers having range of lateral head loss of drip irrigation more than 20 %

4. Manifold head loss reduction (%)

The Hazen-William equation used for determining the head loss due to friction is given before in equation No. 2.

The criteria used for classifying farmers on the basis of manifold head loss is tabulated below

Table 3.10 Classification of the farmers based on head loss in manifold

Sr. No.	Range of manifold headloss (%)	Particulars
1	Less than 5	No. of farmers having range of manifold head loss of drip irrigation less than 5 %
2	More than 5	No. of farmers having range of manifold head loss of drip irrigation more than 5 %
3	More than 10	No. of farmers having range of manifold head loss of drip irrigation more than 10 %
4	More than 15	No. of farmers having range of manifold head loss of drip irrigation more than 15 %
5	More than 20	No. of farmers having range of manifold head loss of drip irrigation more than 20 %

3.7.2.2 Cost economics for drip irrigation

i. Fixed cost

Fixed cost remains same irrespective of level of production. These cost remain invariant in the short run but in the long run there is no fixed cost as all the inputs can be varied. Fixed cost includes cost item likes taxes, insurances, cess, depreciation on machineries, implements, tools, buildings, salaries of personal working in the farm, etc. These are also known as indirect, sunk cost and overhead cost. The summation of all these costs are called as total fixed cost (TFC). The annual fixed cost of drip unit can be determine by summation of depreciation cost of drip irrigation system which includes cost of different drip units such as filter, main, submain, manifold, lateral, GTO, end cap, emitter, PVC fitting, valves, pressure gauge, interest on capital investment on drip irrigation and expenditure on repairs and maintenance.

ii. Cost of cultivation

Drip method of irrigation also helps to reduce the cost of cultivation and improve productivity of crops as compared to the same crops cultivated under flood method of irrigation. It is the cost from ploughing to harvesting. It is calculated by summation of cost of all farm inputs and farm operations such as tillage operation as ploughing, furrowing, bunding, and cost of sets for sugarcane planting, fertilizer cost, FYM cost, pesticide cost and charges of weeding, irrigation, harvesting, transport and other charges.

iii. Seasonal cost

The cost which is obtained by summation of fixed cost and cost of cultivation is called seasonal cost.

Seasonal cost = Fixed cost + Cost of cultivation .....(3)

4. Water used (cm)

Water applied per ha is determined by following formula

Volume of water applied (lit.) = Total operating hours per year x Number of drippers x Av. discharge of dripper (lph)

.....(4)

$$\text{Volume in } (m^3) = \frac{\text{Volume of Litre}}{1000} \quad \text{.....(5)}$$

5. Yield (t/ha)

Yield is total production of sugarcane in t/ha.

6. Selling price

Selling price is calculated as price of sugar cane per quintal provided by respective sugar factory.

7. Income (Rs.)

Total returns in terms of money from any enterprise is called income. It is calculated by using following formula

Income (Rs.) = Yield (t/ha) x Selling price (Rs/t) .....(6)

8. Net seasonal income (Rs.)

Net seasonal income is income which is obtained by subtracting seasonal cost from income from produce cost. It is calculated by using following formulae

Net seasonal income (Rs.) = Seasonal income from produce (Rs./ha) - Seasonal cost (Rs./ha) ...(7)

9. Additional area cultivated due to saving of water (ha)

Drip irrigation resulted into saving of certain amount of water which can be used to bring additional area under irrigation. Additional area irrigated due to saving of water is calculated by following formula.

$$\text{Additional area cultivated due to saving of water (ha)} = \frac{\text{Water used under FM, ha-cm} - \text{Water used under DM, ha-cm}}{\text{Water used in DM, ha-cm}} \quad \ldots(8)$$

Where,

FMI = Flood method of irrigation

DMI = Drip method of irrigation

10. Additional expenditure due to additional area

Additional expenditure due to additional area (ha) is calculated by following formula

Additional expenditure due to additional area (Rs.) = Additional area cultivated due to water saving (ha) x Seasonal cost (Rs./ha) ...(9)

11. Additional income due to additional area (Rs.)

Additional income due to additional area (Rs.) is calculated by following formula.

Additional income due to additional area (Rs.) = Additional area cultivated due to water saving (ha) x Income from produce (Rs./ha) .....(10)

12. Additional net income (Rs.)

Additional net income (Rs) is calculated by following formula.

Additional net seasonal income (Rs.) = Additional area cultivated due to water saving (ha) x Net seasonal income from produce (Rs./ha) .....(11)

13. Gross cost of production (Rs.)

Gross cost of production (Rs.) is calculated by following formulae.

Gross seasonal cost of production (Rs.) = Seasonal cost + Additional expenditure due to additional area .....(12)

14. Total net seasonal income (Rs.)

Total net income (Rs.) is summation of net seasonal income and additional income due to additional area. It is calculated by following formula

Total net Income (Rs.) = Net seasonal income (Rs.) + Additional expenditure due to additional area (Rs.) .....(13)

15. Benefit:cost ratio

It is the ratio of gross seasonal income to gross seasonal cost. It is calculated by using following formula.

$$\text{Benefit:cost ratio} = \frac{\text{Gross seasonal income}}{\text{Gross seasonal cost}} \quad \text{.....(14)}$$

16. Net extra income

It is the extra income due to adoption of improved practice over conventional practice. Net extra income is calculated by following formula,

Net extra income = Net seasonal income (Rs.) in DM - Net seasonal income (Rs) in farmer practice ....(15)

17. Net profit (Rs.) per cm water used

Net profit (Rs.) per cm water used or the water productivity is net income (Rs.) obtained per cm of water used. Water productivity is calculated by following formula.

$$\text{Water productivity (Rs/ha-cm)} = \frac{\text{Net seasonal income (Rs.)}}{\text{Water used (cm)}} \quad \text{.....(16)}$$

18. Water use efficiency (q/ha.cm)

Water use efficiency is defined as the ratio of yield of marketable produce of the crop to total water used during the crop growth period.

$$\text{WUE (q/ha.cm)} = \frac{\text{Yield (q/ha)}}{\text{Water used (cm)}} \quad \text{.....(17)}$$

3.7.2.3 Constraints in adoption and use of drip irrigation system for sugarcane

Constraints in adoption of drip irrigation system is worked out as per the questions asked to the farmers during the visit, for this a questionnaires were prepared.

The constraints which to be worked out were categorised as economic, extension, technical and other constraints. In order to find out economic constraints points considered were high initial cost of drip sets, difficulty in preparation of loan proposal high cost of spare parts and timely availability of loan.

In order to workout technical constraint points considered were lack of technical knowledge, faulty design, clogging of emitter and lateral damage, while extension constraints were worked out by considering points such as inadequate training to farmer improper demonstration on field, irregular guidance and

supervision, other constraint were irregular electric supply, inadequate irrigation supply and problem of rodent.

3.7.2.4 Suggestions of respondents to overcome these constraints

Suggestions were also obtained from the respondents to overcome the above constraints. Some economic suggestion were worked out to minimized high initial investment, easy way for preparation of loan proposal, availability of loan on time and reduction in the cost of spare parts.

To worked out technical suggestion points considered were provision for proper technical knowledge, to provide proper design, proper solution against clogging of emitters, quality material to avoid lateral breakage. Extension suggestion were worked as proper training to farmer, organized demonstration on field, to provide regular guidance and supervision other suggestion were to provide regular irrigation supply, solution against rodent, proper irrigation supply.

4. RESULTS AND DISCUSSION

This chapter deals with the collection, analysis and interpretation of data. The data collected from 100 user of Drip irrigation for sugarcane from 6 tahsils of Ahmednagar district of Maharashtra were compiled through primary and secondary tables as per objective of study. Simple percentage and frequencies were worked out for descriptive analysis. Careful consideration must be given to drip design to ensure that the consumptive use rate of the plant must be met by the system. The information on pressure discharge variation, head loss in lateral, manifold, submain and main, drip emission uniformity along lateral, cost economics for drip and constraints in operating drip system is necessary for the efficient design of the drip.

The data is presented in tabular form with graphs under the following heads, subheads and are discussed as under.

4.1 Socio-economic characteristics of farmers adopting drip irrigation for sugarcane

Flow irrigation and drip irrigation are the major irrigation methods used by the farmers for sugarcane in north Ahmednagar district. Keeping this in view, it was necessary to study the socio-economics characteristics and socio-economics condition of the farmers who were using drip irrigation system in sugarcane.

4.1.1 Personal aspects of farmers adopting drip irrigation for sugarcane

4.1.1.1 Education

The information regarding the formal education received by the sugarcane drip irrigation user was collected and analyzed. The results are presented in Table 4.1.

Table 4.1 Distribution of sugarcane drip irrigation user as per their level of education

Sr. No.	Category	No. of users of drip for sugarcane (N=100)
1	Illiterate	01
2	Primary education	16
3	Secondary education	36
4	Higher secondary	12
5	Degree/diploma	35
	Total	**100**

The data from Table 4.1 showed that average education of the farmers using DMI was above secondary education. Out of 100 users, 35 drip irrigation system users for sugarcane had degree or diploma education, while 48 users had secondary and higher secondary education. This indicated that majority of the drip users had moderate to higher education.

This suggested that farmers using DMI had remarkably higher education. These finding is in line with the findings of Ahire *et al.* (1999), Kale (2000) and Patil (2007).

4.1.2 Socio-Economic aspects of farmers adopting drip irrigation for sugarcane

This study was worked out in the major sugarcane growing tahsils of Ahmednagar district in order to study the socio economics aspects of drip irrigation for respective area.

4.1.2.1 Taluka wise classification of farmers

For present study it was necessary to study farmers selected randomly but covering whole area of North Ahmednagar district for effective results.

Table 4.2 Taluka wise classification of drip users

Sr. No.	Name of Taluka	Number of Farmers
1.	Kopargoan	19
2.	Rahata	19
3.	Srirampur	15
4.	Newasa	16
5.	Rahuri	15
6.	Sangamner	16
	Total	**100**

The data from Table 4.2 indicates that total 100 number of drip irrigation system users for sugarcane were selected from 100 villages of six tahsils of Ahmednagar districts. The sample of 19, 19, 15, 16, 15 and 16 farmers were randomly selected from Kopargoan, Rahata, Srirampur, Newasa, Rahuri and Sangamner respectively, which is major sugarcane producing area of Ahmednagar district.

4.1.2.2 Land holding wise classification of farmers

For present study, it was necessary to study farmer as per their land holding for effective result of this study. Farmers are classified as per their land holding are shown in Table 4.3

Table 4.3 Classification of farmers as per land holding

Sr. No.	Category of farmers	Number of farmers
1.	Marginal (less than 1 ha)	4
2.	Small (1-2 ha)	32
3.	Medium (2-10 ha)	63
4.	Large (above10 ha)	1
	Total	**100**

It is observed from Table 4.3 that 63 drip irrigation system users for sugarcane had 2-10 ha area under sugarcane while 32 drip irrigation system users had 1-2 ha area under sugarcane. Thus 95 were small to medium farmers.

This clearly indicated that majority of drip irrigation system users for sugarcane were small to medium land holding category. These finding is in line with the findings of Patil (2007).

4.2 Hydraulics of drip irrigation:

Careful consideration must be given to drip design to ensure that the consumptive use rate of the plant must be met by the system. A drip irrigation system deliver water to the crop through network of main, submain and lateral with emitters inserted along the length of lateral. Precise design of lateral is, therefore, very important as the system operates at comparatively low head. The emission uniformity of at least 90 percent is advisable in drip irrigation system. Therefore, lateral should be designed in such a way that there is only 10 per cent variation in discharge of first and last emitters inserted on lateral. Where,

manifold and main should be designed in such a way that there is only 20 per cent variation in discharge.

The information on pressure discharge variation, head loss in lateral, manifold, sub main and main, drip emission uniformity along lateral is necessary for the efficient design and performance of the drip. The result of the test along with their analyses are reported and discussed below.

4.2.1 Emission Uniformity (%)

In drip irrigation, the out flow from each emitter is controlled by the pressure distribution along the lateral line. The pressure distribution along a drip irrigation line, sub main or lateral is controlled by the energy drop on account of friction and the energy gained or lost due to land slopes either downward or upward, respectively.

The variation of discharge from emitters along a lateral line is function of the total length and inlet pressure, emitter spacing and the total flow rate. This creates the design problem to select the right combination of length and pressure in order to achieve an acceptable non-uniform pattern of irrigation. Field emission uniformity estimation of drip irrigation system is important from several perspective. From engineering perceptive is important to see whether a design is satisfactory. From perceptive of irrigator's, it is important for irrigation scheduling, fertilizer injection and general field performance. Distribution of drip irrigation system user for sugarcane as per emission uniformity (%) is shown in Table 4.4.

Table 4.4 Distribution of drip irrigation system user for sugarcane as per emission uniformity (%)

Sr. No.	EU% Range	Number of farmer
1.	95-100	0
2.	90-95	56
3.	85-90	31
4.	80-85	3
5.	Less than 80	10
	Total	**100**

It is clearly observed from the Table 4.4 that out of 100 about 56 per cent of drip irrigation system users for sugarcane had EU above 90 per cent which can be categorized as excellent, while 44 per cent of drip irrigation system users for sugarcane had EU below 90 per cent, which is undesirable.

4.2.2 Average discharge variation (%)

The average discharge variation of all 100 farmers was measured as per the procedure discussed in chapter 3.

Table 4.5 Distribution of farmers as per average discharge variation

Sr. No.	Range of average discharge variation (%)	Number of farmers
1.	More than 5	17
2.	More than 10	11
3.	More than 15	26
4.	More than 20	36
5.	More than 25	9
6.	30 and above	1
	Total	**100**

It is observed from the Table 4.5 that out of 100 users about 46 drip irrigation system users had average discharge variation more than 20 per cent, while 54 per cent of drip irrigation system users had average discharge variation less than 20 per cent. As per the norms prescribe by Keller and Blisner (1998) discharge variation should be less than 10 per cent for sensitive crops and can be up to 20 per cent for sturdy crops like sugarcane.

This clearly suggested that large proportion of drip irrigation system users for sugarcane had average discharge variation per cent above 20 per cent which is not desirable. Discharge variation mainly depends on system parameters such as lateral length, number of emitters per lateral, manifold size and its length etc. It is also caused by negligence toward proper designing by dealer.

4.2.3 Lateral head loss (%)

The lateral head loss of all 100 farmers was measured as per the procedure discussed in Chapter 3. Hazen-William's formula was used for estimating head loss for drip lateral. Results of lateral head loss (%) is shown in Table 4.6.

Table 4.6 Distribution of drip users for sugarcane as per lateral head loss

Sr. No.	Range of lateral head loss (%)	Number of Farmer
1.	Less than 5	88
2.	Less than 10	07
3.	Less than 15	05
4.	Less than 20	00
5.	More than 20	00
	Total	**100**

It is observed from the Table 4.6 that out of 100, about 88 per cent and 95 per cent of drip irrigation system users for sugarcane had lateral head loss less than 5 and 10 per cent, respectively while 5 per cent of drip irrigation system users for sugarcane had lateral head loss above 10 per cent.

This clearly observed that large proportion of drip irrigation system users for sugarcane had lateral head loss below 10 per cent, which is within advisable range.

4.2.4 Manifold head loss (%)

The manifold head loss of all 100 farmers was measured as per the procedure discussed in chapter 3. Hazen-William's formula was used for estimating head loss for manifold. Results of manifold head loss (%) is shown in Table 4.7.

Table 4.7 Distribution of users of drip irrigation system for sugarcane as per manifold head loss (%)

Sr. No.	Range of manifold headloss (%)	Number of farmer
1	Less than 5	10
2	Less than 10	64
3	Less than 15	25
4	Less than 20	1
5	More than 20	00
	Total	**100**

It is observed from the Table 4.7 that out of 100, about 74 per cent of drip irrigation system users for sugarcane had manifold head loss below 10 per cent while 26 per cent of drip irrigation system users for sugarcane had manifold head loss above 10 per cent. There was no farmer having manifold head loss more than 20 per cent.

This clearly indicated that all drip irrigation system users for sugarcane had manifold head loss less than 20 per cent which is advisable as per prescribe norms (Keller and Blissner, 1990).

4.2.5 Hydraulics of drip irrigation as per land holding and education

4.2.5.1 Average EU per cent variation as per land holding

Field emission uniformity estimation of drip irrigation system is important from several perspective. The emission uniformity of at least 90 per cent is advisable in drip irrigation system.

Table 4.8 Distribution of drip irrigation users by average EU and land holding

Sr. No.	Category of farmer	Number of farmers in particular EU range (%)					Total
		95-100	Less than 95	Less than 90	Less than 85	Less than 80	
1.	Marginal	-	2	2	-	-	4
2.	Small	-	20	10	2	-	32
3.	Medium	-	33	19	1	10	63
4.	Large	-	1	-	-	-	1
	Total	**-**	**56**	**31**	**3**	**10**	**100**

Out of total medium farmers, 52 per cent users had EU above 90 per cent while 48 per cent of medium farmers had EU less than 90 percent which is not advisable. In case of small farmers, 63 per cent users had EU above 90 per cent.

This indicated that more than 50 per cent users having area between 2-10 ha had EU above 90 percent which is advisable. As suggested by Karmali and Keller (1975).

4.2.5.2 Average EU as per education

Distribution of users of drip irrigation system for sugarcane by average EU and education is shown in Table 4.9.

Table 4.9 Distribution of users by average EU and education

Sr. No.	Category of farmer	Number of farmers in particular EU range (%)					Total
		95-100	90-95	85-90	80-85	Less than 80 %	
1	Illiterate	-	1	-	-	-	1
2	Primary school	-	7 (44)	8	1	-	16
3	Secondary school	-	20 (56)	13	1	2	36
4	Higher secondary	-	4 (39)	6	-	2	12
5	Degree	-	24 (69)	4	1	6	35
	Total		**56**	**31**	**3**	**10**	**100**

(Figures in parenthesis indicates per cent)

Out of 100 drip irrigation system users 83 per cent of users had education more than higher secondary. The EU values of more than 90 per cent were observed in 44 per cent of the farmers having primary education, in 56 per cent farmers having secondary education and in 69 per cent farmers having education upto degree. Thus, a positive correlation was observed between education and EU to some extent; which was expected as emission uniformity is very much related to proper design, maintenance and operation of system which requires more technical awareness. Similar sort of

negative correlation was observed between level of education and number of farmers having less than 90 per cent emission uniformity.

4.2.5.3 Average discharge variation (%) as per land holding

Average discharge variation less than 20 per cent is desirable for effective performance of system. Discharge variation mainly depends on system parameters such as lateral length, number of emitters per lateral, manifold size and its length etc. It is also caused by negligence toward proper designing by dealer and maintenance by user. Distribution of users of drip irrigation system for sugarcane by average discharge variation (%) as per land holding is given in Table 4.10.

Table 4.10 Distribution of users of drip irrigation system for sugarcane by average discharge variation (%) as per land holding

Sr. No.	Category of farmer	Number of farmers in particular average discharge range						Total
		Average discharge variation (%)						
		Less than 10	Less than 15	Less than 20	Less than 25	Less than 30	30 and above	
1	Marginal	1	-	1	2	-	-	4
2	Small	-	6	11	10	5	-	32
3	Medium	16	5	13	24	4	1	63
4	Large	-	-	1	-	-	-	1
	Total	**17**	**11**	**26**	**36**	**9**	**1**	**100**

It is observed from the Table 4.10 that out of total medium farmers 54 per cent users had average discharge variation less than 20 per cent, while 46 per cent users had average discharge variation more than 20 per cent by case of small farmers also similar trend was observed. As per the norms prescribe by

Keller and Blisner (1990) discharge variation should be less than 10 per cent for sensitive crops and can be up to 20 per cent for sturdy crops like sugarcane.

4.2.5.4 Average Discharge variation (%) as per education

Average discharge variation as per education was worked out for effective analysis of data. Distribution of drip irrigation system users for sugarcane by average discharge variation as per education is given in Table 4.11.

Table 4.11 Distribution of user drip irrigation system for sugarcane by average discharge variation (%) as per education

Sr. No.	Category of farmer	Number of farmers in particular average discharge range						Total
		Average discharge variation (%)						
		Less than 10	Less than 15	Less than 20	Less than 25	Less than 30	More than 30	
1	Illiterate	1						1
2	Primary school	5	2	3	6	-	-	16
3	Secondary school	4	4	13	7	8	1	36
4	Higher secondary	3	3	2	4			12
5	Degree	4	3	8	19	1		35
	Total	**17**	**11**	**26**	**36**	**9**	**1**	**100**

It is observed from the Table 4.11 that out of total per cent of educated above twelve standard about 52 per cent users had average discharge variation less than 20 per cent, while 48 per cent users had average discharge variation more than 20 per cent which is not permissible.

It was found that as education level increased the per cent of users having average discharge variation less than 20 per cent is not increased.

4.2.5.5 Lateral head loss (%) as per land holding

The lateral head loss of all 100 farmers was categorized as per the land holding. Hazen-William's formula was used for estimating head loss for drip lateral. Results of lateral head loss (%) is shown in Table 4.12.

Table 4.12 Distribution of user drip irrigation system for sugarcane by lateral head loss (%) as per land holding

Sr. No.	Category of farmer	Number of farmers in particular lateral head loss range					Total
		Lateral head loss (%)					
		Less than 5	Less than 10	Less than 15	Less than 20	More than 20	
1	Marginal	4	-	-	-	-	4
2	Small	29	1	2	-	-	32
3	Medium	55	6	2	-	-	63
4	Large	-	-	1	-	-	1
	Total	**88**	**7**	**5**	**-**	**-**	**100**

It is observed from the Table 4.12 that out of 100, about 95 per cent of drip irrigation system users for sugarcane had lateral head loss less than 10 per cent in which 96 per cent medium and 91 per cent small farmers had lateral head loss less than 10 per cent, while 5 per cent of drip irrigation system users for sugarcane had lateral head loss above 10 per cent.

It is observed that large number of drip irrigation system users had lateral head loss reduction less than 10 per cent.

4.2.5.6 Lateral head loss (%) as per education

The lateral head loss of all 100 farmers was distributed as per the education. Hazen-William's formula was used for estimating head loss for drip lateral. Results of lateral head loss (%) is shown in Table 4.13.

Table 4.13 Distribution of users of drip irrigation system for sugarcane by lateral head loss (%) as per education

Sr. No.	Category of farmer	Number of farmers in particular lateral head loss range					Total
		Lateral head loss (%)					
		Less than 5	Less than 10	Less than 15	Less than 20	More than 20	
1	Illiterate	1	-	-	-	-	1
2	Primary school	13	2	1	-	-	16
3	Secondary school	33	1	2	-	-	36
4	Higher secondary	7	3	2	-	-	12
5	Degree	34	1	-	-	-	35
	Total	**88**	**7**	**5**	**-**	**-**	**100**

It is observed from the Table 4.13 that out of 100, about 95 per cent of drip irrigation system users for sugarcane had lateral head loss less than 10 per cent in which all the degree holders had lateral head loss less than 10 per cent; while 5 per cent of drip irrigation system users for sugarcane had lateral head loss above 10 per cent.

It is observed that large number of drip irrigation system users had lateral head loss reduction less than 10 per cent. In which, most of literate had lateral head loss less than 10 per cent.

4.2.5.7 Manifold head loss (%) as per land holding

The manifold head loss of all 100 farmers measured as per the land holding is discussed in chapter 3. Hazen-William's formula was used for estimating head loss for manifold. Results of manifold head loss (%) is shown in Table 4.14.

Table 4.14 Distribution of users of drip irrigation system for sugarcane by manifold head loss (%) as per land holding

Sr. No.	Category of farmer	Number of farmers in particular manifold head loss					Total
		Manifold head loss (%)					
		Less than 5	Less than 10	Less than 15	Less than 20	Less than 25	
1	Marginal		2	2	-	-	4
2	Small	6	20	6	-	-	32
3	Medium	4	42	17	-	-	63
4	Large	-	-	-	1	-	1
	Total	**10**	**64**	**25**	**1**	**-**	**100**

It is observed from the Table 4.14 that out of total medium farmers, 73 per cent of drip irrigation system users for sugarcane had manifold head loss below 10 per cent while 27 per cent of medium farmers had manifold head loss above 10 per cent, whereas 41 per cent of small farmers had manifold head loss less than 10 per cent. There was no farmer having manifold head loss more than 20 per cent.

This clearly indicates that all drip irrigation system users for sugarcane had manifold head loss less than 20 per cent which is advisable as per prescribe norms (Keller and Blissner, 1990).

4.2.5.8 Manifold head loss (%) as per education

The manifold head loss of all 100 farmers was classified as per the education level. Distribution of users of drip irrigation system for sugarcane by manifold head loss (%) as per education is shown Table 4.15.

Table 4.15 Distribution of users of drip irrigation system for sugarcane by manifold head loss (%) as per education

Sr. No.	Category of farmer	Number of farmers in particular manifold head loss					Total
		Manifold head loss (%)					
		Less than 5	Less than 10	Less than 15	Less than 20	Less than 25	
1	Illiterate	-	1	-	-	-	**1**
2	Primary school	4	8 (75)	4	-	-	**16**
3	Secondary school	4	20 (66)	11	1	-	**36**
4	Higher secondary	2	8 (83)	2	-	-	**12**
5	Degree		27 (77)	8	-	-	**35**
	Total	10	64	25	1	-	100

(Figures in parenthesis indicates per cent farmers having less than 10 per cent manifold head loss)

It is clearly observed that all the farmers in all levels of education had manifold head loss below 20 per cent which is advisable.

4.3 Benefits of drip irrigation

Drip irrigation system is considered as most suitable water saving technique, eliminating water channels, bring more area under irrigation and reducing the use of

purchased inputs. Drip irrigation involves application of water only at the roots of the plant where it is required and thereby saving more water and brings more area under irrigation. The crop yields by this method of irrigation are higher with reduction in cost of fertilizers, pesticides and power for irrigation. The drip irrigation system requires heavy initial investment and mostly used in wide spaced crops. As a result, the cultivators are becoming more conscious about cost of installation of this system and economic analysis especially for sugarcane crop for their profitable production. Following is the results of cost economics for drip irrigation.

4.3.1 Fixed cost

Fixed cost reflects the amount of capital investment in well, pumping unit and drip set (drip set consists of screen filter, control & flush valve as fixed items while complete ventury and bypass assemblies and sand filter varies from crop to crop). Prices of variable inputs such as labour, electricity and expenses required for pumping and distributing water reflects operating cost. Maintenance costs consist of expenses incurred on repair and lubricant etc.

4.3.1.1 Fixed cost as per land holding

Distribution of users of drip irrigation system for sugarcane by fixed cost as per land holding is given in Table 4.16.

Table 4.16 Fixed cost of drip irrigation system in sugarcane as per land holding

Sr. No.	Category of farmer	Fixed cost (Rs./ha)
1	Marginal	31308.5
2	Small	28872.75
3	Medium	28060.83
4	Large	27531.00

In above given Table 4.16, it was found that maximum amount of fixed cost (Rs./ha) i.e. Rs. 31308 was resulted in the marginal farmer and lowest fixed cost i.e. Rs. 27531 was resulted among large farmer.

It clearly indicated that farmers having less land had high fixed cost as compared to medium to large farmers.

4.3.1.2 Fixed cost as per education

Fixed cost as per education was worked out for effective analysis of this study. Results of drip irrigation system for sugarcane for fixed cost as per education is demonstrated in Table 4.17

Table 4.17 Fixed cost of drip irrigation system in sugarcane as per education

Sr. No.	Category of farmers	Fixed cost (Rs./ha)
1	Illiterate	27205.00
2	Primary school	27766.63
3	Secondary school	28677.16
4	Higher secondary	29806.42
5	Degree	31171.42

In above table, it is found that maximum fixed cost (Rs./ha) was reported in users who had more education and it was lowest among illiterate users. The fixed cost was found to be

increased with education. With increasing education, farmer tend to by few advanced modern accessories, which has increased the system cost. This suggested that as a level of education increased the level of fixed cost had also increased. It is due to literate had used best quality of drip material which have high market price.

4.3.2 Cost of cultivation

It is clear from the tables given below that drip irrigation reduces the total cost of cultivation in sugarcane crop. Though the total cost saving in terms of percentage is not very high in aggregate, it varies across different operations. Among the different operations, cost saving is very high in cost of irrigation application, land preparation followed by sets and planting. Saving is also found in fertilizers. This is because some of the adopters have used water soluble fertilizers and thus, the cost incurred on fertilizers is relatively less. A few earlier studies have reported that drip method of irrigation also reduces the cost of fertilizers enormously as it can be supplied along with water. Since, water is supplied through pipe network under drip method of irrigation, it does not require any labour. But, in the case of surface method of irrigation, labour input is necessary to control water supply (changing course of water from one field to other) and to govern leakage and seepage. In addition to saving in cost of labour, cost incurred on account of electricity (for operating pump-set) is also less as drip requires less amount of water when compared to flood method of irrigation. Saving under cost of cultivation is noticed in ploughing and preparatory operation. As indicated by earlier studies, the cost saving is also very high in weeding operation. Cost saving in

weeding operation is high because in drip only specified portion of root zone is wetted, this restricting the weeds in non-cropped space. It is necessary to determine cost of cultivation for effective result of this study as per land holding and education.

4.3.2.1 Cost of cultivation as per land holding

Drip method of irrigation helps to reduce the cost of cultivation and improve productivity of crops as compared to the same crops cultivated under flood method of irrigation. Results of cost of cultivation as per land holding is given in Table 4.18.

Table 4.18 Cost of cultivation of users of drip irrigation system in sugarcane as per land holding

Sr. No.	Category of farmer	Cost of cultivation (Rs./ha)
1	Marginal	50262.50
2	Small	50732.81
3	Medium	50927.30
4	Large	48450.00

In above Table, it is demonstrated that highest cost of cultivation i.e. Rs. 50927 per ha was reported in the medium farmers.

There was not much variation in the cost of cultivation among the farmers categorized as per land holding as the cost of cultivation varies with situational factors like soil quality, condition of the terrain, farmers' approach, etc. These finding is in line with the findings of Narayanamoorthy (2006).

4.3.2.2 Cost of cultivation as per education

The cost of cultivation as per education of sugarcane growing farmers was determined. Results of cost of cultivation as per education is given in Table 4.19.

Table 4.19 Cost of cultivation of users of drip irrigation system in sugarcane as per education

Sr. No.	Category of farmers	Cost of cultivation (Rs./ha)
1	Illiterate	51000.00
2	Primary school	50591.25
3	Secondary school	50961.39
4	Higher secondary	50225.00
5	Degree	51032.00

The results of cost of cultivation demonstrated that there was not much variation in cost of cultivation (Rs./ha) as per users education level of cultivation and education of farmer.

4.3.3 Seasonal total cost

The seasonal total cost is worked out as per procedure described in chapter 3. Seasonal total cost had been found to be reduced in drip irrigation for sugarcane as compared to flood method of irrigation. The results of seasonal total cost are demonstrated as per land holding and education.

4.3.3.1 Seasonal total cost as per land holding

It is necessary to study the seasonal total cost as per land holding. The results of seasonal total cost are demonstrated as per land holding in Table 4.20.

Table 4.20 Seasonal total cost of users of drip irrigation system in sugarcane as per land holding

Sr. No.	Category of farmer	Seasonal total cost (Rs./ha)
1	Marginal	81571.00
2	Small	79605.56
3	Medium	78999.04
4	Large	78981.00

From finding of seasonal total cost it is clearly suggested that there was not much variation in seasonal total cost (Rs./ha)

amongst all farmers; however it was found to be inversely related to land holding and total cost per ha is decreased with increasing land holding.

Seasonal total cost is worked out by summing the fixed cost and cost of cultivation, this aspect is also varied with situational factors and resulted into slight variation with variation in seasonal total cost.

4.3.3.2 Seasonal total cost as per education

The co-relation between total cost per ha and education of the farmer is also studied. It is necessary to study the seasonal total cost as per education. The findings of seasonal total cost are demonstrated as per education in Table 4.21.

Table 4.21 Seasonal total cost of users of drip irrigation system in sugarcane as per education

Sr. No.	Category of farmers	Seasonal total cost (Rs./ha)
1	Illiterate	78205.00
2	Primary school	78357.88
3	Secondary school	79638.55
4	Higher secondary	79878.67
5	Degree	79203.43

From finding of seasonal total cost it is indicated that there is slight variation in seasonal total cost (Rs./ha) as per level of education of users. The seasonal cost was found to be influenced with education and increased as the education level of farmer was increased.

4.3.4 Water use (cm)

Water use refers to total quantity of water applied to the sugarcane crop through drip method of irrigation including effective part of rainfall. Water use pattern of the farmers varies with the source of

irrigation. Since water was supplied through a pipe network in drip method of irrigation mainly using groundwater, the water supply can be controlled easily. Therefore, significantly water use under drip method irrigation differed with the farmers who use flood method of irrigation. The quantity of water used by sugarcane under drip irrigation was less as compared to flood method of irrigation. The use of irrigation water under the conventional method was about 250 to 300 cm. Drip technology may result in reducing this usage usually to about 100 cm (as it partly saves water by eliminating field percolation losses of irrigation application). These statistics mean 50 to 66 per cent water savings on gross basis (Dhavan, 2000).

4.3.4.1 Water use (cm) as per land holding

Water use (cm) as per land holding was calculated by number of hours drip irrigation system was operated per season by the farmer. This aspect was studied through results shown in Table 4.22.

Table 4.22 Water used (cm) by users through drip irrigation system in sugarcane as per land holding

Sr. No.	Category of farmer	Water used (cm)
1	Marginal	158.50
2	Small	150.78
3	Medium	148.73
4	Large	157.00

The findings in Table 4.22 that water used by marginal farmer for sugarcane through drip was found to be maximum, similar case was found in large farmers as compared to small and medium farmer.

As per the observations recorded by Dhavan (2000) and indicated in many scientific studies that drip technology may result

in reducing usage usually to about 100 cm but, the results of present study showed that all farmers had used about 50 per cent more water than prescribed norms.

4.3.4.2 Water used as per education

Water used (cm) as per education was calculated by number of hours irrigation was effected by the farmer as per the procedure described in chapter 3. This aspect was studied through results shown in Table 4.23.

Table 4.23 Water used (cm) by users through drip irrigation system in sugarcane as per education

Sr. No.	Category of farmers	Water used (cm)
1	Illiterate	134.00
2	Primary school	153.68
3	Secondary school	149.50
4	Higher secondary	151.83
5	Degree	148.25

This indicated that water used (cm) by degree holders through drip in sugarcane was found to be less as compared to all literacy group (except the illiterate sample which had only one farmer). This showed that water used in sugarcane through drip irrigation system varied according to education level. Naturally, farmers with good education have more awareness about the improved technology and they can adopt it better than others.

4.3.5 Yield of produce (q/ha)

Using the data collected from field trials from different region of Ahmednagar district of Maharashtra it was found that there was increase in yield of sugarcane under drip irrigation as

compared to flood method of irrigation. Yield increase varied from 22 percent to 30 per cent under DMI over the method of flood irrigation. These finding are in line with Hapase (1993).

4.3.5.1 Yield of produce (t/ha) as per land holding

Yield of produce (t/ha) as per land holding was calculated through questions asked to the respondents during study. The aspect was studied through results shown in Table 4.24.

Table 4.24 Yield of produce (t/ha) of users for drip irrigation system in sugarcane as per land holding

Sr. No.	Category of farmer	Yield of produce (t/ha)
1	Marginal	148.75
2	Small	147.96
3	Medium	143.41
4	Large	135.00

From above Table 4.24 it is clearly indicated that, there was inverse relationship between sugarcane yield and land holding of farmers. The marginal farmer recorded maximum yield (148.75 t/ha) and the average yield of large farmers was lowest (135 t/ha). It may be due to the fact that marginal farmer can give more attention to his farm as size of farm is small where as, it was difficult for large farmer to look over his farm due to bigger holding size.

4.3.5.2 Yield of produce (q/ha) as per education

Yield of produce (q/ha) was calculated as per procedure described in chapter 3. This aspect was studied through results shown in Table 4.25.

Table 4.25 Yield of produce (q/ha) of users for drip irrigation system in sugarcane as per education

Sr. No.	Category of farmers	Yield of produce (q/ha)
1	Illiterate	130.00
2	Primary school	138.43
3	Secondary school	145.27
4	Higher secondary	147.91
5	Degree	147.14

From Table 4.25 it is clearly suggested that there was direct relationship between yield and education level of farmers. The yield was improved from illiterate (130 t/ha) to degree holders (147.14 t/ha). Drip irrigation is a precision technology needs several high-tech aspects like filtration, acid/chlorine treatment fertigation etc. to be considered while using it for sugarcane crop more effectively, efficiently and economically. The technical awareness about these aspects is usually improved with education of farmer and results into more productivity, enhanced life of drip set etc.

4.3.6 Income from produce (Rs.)

Income from produce is dependent on two factors i.e. yield of a cane per hectare and selling price offered by respective sugarcane factory.

4.3.6.1 Income from produce (Rs.) as per land holding

Income of produce was calculated as per procedure described in chapter 3. This aspect was studied through results shown in Table 4.26.

Table 4.26 Income from produce as per land holding

Sr. No.	Category of farmer	Income from produce (Rs.)
1	Marginal	340800
2	Small	335785
3	Medium	337495
4	Large	340900

From given Table 4.26, it was indicated that highest income from produce per ha (Rs.) was reported in the large farmer and lowest income from produce (Rs.) i.e. Rs.335785 was reported among small farmer.

4.3.6.2 Income from produce (Rs.) as per education

Income of produce as per education was calculated as per procedure described in chapter 3. This aspect was studied through results shown in Table 4.27.

Table 4.27 Income from produce (Rs.) as per education

Sr. No.	Category of farmers	Income from produce (Rs.)
1	Illiterate	340850.0
2	Primary school	338343.8
3	Secondary school	340900.0
4	Higher secondary	340900.0
5	Degree	331265.3

From given Table 4.27, it was observed that maximum amount of income from produce Rs.340900 was reported in users having secondary education and lowest income from produce Rs.331265.3 was reported in degree/diploma users. There is variation in the income from produce as per education level.

4.3.7 Net seasonal income

Net seasonal income was the difference between seasonal cost and income from produce. It was depended upon many factors related to sugarcane cultivation and rate offered by the factories.

4.3.7.1 Net seasonal income as per land holding

Net seasonal income as per land holding was calculated as per procedure described in chapter 3. This aspect was studied through results shown in Table 4.28.

Table 4.28 Net seasonal income as per land holding

Sr. No.	Category of farmer	Net seasonal income (Rs./ha)
1	Marginal	259329.0
2	Small	256181.9
3	Medium	258496.2
4	Large	261919.0

In given Table 4.28, it was found that highest net seasonal income of Rs. 261919 was obtained to large farmers and lowest average income of Rs. 256182 was obtained by small farmers. There existed a positive co-relation between net seasonal income and land holding except in marginal farmer (may be due to small sample).

4.3.7.2 Net seasonal income (Rs.) as per education

Net seasonal income as per education was calculated as per procedure describe in chapter 3. This aspect was studied through results shown in Table 4.29

Table 4.29 Net seasonal income as per education

Sr. No.	Category of farmers	Net seasonal income (Rs./ha)
1	Illiterate	262695.0
2	Primary school	259985.9
3	Secondary school	261261.5
4	College	261021.3
5	Degree/diploma	252062.3

From above Table 4.29, it indicated that the highest net seasonal income (Rs. 262695 per ha) was reported in drip irrigation system users who are illiterate and lowest net seasonal income (Rs. 252062 per ha) was reported in degree/diploma holders.

4.3.8 Additional area (ha)

It is also possible to increase the area under irrigation from the saving of water achieved due to the adoption of drip method of irrigation. In order to study this parameters, it was estimated how much of additional area can be brought under irrigation by saving water in sugarcane field of different farms. An additional area of about 0.80 to 1.20 ha can be brought under irrigation by adopting drip method of irrigation in sugarcane.

4.3.8.1 Additional area (ha) as per land holding

DMI also significantly helps to bring additional area under irrigation through saving of water, besides providing various other benefits to the farmers. Additional area as per land holding was calculated as per procedure describe in chapter 3. This aspect was studied through results shown in Table 4.30

Table 4.30 Additional are as per land holding

Sr. No.	Category of farmer	Additional area (ha)
1	Marginal	1.20
2	Small	1.29
3	Medium	1.34
4	Large	1.23

From above Table 4.30, it was indicated that additional area of 1.34 ha was reported highest in the medium farmer and lowest was reported among marginal farmer (1.20 ha). Additional area that can be brought under irrigation mainly depends on water saving due to drip method of irrigation and efficiently he was using the drip system. The average additional area of all farmers increased was 1.26 ha.

4.3.8.2 Additional area as per education

Additional area as per education was calculated as per procedure described in chapter 3. The results of additional area are given in Table 4.31.

Table 4.31 Additional are as per education

Sr. No.	Category of farmers	Additional area (ha)
1	Illiterate	1.65
2	Primary school	1.25
3	Secondary school	1.33
4	Higher secondary	1.24
5	Degree	1.36

From above Table 4.31, it was indicated that highest additional area of 1.65 ha was reported in the illiterate and lowest in education upto college (1.24 ha).

4.3.9 Gross cost (Rs.)

Gross cost was calculated by summation of the seasonal cost and additional expenditure by additional area. Gross cost as per land holding and education are given in following tables.

4.3.9.1 Gross cost (Rs.) as per land holding

Gross cost as per land holding was calculated as per procedure described in chapter 3. The results of gross cost are given in Table 4.32.

Table 4.32 Gross cost of users of drip irrigation system in sugarcane as per land holding

Sr. No.	Category of farmer	Gross cost (Rs.)
1	Marginal	182072
2	Small	183172
3	Medium	184962
4	Large	173557

In above table, results of gross cost (Rs.) indicated that highest gross cost was reported in the medium farmer (Rs. 184962) and lowest gross cost was reported among large farmer (Rs. 173557).

4.3.9.2 Gross cost as per education

Gross cost as per education was calculated as per procedure described in chapter 3. The results of gross cost are given in Table 4.33.

Table 4.33 Gross cost (Rs.) of users of drip irrigation system in sugarcane as per education

Sr. No.	Category of farmers	Gross cost (Rs.)
1	Illiterate	207184
2	Primary school	176658
3	Secondary school	185830
4	Higher secondary	179148
5	Degree	186931

From Table 4.33, it was clearly indicated that highest gross cost was reported in users who are illiterate (Rs. 207184) and lowest gross cost was reported in users who had primary education (Rs. 176658).

4.3.10 Total net income (Rs.)

Total net income (Rs.) was summation of net seasonal income and additional income from additional area. Total net income as per land holding and education are demonstrated in following tables.

4.3.10.1 Total net income (Rs.) as per land holding

Total net income as per land holding was calculated as per procedure described in chapter 3. The results of total net income are given in Table 4.34.

Table 4.34 Total net income (Rs.) as per land holding

Sr. No.	Category of farmer	Total net income (Rs.)
1	Marginal	579726.9
2	Small	588385.9
3	Medium	605029.0
4	Large	575554.5

From Table 4.34, it was clearly indicated that, highest total net income was reported in the medium farmer (Rs. 605029.0) and lowest total net income was reported among a large farmer (Rs. 575554.5). It clearly suggested that, large variation was found in total net income as per land holding, however no co-relation was found between total net income and land holding of users.

4.3.10.2 Total net income as per education

Total net income as per education was calculated as per procedure described in chapter 3. The results of total net income are given in Table 4.35.

Table 4.35 Total net income as per education

Sr. No.	Category of farmers	Total net income (Rs.)
1	Illiterate	695945.7
2	Primary school	585757.4
3	Secondary school	608886.9
4	Higher secondary	585398.4
5	Degree	390992.1

From Table 4.35, it was clearly indicated that, highest total net income was reported in users who was illiterate (Rs. 695945.7) and lowest total net income was reported in users who was degree or diploma holder (Rs. 390992.1). It clearly suggested

that variation was found in total net income as per users education but without any co-relation.

4.3.11 B:C Ratio

The B:C ratio estimated excluding water saving varies from 1.31 in sugarcane and including water saving it was 2.78 (Narayanamoorthy, 2006). B:C Ratio as per land holding and education are demonstrated in following tables.

4.3.11.1 B:C ratio as per land holding

B:C ratio as per land holding was calculated as per procedure described in chapter 3. The results of B:C ratio are given in Table 4.36.

Table 4.36 B:C ratio of users of drip irrigation system in sugarcane as per land holding

Sr. No.	Category of farmer	B:C Ratio
1	Marginal	4.19
2	Small	4.23
3	Medium	4.28
4	Large	4.31

From Table 4.36, it clearly indicated that, highest B:C ratio i.e. 4.31 was reported in the large farmer and lowest B:C ratio i.e. 4.19 was reported among a marginal farmer.

This suggested that there was positive co-relation between B:C ratio and land holding as increase in the B:C ratio from marginal farmers to the large farmers was observed. As the B:C ratio was above 4.0 in all the farmers, it can be concluded that the investment in drip system is economically viable and sound for sugarcane.

4.3.11.2 B:C ratio as per education

B:C ratio as per education was calculated as per procedure described in chapter 3. The results of B:C ratio are given in Table 4.37.

Table 4.37 B:C ratio as per education

Sr. No.	Category of farmers	B:C ratio
1	Illiterate	4.35
2	Primary school	4.33
3	Secondary school	4.29
4	Higher secondary	4.24
5	Degree	4.18

From Table 4.37, it was clearly indicated that highest B:C ratio i.e. 4.35 was reported in the illiterate users and lowest B:C ratio i.e 4.18 was reported among a users who had education above degree. This suggested that there was negative co-relation between B:C ratio and level of education.

4.3.12 Net extra income (Rs.)

It is the additional income due to adoption of improved practice over conventional practice. Net extra income is calculated by taking difference of net seasonal income (Rs.) in drip method and net seasonal income (Rs.) in farmer practice. Net extra income as per land holding and education are demonstrated in following tables.

4.3.12.1 Net extra income as per land holding

Net extra income as per land holding was calculated as per procedure described in chapter 3. The results of net extra income are given in Table 4.38.

Table 4.38 Determination of net extra income as per land holding

Sr. No.	Category of farmer	Net extra income (Rs.)
1	Marginal	88378.70
2	Small	85231.64
3	Medium	87545.90
4	Large	90968.70

From above table, it was demonstrated highest net extra income (Rs. 90968.70) was reported in the large farmer and lowest net extra income (Rs. 85231.64) was reported among a small farmer. It clearly suggested that variation was found in net extra income as per land holding, but no clear co-relation existed between two parameters.

4.3.12.2 Net extra income as per education

Net extra income as per education was calculated as per procedure described in chapter 3. The results of net extra income are given in Table 4.39.

Table 4.39 Net extra income as per education

Sr. No.	Category of farmers	Net extra income (Rs.)
1	Illiterate	917447.00
2	Primary school	89035.58
3	Secondary school	90311.15
4	Higher secondary	90071.03
5	Degree	81111.99

From above table, it was demonstrated highest net extra income was reported in users who was illiterate (Rs. 917447.00) and lowest net extra income was reported in users who had education level above degree. It indicated that higher education farmers had lowest net extra income because due to better know-how of available technology in respect of variety, nutrient

management, intercultivation, pest management etc., they were getting good yields under flood method of irrigation also. Thus, on adoption of drip, they recorded some additional income as compared to conventional method of irrigation, but the differences were less as compared to farmers having lower education.

4.3.13 Net profit per cm water used

Net profit in Rs. per cm of water used or the water productivity is net income (Rs.) obtained per cm of water used. Net profit as per land holding and education are demonstrated in following tables.

4.3.13.1 Net profit per unit water used as per land holding

Net profit per cm water used as per land holding was calculated as per procedure described in chapter 3. The results of net profit per cm water used are given in Table 4.40.

Table 4.40 Net profit per unit water as per land holding

Sr. No.	Category of farmer	Net profit (Rs./cm water)
1	Marginal	1647.68
2	Small	1708.50
3	Medium	1748.93
4	Large	1668.27

From given table, it was indicated that lowest net profit/water used i.e. Rs. 1647.68 was reported in the small farmers and highest net profit i.e. Rs. 1748.93 was reported among a medium farmers. The parameter varied with land holding but without any co-relation.

4.3.13.2 Net profit as per education

Net profit per cm water used as per education was calculated as per procedure described in chapter 3. The results of net profit per cm water used are given in Table 4.41.

Table 4.41 Determination of net profit (Rs.)/cm water as per education

Sr. No.	Category of farmers	Net profit (Rs./cm water)
1	Illiterate	1960.41
2	Primary school	1698.40
3	Secondary school	1758.14
4	Higher secondary	1726.20
5	Degree	1713.48

From given table, it was indicated that highest net profit/water used i.e. Rs.1960.41 was reported in drip irrigation system users who was illiterate and lowest net profit (Rs.) i.e.1713.48 was reported in users who had education level upto primary school.

4.3.14 Water use efficiency (q/ha.cm)

Water use efficiency (i.e., water consumed to produce one unit of crop output) is also significantly higher in drip-irrigated crops when compared to the same crops cultivated under non-drip irrigated condition. According to observations recoded by the Narayanamoorthy (2006), sugarcane cultivated under drip method of irrigation consumes only 1.28 horse power (HP) hours of water to produce one quintal of sugarcane as against 2.83 HP hours of water under flood method of irrigation, i.e., about 1.55 HP hours of additional water is consumed to produce one quintal of sugarcane under flood method of irrigation.

4.3.14.1 Water use efficiency (q/ha-cm) as per land holding

Water use efficiency (q/ha-cm) as per land holding was calculated as per procedure described in chapter 3. The results of water use efficiency (q/ha-cm) are given in Table 4.42.

Table 4.42 Water use efficiency (q/ha-cm) as per land holding

Sr. No.	Category of farmer	Water use efficiency (q/ha-cm)
1	Marginal	9.39
2	Small	9.87
3	Medium	9.71
4	Large	8.60

From above table, it was clearly indicated that the highest water use efficiency i.e. 9.87 q/ha-cm was reported in the small farmer and lowest water use efficiency i.e. Rs 8.60 q/ha-cm was reported among a large farmer.

The cane productivity and water use found to be negatively co-related with land holding hence as the water use efficiency depends on productivity and water used for sugarcane, it also followed the same sort of relationship.

4.3.14.2 Water use efficiency as per education

Water use efficiency as per education was calculated as per procedure described in chapter 3. The results of water use efficiency are given in Table 4.43.

Table 4.43 Water use efficiency as per education

Sr. No.	Category of farmers	Water use efficiency (q/ha-cm)
1	Illiterate	9.70
2	Primary school	9.04
3	Secondary school	9.80
4	Higher secondary	9.70
5	Degree	9.98

From above Table 4.43, it was clearly indicated that the highest water use efficiency i.e. 9.98 q/ha-cm was reported in drip irrigation system users who had education level above degree and lowest water use efficiency i.e. 9.04 q/ha-cm was reported in users had primary education.

This suggested that users who had more education utilized water more efficiently to produce one quintal of sugarcane as compared to other farmers and resulted into improved water use efficiency.

4.3.15 Payback period

It indicates the number of years by which the net return (R) equals to the establishment cost of drip sets. Pay back period as per land holding and education are demonstrated in following tables.

4.3.15.1 Payback period as per land holding

Pay back period as per land holding was calculated as per procedure described in chapter 3. The results of pay back period (year) are given in Table 4.44.

Table 4.44 Payback period (year) as per land holding

Sr. No.	Category of farmer	Payback period (year)
1	Marginal	0.78
2	Small	1.02
3	Medium	1.08
4	Large	1.07

From above table, it was clearly indicated that, highest payback period i.e. 1.08 years was reported in the medium farmer and lowest payback period i.e. 0.78 years was reported among a marginal farmer. As sugarcane can be harvested in one year therefore it gives return yearly, hence the pay back period of most of

the farmers who had area under drip system was nearly one year. These findings were in line with Malik and Luhach (2002).

4.3.15.2 Payback period (year) as per education

Pay back period as per education was calculated as per procedure described in chapter 3. The results of pay back period (year) are given in Table 4.45.

Table 4.45 Payback period of drip irrigation system in sugarcane as per education

Sr. No.	Category of farmers	Payback period (year)
1	Illiterate	0.83
2	Primary school	0.70
3	Secondary school	1.03
4	Higher secondary	0.91
5	Degree	0.94

From above Table 4.44, it was clearly indicated that, highest payback period i.e.1.03 years was reported in users who had secondary education and lowest payback period i.e.0.83 was reported in illiterate users.

4.4 Constraints in adoption of drip irrigation for sugarcane

The users of drip irrigation system for sugarcane may have many problems regarding to different aspects. These constraints are presented in following tables.

4.4.1 Economic constraints

Economics constraints are the major constraints faced by the farmers. High initial cost of drip system is one of the major constraints responsible for the slow growth or spread of the

technology in country like India. During this study following constraints were recorded from respondents.

Table 4.46 Economic constraints as per land holding

Sr. No.	Constraints	Marginal	Small	Medium	Large	Total
1	High initial investment	4	25	40	0	69
2	Problem in preparation of loan proposal	4	20	35	0	59
3	Unavailability of loan in time	4	20	30	0	54
4	High cost of spare parts	4	31	45	0	80
	Total	**16**	**96**	**150**	**0**	**262**

From Table 4.46 it was revealed that, the considerable economic constraints was faced by the marginal, small and medium farmers having drip irrigation system for sugarcane. It observed that, 4 marginal farmers, 25 small and 40 medium farmers face constraint as higher investment required for drip irrigation system.

However, 4 marginal, 20 small and 30 medium farmers faced problems related to preparation of loan proposal while 4 marginal farmers, 20 small and 45 medium farmers faced problems in timely availability of loan. It is also found that 4 marginal, 31 small and 45 medium farmers faced problems related to high cost of spare parts of drip irrigation system. Large farmers didn't have any economic constraints.

It clearly indicated that large proportion of marginal, small, medium farmers using drip irrigation system for sugarcane faced maximum problems in high investment of drip irrigation system and high cost of spare parts. This finding is in line with the findings of Kalasaria (1993).

4.4.2 Technical constraints

Technical constraints were very important constraints faced by the illiterates and other low educated users. Following technical constraints were observed during this study.

Table 4.47 Distribution of users as per technical constraints

Sr. No.	Constraints	Marginal	Small	Medium	Large	Total
1	In installation of system					
a.	Lack of technical knowledge	4	30	60	1	95
b.	Improper design	4	30	58	1	93
2	Maintenance of drip irrigation system					
a.	Clogging of emitters	4	31	55	1	91
b.	Breaking of laterals	4	30	56	1	91
	Total	**16**	**121**	**229**	**4**	**370**

From Table 4.47 it was revealed that, the considerable technical constraints were faced by the marginal, small and medium farmers having drip irrigation system for sugarcane. It was observed that, 4 marginal farmers, 30 small and 40 medium farmers had lack of technical knowledge. It was also observed that 4 marginal, 30 small and 58 medium farmers had problem in improper design while 4 marginal farmers, 31 small and 55 medium farmers had problem in clogging of drippers. It is also observed that 4 marginal, 30 small and 56 medium farmers had problem in breaking of laterals of drip irrigation system during interculturing and harvesting.

This clearly observed that large proportion of marginal, small, medium farmers using drip irrigation system for sugarcane

had problem in lack of technical knowledge and clogging of emitters. These findings are in line with the findings of Ingale and Sagane (1992).

4.4.3 Extension constraints

Following are the extension constraints worked out during this study.

Table 4.48 Distribution of users as per extension constraints

Sr. No.	Constraints	Marginal	Small	Medium	Large	Total
1	Lack of training to farmers	4	28	45	1	78
2	Improper facilities for demonstration on field	4	26	45	1	76
3	Inadequate guidance and supervision	4	30	50	0	84
	Total	**12**	**84**	**140**	**2**	**238**

From Table 4.48 it was revealed that, the considerable extension constraints were faced by the marginal, small and medium farmers having drip irrigation system for sugarcane. It was observed that, 4 marginal farmers, 28 small and 45 medium farmers had lack of training. It was also observed that 4 marginal, 26 small and 45 medium farmers had problem in lack of demonstration facilities on farm. While, 4 marginal farmers, 30 small and 50 medium farmers had problem in unavailability of regular guidance and supervision.

It indicated that large proportion of marginal, small, medium farmers using drip irrigation system for sugarcane had

problem in unavailability of regular guidance and supervision. This finding is in line with the findings of Ingale and Sagane (1992).

4.4.4 Others constraints

Other constraints which were worked out in this study were irregular electric supply, inadequate irrigation supply, rodent problem etc.

Table 4.49 Distribution of users as per other constraints faced by them

Sr. No.	Constraints	Marginal	Small	Medium	Large	Total
1	Irregular electric supply	4	31	64	1	100
2	Inadequate irrigation supply	4	20	50	0	74
3	Problem of rodent	4	31	64	1	100
	Total	**12**	**82**	**178**	**2**	**274**

From Table 4.49 it was revealed that, the considerable other constraints were faced by the marginal, small and medium farmers having drip irrigation system for sugarcane. It was observed that 4 marginal farmers, 31 small and 64 medium farmers and also a large farmer had problem in irregular electricity. It was observed that, 4 marginal, 20 small and 50 medium farmers had problem in inadequate irrigation supply on farm. While 4 marginal farmers, 31 small and 64 medium farmers had problem in rodent attack. One large farmer who had the problem of rodent.

This clearly observed that large proportion of marginal, small, medium farmers using drip irrigation system for sugarcane had problem in irregular electricity supply and problem of rodent. This findings are in line with the findings of Patil (2007).

4.5 Suggestions of respondents to overcome constraints

Suggestions were also obtained from the respondents to overcome the above mentioned constraints i.e. financial suggestions, technical suggestions, extension suggestions and other suggestions.

4.5.1 Financial suggestions

Financial suggestions offered by farmers were regarding insufficient, capital requirement and from where to obtain loan and purchase of spare parts. These aspects are classified according to marginal, small, medium and large farmers. Following are the suggestion revealed during this study by farmers.

Table 4.50 Economic suggestions from the farmers

Sr. No.	Suggestions	Marginal	Small	Medium	Large
1	Initial cost need to be minimized	4	31	55	0
2	Short and easy proposal need to be made for submission of loan proposal	4	30	45	0
3	Loan should be made in time	4	28	50	0
4	Cost of spare parts should be minimized	4	31	50	0
	Total	**16**	**120**	**150**	**0**

From Table 4.50 it was revealed that, the considerable economic suggestions were made by the marginal, small and medium farmers having drip irrigation system for sugarcane. It was observed that 4 marginal farmers, 31 small and 55 medium farmers made suggestions that drip irrigation system cost need to be minimized.

It was observed that 4 marginal, 30 small and 45 medium farmers made suggestions regarding short and easy procedures for preparation of loan while 4 marginal farmers, 28

small and 50 medium farmers had a suggestions regarding means for timely availability of loan. It is also observed that 4 marginal, 31 small and 50 medium farmers had a suggestions regarding the reducing the cost of spare parts of drip irrigation system. Large farmers did not have economic suggestions.

This clearly observed that large proportion of marginal, small, medium farmers using drip irrigation system for sugarcane had maximum suggestion on high investment of drip irrigation system and high cost of spare parts. This finding is in line with the Kalasariya (1993).

4.5.2 Technical suggestions

Technical suggestions were insisted by farmers regarding insufficient technical knowledge about systems such as installation, design, maintenance, clogging, breaking of laterals etc Following are the suggestion revealed during this study.

Table 4.51 Technical suggestions provided by farmers

Sr. No.	Suggestion	Marginal	Small	Medium	Large
1	Installation of system				
a.	Technical knowledge should be provided	4	31	60	1
b.	Proper design with skilled labour	4	31	55	1
2	Maintenance of drip irrigation system				
a.	Proper solution against clogging of emitter	4	31	55	1
b.	Quality material to avoid lateral breakage	4	31	60	1
	Total	**16**	**124**	**210**	**4**

From Table 4.51 it was revealed that the considerable technical suggestions were given by the marginal, small and medium farmers who had drip irrigation system for sugarcane. It observed that 4 marginal farmers, 31 small and 60 medium farmers had suggestion on providing technical knowledge. It was observed that 4 marginal, 31 small and 55 medium farmers had suggestions that the dealer should have skilled manpower for proper design of drip system, while 4 marginal farmers, 31 small and 55 medium farmers had suggested to provide proper treatments to avoid clogging of drippers. It is also observed that 4 marginal, 31 small and 60 medium farmers had suggestion on ways and means to avoid breaking of laterals of drip irrigation system.

This clearly observed that large proportion of marginal, small, medium farmers using drip irrigation system for sugarcane had suggestion on lack of technical knowledge and clogging of emitters. This finding is in line with the findings of Ingale and Sagane (1992).

4.5.3 Extension suggestions

Extension suggestion by farmers were related to insufficient extension knowledge about systems in regards of installation, design, maintenance, clogging, breaking of laterals etc. These suggestions are classified according to marginal, small, medium and large farmers. Following are the suggestion revealed during this study by farmers.

Table 4.52 Extension suggestions from the farmers

Sr. No.	Constraints	Marginal	Small	Medium	Large	Total
1	Training should be provided to farmer	4	20	40	1	65
2	Facilities for demonstration on field	4	25	48	1	78
3	Guidance and supervision should be provided to farmer	4	25	50	0	79
	Total	**12**	**70**	**138**	**2**	**222**

From Table 4.52 it was revealed that the considerable extension suggestions were given by the marginal, small and medium farmers who had drip irrigation system for sugarcane. It was observed that 4 marginal farmers, 20 small, 40 medium farmers and 1 large farmer had suggestion on providing series of trainings by University, State Agriculture Department and Manufacturer of drip. It also observed that 4 marginal, 25 small and 48 medium farmers and 1 large farmer had suggestion on providing large number of demonstrations on farm. While 4 marginal farmers, 25 small and 50 medium farmers had suggestion on of regular guidance and supervision by manufacturers.

This clearly observed that large proportion of marginal, small, medium farmers using drip irrigation system for sugarcane had suggestion on unavailability of regular guidance and supervision.

4.5.4 Other suggestion

Other suggestion insisted by farmers involved irregular electric supply, inadequate irrigation supply, problem of rodent etc.

Following are the suggestion revealed during this study by farmers.

Table 4.53 Other suggestion provided by drip users

Sr. No.	Suggestion	Marginal	Small	Medium	Large
1	Regular electric supply should be provided	4	31	64	1
2	Proper irrigation supply	4	25	50	0
3	Solution to control rodent	4	31	60	1
	Total	**4**	**87**	**174**	**2**

From Table 4.53 it was revealed that the considerable other suggestions were provided by the marginal, small and medium farmers who had drip irrigation system for sugarcane. It observed that 4 marginal farmers, 31 small and 64 medium farmers and also a large farmer had suggestion on irregular electricity. It observed that 4 marginal, 25 small and 50 medium farmers had suggestions on inadequate irrigation supply on farm. While 4 marginal farmers, 31 small and 60 medium farmers had suggestion on rodent attack. Only 2 large farmers had the suggestion on problem of rodent.

This clearly observed that large proportion of marginal, small, medium farmers using drip irrigation system for sugarcane had suggestion on irregular electricity supply and problem of rodent. This finding is in line with the findings of Patil (2007).

5. SUMMARY, CONCLUSIONS AND IMPLICATIONS

This chapter includes summary, conclusions and implications for further research and action. A brief summary of this research includes the conclusions drawn on the basis of analysis and interpretation of data. This is followed by the implications for further actions, particularly for solving problems.

The consecutive drought system in Maharashtra state necessitated the conservation, storage and efficient utilization of available irrigation water simultaneously, diverting the attention of farmers towards water saving technologies like drip irrigation, sprinkler irrigation, micro-irrigation, rain gun, etc. which has registered as a strong factor in augmenting crop yield under available irrigation potential.

Drip irrigation for sugarcane is developing very fast in our country and is becoming increasingly popular in the state of Maharashtra. It is being adopted for various agronomical crops, horticultural crops and cash crops due to strong financial support from state govt. by way of providing subsidies/loans, research, development activities in Agriculture universities in the state and farmers active participation in adoption of drip irrigation system. There is a good potential to increase crop yield with increased water use efficiency. It helps in reducing the weeds, pests and diseases.

Use of drip irrigation system to irrigate the sugarcane crops is started recently. It is therefore, felt imperative to know the experiences of adaptors that is users of system for sugarcane also.

With this view the research study entitled, “Constraints identification of drip irrigation system for sugarcane in Ahmednagar district” was undertaken.

The present study was conducted in six tahsils of Ahmednagar districts. Random sampling method was used for selection of users of drip irrigation for sugarcane. 100 villages are selected from six tahasil. From these 100 users of drip irrigation systems for sugarcane were interviewed for study. Technical reading such as hydraulics of drip was calculated from field data collection and analysis. The data collected were processed and analyzed. A summary of the important findings is given below.

5.1 Summary

5.1.1 Socio-economic characteristics of drip irrigation:

Total 100 drip irrigation system users for sugarcane were randomly selected from 100 villages of six tahsils of Ahmednagar districts.

Out of total users of drip system in sugarcane average users had education above twelth standard. Whereas, from total sample of users 95 per cent were small to medium farmers.

5.1.2 Hydraulics of drip irrigation

To evaluate the drip hydraulics, the study was conducted on the farmers field who had sugarcane under drip system. The readings for the main, sub main, manifold and laterals was monitored with pressure gauge. Once the valves are adjusted for specific pressure, the same was maintained throughout the test. The water discharge through the emitters was collected in catch

cans placed below the lateral for one minute and later converted into discharge of emitters.

From this study it was indicated more than 50 percent users had EU above 90 percent which is advisable as suggested by Karmali and Keller (1975). It was also revealed that large proportion of drip irrigation system users for sugarcane had average discharge variation above 20 per cent which is not desirable as per the norms prescribe by Keller and Blisner (1990). It was concluded that large proportion of drip irrigation system users for sugarcane had lateral head loss below 10 per cent, which is within advisable range. All drip irrigation system users for sugarcane had manifold head loss less than 20 per cent which is advisable as per prescribe norms Keller and Blissner (1990). For better understanding the results of the study the hydraulics was also categorized as per land holding and education.

5.1.2.1 Hydraulics for Drip as per land holding

From the field investigation it was revealed that out of 100 drip irrigation system users, more than 52 per cent users having area between 2-10 ha had EU above 90 per cent which is advisable. It was also indicated that large proportion of medium farmers had average discharge variation above 20 per cent which is not desirable.

5.1.2.2 Hydraulics for Drip as per education

From the field investigation it was revealed that out of 100 drip irrigation system users 83 of users had education more than twelve standard of which 56 per cent users had EU above 90 per cent. As the education level goes on increasing, the EU falls

below 90 per cent which is not advisable. From this study it was also indicated that as education level increased, the per cent of users having average discharge variation above 20 per cent is also increased which is surprising fact.

Large proportion of drip irrigation system users had lateral head loss less than 10 per cent and all the educated drip irrigation system users for sugarcane had manifold head loss less than 20 per cent which is advisable as per prescribe norms (Keller and Blissner, 1990).

5.1.3 Cost economics for drip irrigation

The crop yields by drip irrigation method are higher with reduction in cost of labours, fertilizers, pesticides and power for irrigation. The drip irrigation system requires heavy initial investment and used in wide spaced crops. As a result, the cultivators are becoming more conscious about cost of installation of this system and economic analysis of different crops for their profitable production. From this study attempt was made to evaluate the benefits of drip irrigation method.

5.1.3.1 Cost economics for drip irrigation as per land holding

From the field investigation it was revealed that farmers having less land had high fixed cost as compared to medium to large farmers. There was not much variation in the cost of cultivation among these farmers as the cost of cultivation varies with situational factors like soil quality, condition of the terrain, farmers' approach, etc. The study indicated that there is linear decreased in yield from marginal farmers to large farmers, it may be due to marginal farmer had more attention to his farm.

The average additional area of all farmers was found to be increased to 1.26. This study also suggested that there was linear increased in the B:C ratio from marginal farmers to the large farmers. Therefore, the investment in drip system is economically viable and sound. About water use efficiency, it was indicated that small farmers utilized more water to produce one quintal of sugarcane as compared to other farmers. The pay back period of most of the farmers who had area under drip system was nearly one year.

5.1.3.2 Cost economics for drip irrigation as per education

From the field investigation it was revealed that as a level of education increased the level of fixed cost had also increased. It is due to literate had used best quality of drip material which have high market price. There was not much variation in cost of cultivation (Rs./ha) as per education level of users as the cost of cultivation varies with situational factors like soil quality, condition of the terrain, farmers' approach, etc. Water used (cm) by illiterate through drip in sugarcane was found to be less as compared to literates. This showed that water used in sugarcane through drip irrigation system varied according to education level.

It was clearly suggested that there is linear decreased in yield from illiterate users to literates' users. This clearly indicated that literates had more attention to his farm as compared to illiterates. The average additional area that can be brought under irrigation by adopting drip method of irrigation in sugarcane was 1.36 ha.

There was linear increased in the B:C ratio from users who had education above degree to the illiterates users. It was

suggested that users who had education above degree utilized more water to produce one quintal of sugarcane as compared to other farmers. From this study it was also revealed that highest payback period i.e. 1.03 years was reported in users who had secondary education and lowest payback period i.e.0.83 was reported in illiterate users.

5.1.4 Constraints in adoption of drip irrigation for sugarcane

Large proportion of marginal, small, medium farmers using drip irrigation system for sugarcane faced maximum problem in high investment of drip irrigation system and high cost of spare parts. Majority of marginal, small, medium farmers using drip irrigation system for sugarcane had faced problems in lack of technical knowledge and clogging of emitters. Faulty design of drip system was one of the major technical constraints faced during this study. Another problem was the breakages of the lateral during inter cultivation operation.

Extension constraints were due to lack of extension activities such as inadequate training to farmers, unavailability of regular guidance and supervision etc Other constraints involved irregular electric supply, inadequate irrigation supply, problem of rodent etc.

5.1.5 Suggestions of respondents to overcome these constraints

Farmers insisted economic suggestions regarding initial investment of drip irrigation. Another economic suggestion given by farmer was difficulty in preparation of loan proposal. Users of drip

irrigation system for sugarcane had mainly suggested overcoming the problem of high investment of drip irrigation system and high cost of spare parts. Users of drip irrigation system for sugarcane had insisted dealer should provide technical knowledge regarding the drip system and to find solution on clogging of emitters.

It was revealed that majority of users of drip irrigation system for sugarcane had suggested provide regular guidance and supervision. There were suggestion regarding regular electricity supply and insisted about the solution to eliminate rodent.

5.2 Conclusion

Looking to the results of the study on constraints identification of drip irrigation system for sugarcane in Ahemednagar district. Following conclusions are drawn:

1. Average users of the drip irrigation system for sugarcane had education above secondary level and majority of users had area between 1-10 ha.
2. As revealed from study more than 50 per cent users had EU above 90 percent which was advisable and majority of users had average discharge variation above 20 per cent which is not desirable. Majority of users had lateral head loss below 10 per cent, which was within advisable range whereas all the drip irrigation system users had manifold head loss less than 20 per cent which is advisable.
3. It was found that, education level goes on increasing, the EU values also increased.

4. It was revealed that drip irrigation reduces the total cost of cultivation in sugarcane crop and it was also revealed that there was increased in yield of sugarcane under drip irrigation.
5. The average additional area can be brought under irrigation by adopting drip method of irrigation in sugarcane was more than unity which was economically advisable. The B:C ratio was found to be greater than unity in sugarcane crops which revealed that investment in drip system is economically viable and sound.
6. The pay back period of most of the farmers who had area under drip system was nearly one year.
7. It was revealed from the study that main economic constraint faced by users were high initial cost of system and high cost of spare part. Lack of technical knowledge were the major technical constraints observed during the study. Unavailability of regular guidance and supervision were some extension constraints. Problem of rodents is other constraint faced by the users.

5.3 Research implications

The present study is of exploratory type and therefore to judge its validity on large scale, the studies similar to the present need to be replicated in other areas. The studies regarding the characteristics of farmers in relation to their knowledge of irrigation water management practices of selective nature are suggested. All the aspects of drip irrigation systems constraints, suggestions and the impact of drip irrigation system over surface irrigation system are not studied.

Therefore, other aspects need to be studied to a greater depth, in future investigation. However, this study would be useful as guideline for further studies of similar type.

6. LITERATURE CITED

Anonymous, 2009. Economic Survey of Ahmednagar. pp. 6-10.

Anonymous, 2011. Economic Survey of Maharashtra. pp. 47-48.

Ahire M.C., Tawde N.D. and Nirban A.J. 1999. Factors associated with the use of drip and flow irrigation system by farmers. Maharashtra J. Ex. Ed. 18 : 57-60.

Bannapure, S.K. 2007. Adoption of management practice of drip irrigation system for Banana in Jalgoan district. M.Sc. (Agri.) thesis, MPKV, Rahuri (Unpublished).

Chaugule, S.A. 2002. Hydraulics of Drip Irrigation in-built Emitter Lines. M.Sc. (Agri.) thesis, MPKV, Rahuri (Unpublished).

Chavai, A.M., Sadaphal, S.S., Bhange, S.B. and Gurav, B.S. 2003. Opinions of the drip adopters about nature and extent of benefits due to drip irrigation system used for sugarcane crop. Cooperative Sugar. 34(12): 961-962

Chavan, S.S., Chavai, A.M. and Pande R.S. 2003. Socio-economic constraints in the use of drip irrigation. Abstract book on National seminar entitled extension strategy for efficient irrigation water management and water conservation held on December 13-14 MPKV, Rahuri. pp. 32-33

Desai, S.M 2005. Financial management for banana cultivation in Jalgaon district. M.Sc. (Agri.) thesis, MPKV, Rahuri (Unpublished).

Dhawan, B.D. 2000. The lead Paper for the International Conference on Micro and Sprinkler Irrigation, held at Jalgaon.

Hapase, D.G., Deshmukh, A.S. and Shinde, P.P. 1993. Micro-irrigation in Sugarcane Agriculture in CBIP. pp. 86-89.

Ingale, P.O. and Sagane, N.A. 1992. Constraint in the use drip irrigation system a case study. J. Maharashtra Agric. Univ. 17(2):294-297.

Kalasariya, B.N., Popat, M.N., Munshi, M. A. and Sawaliya, V.J. 1993. Constraint in adoption of drip irrigation and it's suggestion. Proc. of symposium on drip irrigation system - a new approach for Saurashtra –Kutchh area. G.A.U., Junagarth, Gujrat. pp. 118-123.

Kale P.V. 2000. A study of farmers experience in the farm of knowledge and adoption towards drip irrigation system for orchards. M.Sc. (Agri.) thesis submitted to M.P.K.V., Rahuri (unpublished)

Keller, J. and Blisner, R.D. 1990. Sprinkler and trickle irrigation. Van Nostrand Reinhold, New York. pp. 427-602.

Keller, J. and Karmeli, D. 1975. Trickle irrigation design. Parameter sprinkler Manufacturing Corporation, Glendora, California. Transaction of the ASAE-7. pp. 678-684.

Malik, D.P. and Luhach, M.S. 2002. Economics of Water and Agriculture to be held at Institute of Food, Agriculture and Environmental Sciences, The Hebrew University, Jerusalem, Rehovot, Isreal.

Mandalia, 1990. Popularising drip irrigation method. Proc. Of seminar on drip irrigation system held at G.A.U., Anand, Gujrat organize during September. pp. 108-115

Nagare, S.K. 1989. An evaluation of drip irrigation system under farmers condition. M.Sc. (Agri.) thesis submitted to M.P.K.V., Rahuri

Narayanamoorthy, A. 2006. Efficiency of irrigation: a case of drip irrigation. Occasional Paper National Bank for Agriculture and Rural Development, Mumbai. pp. 38-45.

Patel, R.B. 2003. Techno-socio-economics consequences of drip adopter association in south Gujarat. Abstract book on National seminar entitled extension strategy for efficient water management and water conservation held at MPKV, Rahuri on Dec. 13-14. pp 53-58.

Patil, A.A. 2007. A comparative study of user and non users of drip irrigation systems by grape grower. M.Sc. (Agri.) thesis submitted to the M.P.K.V., Rahuri (unpublished).

Patil, R.P. 2002. Purchasing behaviors of banana growers towards drip irrigation system in Jalgoan district. M.Sc. (Agri.) thesis, MPKV, Rahuri (Unpublished).

Phadtare, V.R., Chirprikar, B.P. and Patil, R.Y. 1992. The socio-economic constraints in use rough of drip irrigation. Maharashtra J. Extn. Education, XL : 344-347

Puranik, R.P., Konde, S.R. and Ganorkar, P.L. 1992. Knowledge and adoption of drip irrigation system by farmers in Nagpur district. Maharashtra J. Extn. Education. XL :351-355

Sarkar, A.N. and Hanamashetti, J.S. 2002. Financial viability of drip-irrigation system for sugarcane and grape cultivation in Maharashtra. Asia Pacific J. Rural Dev. 12(1): 1-31

Shinde, P.P. and Jadhav, S.B. 2000. Water management with drip irrigation system for sugarcane. Proceedings of the 62nd Annual Convention of the Sugar Technologists' Association of India held at Agra (India) during 19-21 August, 2000. A36-A41

Srivastava, R.C., Verma, S.M. and Pattnaik, S.K. 2003. Investment decision model for drip irrigation system. Irrigation Sci. 22(2): 79-85

Sundara, B. 2005. Drip irrigation for sugarcane - our experience. Cooperative Sugar. pp. 17-18.

Wu, I.P. and Gitlin, H.M. 1974. Drip irrigation design based on uniformity. Trans. ASAE. 17(3):429-432.

7. APPENDIX

Appendix A. Case studies of single user

7.1 Details of farmer

Name : Suresh Bansilal Bafana

Village : Vambori

Taluka : Rahuri

District : Ahmednagar

Total area : 9 ha

Education : B.Com

Age : 50

Crop : Sugarcane

Case study for 1ha

Design details

1.	Main	=	100 m
2.	Submain	=	100 m
3.	Number of lateral	=	88
4.	Lateral length	=	4444 m
5.	Emitters	=	7407 nos.

7.2 Hydraulics of drip irrigation

Results of drip hydraulics are determined in chapter 4 as per the case study shown below.

	Operating pressure, kg/cm²							1.5 kg/cm²						
	Pump discharge							3 hp(17500)						
Dripper Readings														
Dripper reading at lateral head								Dripper reading at lateral end						
1	2	3	4	5	6	7		1	2	3	4	5	6	7
66	65	64	63	62	61	60		66	65	64	62	60	58	58
Lateral pressure readings, kg/unit														
Lateral reading at the head								Lateral reading at the tail						
1	2	3	4	5	6	7		1	2	3	4	5	6	7
1.5	1.45	1.43	1.43	1.4	1.4	1.38		1.45	1.45	1.43	1.4	1.36	1.35	1.3
	Average discharge ,lph							3.7457						
	Minimum discharge, lph							3.48						
	Emission Uniformity (%)							92.9						
	Average discharge variation (%)							6.5						
	Average of lateral reading at head, kg/cm²							1.46						
	Average of lateral reading at tail, kg/cm²							1.39						
	Lateral head loss (%)							2.50						

Note: Above figures are calculated as per procedure described in chapter 3.

7.3 Cost of cultivation of sugarcane under drip

Sr. No.	Operations	Cost per hectare (Rs./ha)
1	Ploughing and preparation	5250
2	Furrow and bunding	3100
3	Seed and sowing	9140
4	Fertilizer(In-organic)	12000
5	Farm yard manure	9000
6	Pesticide	1890
7	Weeding and Interculture	6550
8	Irrigation	5500
9	Harvesting	-
10	Transport and marketing	-
11	Others	2900
12	Total cost of cultivation	55350

Costs of harvesting, transport and marketing are not included since sugar factories have incurred these costs.

Note: Above figures are calculated as per procedure described in chapter 3.

7.4 Fixed cost of the Drip Method of Irrigation in sugarcane

Sr. No.	Drip set	Number	Cost / equipment	Total cost
1	Pump	1	8000	8000
2	By Pass	1	1500	1500
3	Screen filter	1	3600	3600
4	PVC Main(75mm)	100	45	4500
5	PVC sub main(50mm)	100	33	3300
6	Lateral 16mm	4444	9.15	40662.6
7	GTO16mm	88	2.5	220
8	END cap16mm	88	2.5	220
9	Emitter 4lph	7400	2.4	17760
10	PVC fitting	1	2000	2000
11	Pressure gauge	1	250	250
12	Valve	1	1000	1000
		Total		75012.6
13	Installation cost 2 to 13 @ 3%			2250.38
14	Total system cost			77262.92
15	Depreciation a)pump 20			360
	b)system 6			11589.45
16	Installation (12 %) a) pump 20			**960**
	b)system 6			**9271.56**
17	Repair and maintenance a) pump 1%	1		80
	b) system 2%	2		1545.22
18	Electricity			0
19	Total fixed cost			23806.26

Note : Above figures are calculated as per procedure described in chapter 3.

7.5 Estimation of economics

Sr. No.	Economics of cost	Cost
1	Fixed cost	23806.26
2	Cost of cultivation, Rs./ha	55350
3	Seasonal cost (1+2)	79156.26
4	Water used, cm	151
5	Yield of cane, t/ha	160
6	Selling price, Rs./t	2000
7	Income from produce, Rs./ha (5×6)	320000
8	Net seasonal income, Rs./ha (7-3)	240843.7
9	Additional area	1.2516
10	Additional expenditure (9×3)	99076.38
11	Additional income (9×7)	400529.8
12	Additional net income (9×6)	301453.4
13	Gross cost (3+10)	178232.6
14	Total net income (9+12)	542297.2
15	B:C Ratio (7/3)	4.0426
16	Net extra income	69893.44
17	Net profit/cm water used (8/4)	1594.992
18	Water use efficiency, q/ha.cm (5/4)	10.60

7.6 Selling price of sugarcane

Sr. No.	Name of Farmer	Village	Area	Yield (t)	Selling Price (Rs.)	Gross Income
1	Suresh Bansilal Bafana	Vambori	9	1575	2000	3150000

Note : The selling price is decided by sugarcane factory of respective area

Appendix B.

¹ã Í ¶ãã Ìã Êãã

ãŸºã‡ãŠ ãÔãÞã¶ã Ìãã¹àÀ¥ãã–¾ãã ,ãããã¥ã ãŸºã‡ãŠ ãÔãÞã¶ã ÔãÞã ,ãÔã¶ã ¶ã Ìãã¹àÀ¥ãã–¾ãã ...Ôã „¦¹ãã ª‡ãŠãÞãã ¦ãÊã¶ãã¦½ã‡ãŠ ,ã¼¾ãã Ôã

ãì Ìã²ãã©¾ãã Þã ¶ãã Ìã ½ãã Ø ã ª Í ã‡ãŠ

Ñãã. £ãÀ½ã ã¶ãÊãÍã •ãã Êãã ª À **¡ã. ¡ã. ¡ã. ¹ã Ìãã À**

¹ã©ã½ã Ìã Óã, †½ã.†Ôã.ÔÔãã. ¹ã½ãŒã,

,ãã¦ãÀãÌã²ãã Íãã Œãã •ãÊãã Ôã Þã¶ã Ì¾ã ÌãÔ©ãã¹ã¶ã ãÌã¼ãã Øã ,ãã¦ãÀãÌã²ãã Íãã Œãã •ãÊãã Ôã Þã¶ã Ì¾ã ÌãÔ©ãã¹ã¶ã ãÌã¼ãã Øã

¶ãã ª¥ãã ‰ãŠ½ãã‡ãŠ 2009/237 ½ãÖã¦½ãã ¹ãŠÊã ‡ãŠãÓã ãÌã²ãã¹ãã Ÿ, ÀãÖÀã,

ã•ã. ,ãÖ½ã ª¶ãØãÀ 413 722

ÔãÌã Ôãã£ãã À¥ã ½ãã ãÖ¦ãã

Íã¦ã‡ãŠ–¾ãã Þ¾ãã ÔãÖ½ãã Øãã¦ã¶ã ‡ãŠã¦ã Ôã Íãã£ã¶ã ¹ã‡ãŠÊ¹ã

,ã. ¹ã‡ãŠÊ¹ã ÔãÁ Öã¦ãã¶ãã Íã¦ã‡ãŠ–¾ãã Þãã ½ãã ãÖ¦ãã¹ã¨ã‡ãŠ

1. Øãã Ìãã Þã ¶ãã Ìã :
2. ¦ãã Êã‡ãŠã : ã•ãÊÖã :
3. Àã•¾ãã Þã ¶ãã Ìã :
4. ½ãÖãÀãÓ>ã¦ãã Êã ‡ãŠãÓã ÖÌãã½ãã ¶ãã ¶ãÔãã À ãÌã¼ãã Øã :
5. ‡ãŠ>ºã ¹ã½ãŒãã Þã ¶ãã Ìã : Ñãã.
6. Ìã¾ã : ãÍãàã¥ã :
7. ãÊãØã
8. ‡ãŠ>ºãã Þãã ¹ã‡ãŠãÀ

9. ‡ãŠ›ì°ãäÞãäì ½ãäãäÖ¦ãäì

,ã.¶ã.	‡ãŠ›ì°ã Ôã ª Ô¾¿ã ¶ãäÌã	¶ãäã¦ã	ãÊãØã	Ìã¾¿ã	ãÍáàäì¥ã	Ì¾¿ãÌãÔãäã¾¿ã

10. £ãäÀ¥ã ‡ãŠÊãÊ¾¿ãäì •ãäì½ãì¶ãäÞãäì ¦ã¹ãäìÍãÊã

,ã.¶ã.	ÔãÌÖì ¶ã./ Øã› ¶ã.	àäì¨ã Ö.	•ãäì½ãì¶ãäÞãäì ¹ã‡ãŠãÀ	°ãäØãäã¾¿ã¦ãäì àäì¨ã [Ö.]		ã•ãÀã¾¿ã¦ã àäì¨ã Ö.
				¹ãä› °ãäØãäã¾¿ã¦ã	ãÌãÖãÀ °ãäØãäã¾¿ã¦ã	

11. Íã¦ã‡ãŠ–¾¿ãäÞãäì (½ãŒ¾¿ã) ã¹ã‡ãŠãäÞãäì ½ãäãäÖ¦ãäì

,ã.¶ã.	°ãäØãäã¾¿ã¦ãäì ã¹ã‡ãŠì	àäì¨ã	ã•ãÀã¾¿ã¦ã ã¹ã‡ãŠ	àäì¨ã
,ã	ŒãÀã¹ã ÖØãäì½ã			
1				
2				
°ã	À°°ãäì ÖØãäì½ã			
1				
2				
‡ãŠ	„¶Öã ß ãì ÖØãäì½ã			
1				
2				
3				
¡	Ìãäãäóã‡ãŠ ã¹ã‡ãŠ			

1				
2				
3				

12. ¹ãã¥ãã Ì¾âÌãÔ©ãã¹ã¶ãã°ãã°ã¦ã Íã¦ã‡ãŠ–¾ãã¶ãã ,ãÔãÊãÊãã ½ãããÖ¦ãã

(Þãã Øã Êãã/ ½â£¾ã½â/ ‡ãŠ½ãã/ ,ãã•ã°ãã¦ã/ ½ãããÖ¦ã ¶ãäÖã)

13. Íã¦ã‡ãŠ–¾ãã Þã ã²ã‡âŠã¹ãã Ôã À ã Ôã À ã Ìãããó ã‡ãŠ „¦¹ã¸ã : Á. ¹ãã¦ã Ìãóã

14. Íã¦ã‡ãŠ–¾ãã Þã Íã¦ãã Ì¾ãã¦ãã À ‡â¦ã ƒ¦ãÀ ½ãã Øãã¶ã ÔãÀãÔãÀã Ìãããóã‡ãŠ „¦¹ã¸ã : Á.

¹ãã¦ã Ìãóã

15. ã Ìãã Ö À/ °ãã ,ãÀ½â£ã¶ã ¹ãã¥ãã „¹ãÔãã Ôãã£ã¶ã

,ã.¶ã.	Ô¨ãã¦ã	¹ã¹ã	¹ãã ƒ¹ãÊãã ƒ¶ã	„¦Ôã•ã¶ã (†Êã.¹ãã.†Ôã)

16. •ãã½â¶ãã Þãã ¶â‡ãŠã Íãã

17. ã Ÿ°ã‡ãŠ ãÔã Þã¶ãã Þ¾ãã ¹ãã¦¾ãã à ã‡ãŠ¹ã£ª¦ãã

,ã.¶ã.	Ìãóã	¹ãã¦¾ãã à ã‡ãŠã Ôãã Ÿã ã¹ã‡ãŠã Œãã Êãã Êã à ã¨ã					
		Œã À ã¹ã		À°°ãã		„¶Öã ß ã	
		ã¹ã‡ãŠã Þã ¶ãã Ìã	à ã¨ã	ã¹ã‡ãŠã Þã ¶ãã Ìã	à ã¨ã	ã¹ã‡ãŠã Þã ¶ãã Ìã	à ã¨ã

1	2005-06						
2	2006-07						
3	2007-08						
4	2008-09						
5	2009-10						

18. Íã¦â‡â-¾ãâÞãâ ...Ôã „¦ã¹ãâ¶ãâÔãâŸã¦ ,âÔãÊãÊâã ãŸº㇠ãÔãÞã¶ã ¹ã£ª¦ãâÞãâ ,ã¶ã½ãÌã : ÌãÓã¦

19. ½ãäÖä¦ãäÞã Ô¨ãã¦ã

,ã. ¶ã.	½ãäÖã¦ãäÞ¾ãä Ô¨ãã¦ãäÞãã ¦ã¹ãäÍãÊã	Ôã¹ã‡ãŠ ¹ãäÀ¹ãäã À¦ãÞãã ‡ãŠãäÊã		
		ã¶ã¾ãã½ã¦ã	‡ãŠ£ãä¦ãÀã	‡ãŠ£ãäÖã ¶ãäÖã
,ã.	**Ì¾å‡ä¦ãäÍã: Ôã¹ã‡ãŠ Ôãã£ã¶ã**			
	1. ã½ã¨ã			
	2. ¶ãã¦ãÌãäƒ‡ãŠ			
	3. Íã•ãåÀã			
	4. ¹ãØã¦åÍãäÊã Íã¦å‡ãŠÀã			
	5. Ô©ãäã¶â‡ãŠ ¹ã¤ãÀã			
ºã.	**¹ãÍãäÔã‡ãŠã¾ã Ôã¹ã‡ãŠ Ôãã£ã¶ã**			
	6. Øãäã½äÔãÌå‡ãŠ			
	7. ‡ãŠãÚã ÔãÖã¾¾ã‡ãŠ			
	8. ‡ãŠãÚã ãÌã²ãã¹ãã¨ãÞã ‡ãŠãÚã ÔãÖã¾¾ã‡ãŠ			
	9. Øã› ãÌã‡ãŠãÔã ,ãã£ã‡ãŠãÀã			
	10. ¦ãäÊã‡ãŠã ãÌãÔ¦ãäÀãã£ã‡ãŠãÀã			
	11. ã•åÊÖã ‡ãŠãÚã ,ãã£ã‡ãŠãÀã			
	12. ...Ôã ãÌã‡ãŠãÔã ,ãã£ã‡ãŠãÀã			
	13. ÔãäŒãÀ ‡ãŠãÀŒãã¶¾ãäÞã ‡ãŠãÚã ,ãã£ã‡ãŠãÀã			
‡ãŠ.	**ºãÖÔã¹ã‡ãŠ Ôãã£ã¶ã**			
	14. ,ãã‡ãŠãÍãÌãäã¥ãã			
	15. ªÀªÍã¶ã			
	16. Ìã¦ã½ãäã¶ã¹ã¨ã			
	17. Íã¦ãäã Ôãäã Ö¦¾ã/ ã¶ã¾ã¦ã‡ãŠãäã Ê‡ãŠ			
	18. ¹ã ªÍã¶ã			
	19. ½ãßãÌã			

	20. ƒ¦›À¶ã›			
¡.	**Øã›Ôã¹ã‡ãŠ**			
	21. ‡ãŠ¦ãã¡ ¹ãã¦¾ãã¡à‡ãŠ			
	22. ¹ãã¡À¥ãã½ã ¹ãã¦¾ãã¡à‡ãŠ			
	23. ¹ãã Íãà㥠ã Ìã Øã			
	24. Þã Þãã Ôã¨ã			
	25. Íã¦ã‡ãŠÀã¡ ÔãÊÊãã			
ƒ.	**ÔãÔ©ãã¦½ã‡ãŠ Ô¨ãã¦ã**			
	26. Øã㽡¹ã Þãã¾ã¦ã			
	27. ¹ã Þãã¾ã¦ã Ôãã½ã¦ãã¡			
	28. ÔãÖ‡ãŠãÀã¡ ÔãÔ©ãã			
	29. ‡ãŠãÓã ÔãÍãã£ã¶ã ‡ãŠ³			
	30. ‡ãŠãÓã ã Ìã²ãã¹ãã Ÿ¡			
	31. ...Ôã ºãã Øãã¾ã¦ãªãÀ Ôã Üã			
ƒ¡.	ƒ¦åÀ			

23. ãŸºã‡ãŠ ãÔãÞã¶ã ¹ã£ª¦ãã ã Ì ã Ó ã¾ã¡ã Íã¦ã‡ãŠ-¾ãã¶ãã ,ãÔãÊãÊã¡ –ãã¶ã

,ã.¶ã.	ãÍã¹ãŠãÀÔã ‡ãŠÊãÊãã ¹ã£ª¦ã/ ã Ì ã Þãã À Êã Êã¡ ¹ãÍ¶ã	,ã¹ãã à ã¦ã „¦¦ãÀ	–ãã¶ãã Þãã ¹ãã¦ãßã		
			Ôã¹ã¥ã	,ãÍã¦ã:	¶ãã Öã
1.	ãŸºã‡ãŠ ãÔãÞã¶ãã Ôãã Ÿã¡ Êãã Øã¥ãã Àã¡ ã‡ãŠ¦ãã¡ ãÌã•ã ,ãã Ìã Í¾ã‡ãŠ ,ãã Ö?	1. ªãºã [1 ã‡ãŠ/Ôã½ãã] 2. „¦Ôã•ã¶ã			
2.	¦ã½ã Þ¾ãã ½ã¦ã¡ •ã½ãã¶ã Ôã½ã¹ãã¦ãßã¡ã¦ã ‡ãŠ¥ã¡ ,ãã Ìã Í¾ã‡ãŠ ,ãã Ö¡ ‡ãŠã?	¶ãã Öã¡			
3.	ãŸºã‡ãŠ ãÔãÞã¶ã ¹ã£ª¦ãã½ãßã¡ ¹ãã¥¾ãã Þãã ã‡ãŠ¦ãã¡ ºã Þã¦ã Öã¦ã?	40 ¦ã¡ 60 ›‡ã‡ãŠ			

4.	...Ôã „¦¹ãã ª¶ãã¦ã ¾ãã ¹ã£ª¦ãã½ãßã „¦¹ãã ª¶ãã¦ã Ìãã¤ Öã¦ã ‡ãŠã¾ã? ,ãÔãÊ¾ããÔã ã‡ãŠ¦ãã?	Öã¾ã, 15 ¦ã 30 ›‡ã‡ãŠ			
5.	¾ãã ¹ã£ª¦ããÔã ¹ãã¥ãã ª¥¾ããÔã Êãã Øã¥ãã Àã Ìãß ¦ã½Öã ‡ãŠÔãã ŸÀÌãã Êã?	1. ÔãÀãÔãÀã ¹ãã¥ãã/ ¦ãã›ã 2. ¦ãã›ãÞ¾ãã ÔãŒ¾ãã 3. ã¹ã‡ãŠãÞãã ØãÀ•ã			
6.	¦ã½Öã ½ãŒ¾ã ,ãã㥠„¹ã½ãŒ¾ã ¶ãßã ã‡ãŠ¦ãã ãª Ìãôãã¶ãã ÔÌãÞœ ‡ãŠÀ¦ãã?	½ãã Ö¶¾ãã¦ã¶ã †‡ãŠª ã			
7.	Ìãã ß Øãã ß¥ã¾ã¨ãã Þãã „¹ã¾ãã Ø ‡ãŠã¾å?	¹ãã¥¾ãã½ã£ãã Ê ,ãã Ìã³ãÌ¾ã ¹ãª©ã ,ãÊãØã ‡ãŠÀ¥¾ãã Ôãã Ÿã			
8.	•ãã ß ãª ãÀ Øãã ß¥ã¾ã¨ãã Þãã „¹ã¾ãã Ø ‡ãŠã¾å?	Œã¦ãã Þã ,ãã Ìã³ãÌ¾ã Œã¡¦ ,ãÊãØã ‡ãŠÀ¥¾ãã Ôãã Ÿã			
9.	¹ãã¥ãã ª¥¾ãã¹ãÌãã ¦¾ãã Þã ¹ã©ã:‡ãŠÀ¥ã ,ãã Ìã Í¾ã‡ãŠ Ôã½ã•ã¦ãã ‡ãŠã¾å?	Öã¾ã			
10.	¦ã½Öã ½ãŒ¾ã ¶ãß ã Þãã Ì¾ãã Ôã ‡ãŠã¥ã¡¾ãã ,ãã£ãã À¦ ŸÀÌãã Êã?	1. ª ãº ã 2. „Þãã 3. „¦Ôã•ã¶ã			

21. ¹ãã¦ãã‰ãŠ¾ãã

½ãäØã 2

...Ôãä¦ãäÊã ãŸº㇠ãÔãÞã¶ã ¹£ª¦ãäÞã ãÌãÍÊãÓã¥ã

¦ã‡ã¦ãä 1.

,ã. ¶ã.	Ìãóã	ãŸ‡ãšã¥ã	ÔãÌÖ/ Øã› ¶ã	ã¹ã‡ãš	àã¨ã (Ö)	•ãä½ã¶ãäÞâä ¹ã‡ãšãÀ	ãÔãÞã¶ã ¹£ª¦ã	Êãäã Ø ã Ì ã ¡ ãÞãäã ¦ãäÀãŒã	¦ãäã ¡ ¥ãäã Þãäã ¦ãäÀãŒã
1.	2005-06								
2.	2006-07								
3.	2007-08								
4.	2008-09								
5.	2009-10								

¦ã‡ã¦ãä 2.

,ã. ¶ã.	Ìãóã	Íãã¦ã‡ãšÀã Üã¦ã ,ãÔãÊãÊãã ½ãŒ¾ã ã¹ã‡ãš	ã¹ã‡ãšã¹ãäÔã¶ã Íã¦ã‡ãš–¾ãäÞã ÔãÀâÔãÀã „¦¹ã¸ã (Á./Ìãóã)	Íã¦ãäÌ¾ãã¦ãÀã‡ã¦ã ã½ãß¥ãäÀ ÔãÀãÔãÀã „¦¹ã¸ã (Á./Ìãóã)	ãÔãÞã¶ã ¦ã¨ã Ìãã¹ãÀãÞãã ŒãÞã		
					Ö Ø ã ½ ã ã Œ ã Þ ã Á./Ö.	, ãã Ì ã ¦ ãã Œ ã Þ ã / Ö ã ¦ ãã ß ¥ ãã Œ ã Þ ã Á./Ö.	Ôã Þ ãã Þ ãã ‡ãš ã Ê ã ½ ã ¾ ãã ª ã
1.	2005-06						
2	2006-07						
3	2007-08						
4	2008-09						
5	2009-10						

¦ã‡ã¦ãä 3.

,ã.	Ìãóã	ãŸ‡ãšã¥ã	¹ãäÀ¹ãäãäÀ‡ãš ãÔãäÞã¶ã ¹£ª¦ã	ãŸº㇠ãÔãäÞã¶ã ¹£ª¦ã	Ìãäã¤ÊãÊÊãä	¹ãäã¥ãäã	Ìãäã¤ÊãÊãä

¶ã.			ã¶ãâÌà ÓŸã ŒãÞã (Á/Ö)	ãªÊãÊã ¹ãâ¥ãâ (Ôã½âã/Ö)	†‡ãš¥ã „¦¹ãâª¶ã (ã‡ãš.)	ã¶ãâÌà ÓŸã ŒãÞã (Á/Ö)	ãªÊãÊã ¹ãâ¥ãâ (Ôã½âã/Ö)	†‡ãš¥ã „¦¹ãâª¶ã (ã‡ãš.)	ã¶ãâÌà ÓŸã ŒãÞã / Ö Øãâ½ã (Á./Ö.)	ºãÞã¦ã (Ôã½âã/Ö.)	„¦¹ã¸ã (ã‡ãš./Ö.)
1	2005-06										
2	2006-07										
3	2007-08										
4	2008-09										
5	2009-10										

¦ã‡ã¦ãâ 4.

,ã. ¶ã.	Ìãóã	ãŸ‡ãšã¥ã	ãŸºã‡ãš ãÔãÞã¶ã ¹ã£ª¦ã		¶ã¹ãšã : ŒãÞã Øã¥ãâ¦¦åÀ		¹ãâ¥ãâ Ìãâ¹åÀ ‡ãšã¾ãà ã½ã¦ãâ	
			¹ãâ¥ãâ ºãÞã¦ã (%)	„¦¹ãâª¶ãâ¦ã Ìãâ¤ (%)	¹ãâÀ¹ãâãÀ‡ãš ¹ã£ª¦ã	ãŸºã‡ãš ãÔãÞã¶ã	ãŸºã‡ãš ãÔãÞã¶ã (ã‡ãšÊãâ/Ö. Ôã½âã)	¹ãâÀ¹ãâãÀ‡ãš ¹ã£ª¦ã (ã‡ãšÊãâ/Ö. Ôã½âã)
1.	2005-06							
2	2006-07							
3	2007-08							
4	2008-09							
5	2009-10							

¦ã‡ã¦ãâ 5.

Ô©ãß	¦ãâ¤ãÞãã ÔãÀãÔãÀã¤ ¹ã¦ãâÖ	¦ãâ¤¾ãâÞ¾ãâ ¹ã¦ãâÖãÞãâ¤ Ôã½âã¶ã¦ãâ	Ôã‡ãšÀã¾ã aãºã	aãºã Ì¾ã¾ã			a¶Œã¼ãâÊã Ìãâ À¦ãâ	„a¼ã¦ã¥ãâ-¾ãâ Ôã½ãÔ¾ãâ	Íã À ã
				„¹ã¶ãÊãâ‡ãš¦ãâÊã aãºã Ì¾ã¾ã	½ãŒ¾ã ¶ãÊãâ‡ãš¦ãâÊã aãºã Ì¾ã¾ã	„¹ã½ãŒ¾ã ¶ãÊãâ‡ãš¦ãâÊã aãºã Ì¾ã¾ã			

2. ...Ôãã½ã£¾ã ãŸºã‡ãŠ ãÔãÞã¶ã ¹ã£ª¦ããÞã ¹ãŠã¾ª

1. ¹ãã¥¾ããÞãã ºãÞã¦ã Öã¦ã ‡ãŠã? Öã¾ã/ ¶ããÖã

   •ãÀ Öã¦ã ,ãÔãÊã ¦ãÀ ã‡ãŠ¦ãã?

2. ‡ãŠã½ãØããÀ ºãÞã¦ã Öã¦ã ‡ãŠã? Öã¾ã/ ¶ããÖã

   •ãÀ Öã¦ã ,ãÔãÊã ¦ãÀ ‡ãŠÍãã?

3. ¦ã¥ãã¶ã¾ã¨ã¥ãã¦ã ½ãª¦ã Öã¦ã ‡ãŠã? Öã¾ã/ ¶ããÖã

4. ã¹â‡ãŠãÞ¾ãã Øã¥ãÌã¦¦ã¦ã Ôã£ãàÀ¥ãã Öã¦ã ‡ãŠã? Öã¾ã/ ¶ããÖã

5. •ãã½ã¶ããÞãã „¦¹ããª‡ãŠ¦ãã ,ãããà¥ã „¦¹ããª¶ãàã½ã¦ãã ã¶ã¾ãã¨ã¦ã ÀãÖ¦ã ‡ãŠã? Öã¾ã/ ¶ããÖã

6. ÀãØã Ìã ã‡ãŠ¡ ã¶ã¾ã¨ã¥ãã¦ã ½ãª¦ã Öã¦ã ‡ãŠã? Öã¾ã/ ¶ããÖã

7. ªãºã ãÔãÞã¶ãã¦ã¶ã ¦ã½Öã Œã¦ã ª¦ãã ‡ãŠã? Öã¾ã/ ¶ããÖã

¼ãäØã 3

1. ãŸºã‡ãŠ ãÔãÞã¶ã ¹ã£ª¦ãäãÌãÓã¾ãä Íã¦ã‡ãŠ–¾ãã¶ãã ,ãÔãÊãÊ¾ãã Ôã½âÔ¾ãã

,ã.¶ã.	Ôã½ãÔ¾ãã	Öã¾ã	¶ãäÖä
1.	ãŸºã‡ãŠ ãÔãÞã¶ã ¹ã£ª¦ãäã Ìãã¹ãÀ¥¾ãäãÌãÓã¾ãä? ãŸºã‡ãŠ ãÔãÞã¶ã ¹ã£ª¦ãäã Ìãã¹ãÀ¦ãã¶ãã ¦ãäãä¨ã‡ãŠ ,ã¡Þã¥ãäã ¾ã¦ãã¦ã		
2.	ÔãäÖã¦¾ãäãÞãäã ,ã¶ã¹ãÊã°£ã¦ãã ãŸºã‡ãŠ ãÔãÞã¶ã ÔãÞãäãÞã ÔãäÖã¦¾ã Ô©ãäã¶ã‡ãŠ ãŸ‡ãŠã¥ãäã „¹ãÊã°£ã Öã¦ã ¶ãäÖã		
3.	ãŸºã‡ãŠ ãÔãÞã¶ã ¹ã£ª¦ãäã °ãÔãÌã¥¾ãäÔãäŸã ÔãÁÌãã¦ãäÔã •ãäÔ¦ã ŒãÞã ¾ã¦ãäã		
4.	‡ãŠ•ã ã½ãßÌã¥¾ãäÔãäŸãÞãäã ¹ã£ª¦ã ã‡ãÊãó› ,ãäãã¥ã ãÌãÊã°ã‡ãŠãÀ‡ãŠ ,ãäÖ		
5.	‡ãŠ•ã ã½ãß¥¾ãäÔãäŸã ãÌãÊã°ã ÊãäØã¦ãäã		
6.	ãŸºã‡ãŠ ãÔãÞã¶ã ¹ã£ª¦ãäãÌãÓã¾ãä ¦ãäãä¨ã‡ãŠ –ãä¶ãäÞãä ,ã¼ãäÌã ,ãäÖ		
7.	ãŸºã‡ãŠ ãÔãÞã¶ã ÔãÞãäÞ¾ãä ¼ãäØãäÞãäã ã‡ãŠ½ã¦ã ,ãÌãä•ãÌãä/ •ãäÔ¦ã ,ãäÖ		
8.	ãÌã•ãÞãäã „¹ãÊã°£ã¦ãä ,ãäã¶ã¾ãä½ã¦ã ,ãäÖ		
9.	,ã¹ãÀã ¹ãäã¥ãäã¹ãÀÌãŸ¾ãäã½ãßã ¹ãäã¥ãäã Ì¾ãÌãÔ©ãä¹ã¶ã ÔãÀßã¦ã Öã¦ã ¶ãäÖã		
10.	ãÌã‰ãŠ¦¾ãäã‡ãŠ¡¶ã ÔãÌãäãÞãäã ,ã¼ãäÌã ãÌã‰ãŠãÍÞãã¦ã ãÌã‰ãŠ¦¾ãäã‡ãŠ¡¶ã ÔãÌãäã ã½ãß¦ã ¶ãäÖã		
11.	ãŸºã‡ãŠ ãÔãÞã¶ã ¹ã£ª¦ãäãÌãÓã¾ãä ¹ãäãÍàã¥ãäãÞãäã ,ã¼ãäÌã ,ãäÖ		
12.	„ª ãÀ Ìã Üã Íãä¹ãäÔã¶ã ¨ãäÔã		

13.	ãŸº¤âŠ ãÔãÞã¶ãã¦ã Þãã¤âŠ¸â¹ã Öã¦ã.		
14.	Øãß¦ãã Öã¦ã.		
15.	ãŸº¤âŠ ãÔãÞã¶ãã¦ã „¹ã¶ãß¾ããÞãã ¦ã›¥¾ããÞãã ¨ãâÔã		

2. ãŸºã‡‡šÃ ãÔãÞã¶ãã ¹ã£ª¦ãäãÌãóã¾ãã Íã¦ã‡‡š–¾ãã¶ãäã ‡‡šÊãÊ¾ãã ÔãÞã¶ãäã

,ã.¶ã.	Ôã¼ãÔ¾ãã		Öã¾ã	¶ãäÖã
1.	‡‡š•ãäÞãäã ÌãßÌãÀ¦ãäã „¹ãÊãº£ã¦ãäã			
2.	ãÌã‰ãš¦¾ãã‡‡š¡¶ã ãÌã‰ãš¹ãÍÞãã¦ã ã¶ã¾ãäã½ã¦ã ½ãäØãªÍã¶ã ,ãäãã¥ã Ôãìãäã ª¥¾ãã¦ã ¾ãäÌäã			
3.	ãŸºã‡‡š ãÔãÞã¶ã ÔãÞãäÞãäã ã‡‡š½ã¦ã ‡‡šÀãÌãäã			
4.	ãŸºã‡‡š ãÔãÞã¶ã ÔãÞãäÞã ¼ãäØã Ìãä•ãÌãäã ªÀã¦ã „¹ãÊãº£ã ÌÖãÌãäã ãŸ‡‡šã¥ãäã „¹ãÊãº£ã¦ãäã			
5.	ÔãÞãäÞ¾ãäã ¼ãäØäãÞãäã Ô©ãäã¶ã‡‡š ãŸ‡‡šã¥ãäã „¹ãÊãº£ã¦ãäã ÌÖãÌãäã			
6.	ãŸºã‡‡š ãÔãÞã¶ã ÔãÞãäÞã ,ã¶ãªãã¶ãäã½ãÊ¾ãã Ìãä¤ ‡‡šÀãÌãäã			
7.	ÔãÞã Ìãä¹ãÀ¥¾ãäÔã ¦¾ãäÞã ÔãÞãäãìãÔã¾ãäã –ãã¶ã ,ãäãã¥ã ‡‡šãÍãÊ¾ã Ìãä¤Ìã¥¾ãäÔã ¹ãäãÍãàã¥ãäÞãäã ØãÀ•ã ,ãäÖ			
8.	ãÌã‰ãš¦¾ãã‡‡š¡¶ã/ ÔãÀ‡‡šãÀã ÔãÔ©ãä‡‡š¡¶ã ¹ãã¦¾ãäãà‡‡šãÞã ,ãã¾ãä•ã¶ã ÌÖãÌã			
9.	ã¶ã¾ãã¼ã¦ã Ìãä•ã¹ãÀÌãŸã ÌÖãÌãäã			
10.	¹ãä¥¾ãäÞãã ¹ãÀÔãä ,ãäãã¥ã ã¶ã¾ãã¼ã¦ã ¹ãÀÌãŸã ÌÖãÌãäã			
11.	¦ãäã>¾ãäÞ¾ãäã ÔãŒ¾ãºã¬ãªÊã ¦ã½ÖãÊãäã ,ãÔãÊãÊãäã ½ãäãÖ¦ãäã Ôãäã Øãäã	1. ‡‡š½ãäã ¹ã¦ãäÞãäã •ã½ãäã¶ã 4 Êãäã/¦ãäÔã ªã¶ã ¦ãäã>¾ãäã 2. „¦¦ã½ã ¹ã¦ãäÞãäã 4 Êãäã/¦ãäÔã †‡šã ¦ãäã>ã		
12.	¦ã½ãÞ¾ãäã ½ã¦ã ¦ãäã>ã¾ã£¾ã Ôãäã‡‡šãäã ‡‡šÍãã¼ãßã Ôãäã Ÿ¦ãäã?	1. Ìãäãß 2. Øãäãß		
13.	Øãäãßã½ãßã ºã•ãÊãÊãäã ¦ãäã>ã ¹ã¶ÖãäÍ‡‡šãäã ‡‡šã¾ãäãã¶Ìã¦ã ‡‡šÀãâÊã	Öã¾ã¡ã‡‡ãÊãäãÀ‡‡šã ,ãã¼Êã [2 >‡ã‡‡šã] ¹ãäã‰ãš¾ãã		
14.	½ãŒ¾ã ,ãäãã¥ã „¹ã½ãŒ¾ã¶ãßãã ÔÌãÞœ ‡‡šÀ¥¾ãäÔãäŸã ¦ã½Öãã ‡‡šãã¥ã¦¾ãäã ¹ã£ª¦ãäÞãäã „¹ã¾ãäãØã ‡‡šÀãÊã?	„ÞÞã ªãºã¾ã‡ã¦ã ¹ãäã¥¾ãäÞãäã ¹ãšÌãäÀãã		
15.	¦ã½Öãã „¦ãäÀãÊãäã ¦ãäã>¾ãäã ‡‡šÍãäã ºãÔãÌãäÊãã?	„¦ãäÀãÊãäã ‡‡šã>‡‡šã¶ãä¦ã		
16.	„¹ã½ãŒ¾ã ¶ãßãã ¦ã½Öãã •ãä¼ã¶ãäã¦ã ãã‡‡š¦ãäã ,ã¦ãÀã¹ã¾ã¦ã Øãäã¡ãÊã?	1 ¹ãšã>		
17.	¦ãäã>¾ãäÞãäã ã¶ãÌã¡ ‡‡šÀ¦ãäã¶ãäã ‡‡šãã¥ã¦¾ãäã Øãäã Ó>ã	1. „¦Ôã•ã¶ã		

	£¾ãã¶ãã¦ã Ü¾ããÊã?	2. ã‡ãš½å¦ã 3. ¦ãã›¾ããÞãã Ì¾ãâÔã		
18.	ãŸºã‡ãš ãÔãÞã¶ã ¹ã£ª¦ãã¦ã¶ã Œã¦ã ª¥¾ãâÔãäŸã ¦ã½Öã ‡ãšã¥ã¦¾ãã ¹ã‡ãšàÞãã Œã¦ã Ìãã¹àÀâÊã?	¹ãã¥¾ãã½â£¾ã ãÌã³ãÌ¾ã ,ãÔãÊãÊãã Œã¦ã		
19.	¾ãã ¹ã£ª¦ãã½â£¾ã ¹ãã¥ãã ,ãâã¥ã Œã¦ããÞã ¹ã½âã¥ã ã‡ãš¦ãã ,ãäÖ?	1:10		
20.	ãÌã³ãÌ¾ã Œã¦ãäºãäºã¦ãã¦ã ãŸºã‡ãš ¹ã£ª¦ãã½â£¾ã ‡ãšã¥ã¦ãã ‡ãšßãã Ü¾ãâÊã?	100 ›‡ã‡ãš ãÌã³ãÌ¾ã Œã¦ããÞãã Ìãã¹àÀ		
21.	ãŸºã‡ãš ãÔãÞã¶ã ¹ã£ª¦ãã´àÀ¦ã½Öã ‡ãšã¥ã‡ãšã¥ã¦ãã Œã¦ã ²ãâÊã?	¾ãâÀ¾ãã, ¡ã¾ã,ã½âãäã¶ã,ã½ã ÔãÊ¹ãš›, ½¾ãiÀ› ,ãã¹ãš ¹ãã›Íã		
22.	¾ãã ¹ã£ª¦ãã½ãß Œã¦ãäÞãã ã‡ãš¦ãã ºãÞå¦ã Öã¦ã?	25 ›‡ã‡ãš		

8. VITA

Nilesh Jalindar Dharam

A Candidate for the degree
of
MASTER OF SCIENCE (AGRICULTURE)
in
IRRIGATION WATER MANAGEMENT
2012

Title of thesis : "Constraints identification of drip irrigation for sugarcane in Ahmednagar district".

Major field : Irrigation Water Management

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