FINAL REPORT

SOCIO ECONOMIC EVALUATION OF DRIP IRRIGATION IN KERALA

SUBMITTED TO

INDIAN NATIONAL COMMITTEE ON SURFACE WATER
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KUNNAMANGALAM, KOZHIKODE-673 571, KERALA

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PROJECT DETAILS

Project Title: Socio economic evaluation of drip irrigation in Kerala

Implementing Institution: Centre for Water Resources Development & Management (CWRDM), Kozhikode- 673 571, Kerala

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Project Duration: Two and a half years

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1. Mr. Basil Basheerudeen - SRF (07-07-2009 to 12-07-2010)
2. Miss Hredhya Haridas - SRF (04-04-2011 to 12-12-2011)
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1. Introduction

Kerala state, which receives an average annual rainfall of 3000mm during the period June to November experiences summer during December to May. This necessitates irrigation for crops for improving yield, which is of utmost importance for Kerala farmers, who operate under high cost of cultivation, primarily due to costly labour and non remunerative market value for their produce. Coconut is the main upland crop of the state, occupying about 41% of the net sown area. Many farmers also cultivate intercrops such as arecanut, banana, vegetables etc. in their coconut gardens. The average productivity of coconut in the state is only 35 nuts per palm per year. Only 20% of the total cropped area under coconut is irrigated in Kerala, which is an important reason for the low crop productivity observed.

Farmers usually practice water consuming surface irrigation methods. Irrigating more area in Kerala through traditional surface irrigation methods is a difficult task on account of water scarcity experienced during summer in many parts of the state, and the undulating topography existing in areas, where upland crops are grown. This is where water economizing methods like drip irrigation offer considerable scope. Drip irrigation is suitable for widely spaced crops like coconut, for which, the cost of drip installation will not be very high. Hence, drip irrigation is a suitable technique in Kerala, which primarily has a coconut based upland cropping system. Further, the subsidy provided by the Agriculture Department for drip irrigation (presently 90%) could be a factor enabling adoption of the irrigation technique by farmers.

However, INCID (1994) reports an area of 3035 ha under drip irrigation in Kerala, out of a total of 70,859 ha for the country. The Status Report (2002) of the Dept. of Agriculture, Kerala on use of plastics in agriculture shows the area under drip irrigation in the state in the range of only 647 to 1330 ha during the period 1996-97 to 1999-2000, even when subsidy @ 70 to 90% was provided to farmers. This report also mentions that during October 2002, 217.72 lakhs under drip/sprinkler irrigation subsidy component remained unspent. This indicates that there exist problems related to adoption of drip irrigation in the state. This is again supported by the Govt. of India report (2004) on micro irrigation, which mentions that only 1.5% of the cultivated area in Kerala is under drip irrigation.

Rane(2011) reports that the area under micro irrigation, including drip irrigation, is only 15885 ha, which works out to 0.6% of the cultivated area in Kerala.

From this, it is clear that there are constraints in adoption of drip irrigation by farmers in Kerala. This warrants an empirical analysis, which has been attempted under this CWRDM project funded by INCID, MoWR, Government of India.

2. Objectives

(i) To study the rate of adoption of drip irrigation and analyze the socioeconomic and institutional factors contributing to adoption and non adoption of drip irrigation system by farmers

(ii) Extension programme on drip irrigation through

(a) Organizing drip irrigation seminars involving drip irrigation adopters, non adopters, officials of the Agriculture Department and drip irrigation firms

(b) Documentation of the programme

3. Methodology

During the first year, the project was undertaken in Kozhikode district of Kerala. Data was collected using pre-tested interview schedules (Shown in Annexure I and Annexure II) from 75 farmers who have adopted drip irrigation and from 50 farmers practicing traditional method of surface irrigation under coconut based cropping system. During the second year, the project was carried out among 75 drip irrigating farmers and 50 farmers practicing surface irrigation in Thrissur district using the interview schedules.

Based on enquiry with the Agriculture Department and Drip irrigation firms, they sent us a list of 79 farmers in Kozhikode and 83 farmers in Thrissur district, who have adopted drip irrigation during the last five years. From this list, 75 farmers each were considered for study in the two districts. One thing, which is indicative of the number of drip irrigation adopters obtained, is that the rate of adoption is low in both the districts. This is also supported by the response of Agriculture Department officials from various

districts during group discussion (presented in this report under the head - Perceptions of Agriculture Department officials on drip irrigation).

Based on the data collected from farmers using the interview schedule, adoption of drip irrigation by farmers was quantified as an adoption index, which is a weighted total score of eight items of drip irrigation adoption, which are shown below. Weightage was given based on the relative importance of each item to adoption of drip irrigation. The sum of weights of all the items was equal to one. The score for each item, multiplied with its weightage gives the weighted score of the item.

a. Area under drip irrigation for various crops

b. Number of years of adoption of drip irrigation

c. Utilizing subsidy for drip irrigation installation

d. Components installed in drip irrigation system

e. Type of emitter used in drip irrigation system

f. Practicing fertigation along with drip irrigation

g. Applying fertilizers directly to soil while adopting drip irrigation

h. Continuation of drip irrigation

Data of drip irrigating farmers and farmers practicing surface irrigation methods on socio economic characteristics such as age, education, farming experience, landholding size and non-farm income source, reasons for adopting drip irrigation, constraints in continuing drip irrigation, crops irrigated through surface irrigation, surface irrigation methods practiced, reasons for not irrigating the entire cultivated area through surface irrigation, awareness on drip irrigation among surface irrigators, interest to adopt drip irrigation and reasons for not having interest among farmers practicing surface irrigation, crop yield under drip irrigation/surface irrigation methods etc. were also collected using the interview schedules.

The collected data has been primarily analyzed as percentage of farmers reporting. Statistical tests were also carried out for interpretation of the data.

Focused group discussions were held with the Agriculture Department officials in Thiruvananthapuram, Kollam, Thrissur, Palakkad, Malappuram, Kozhikode, Kannur and Kasaragod districts on various aspects related to drip irrigation such as extent of adoption of drip irrigation by farmers, procedure followed in identifying farmers, reasons for drip irrigation adoption by farmers, constraints in adoption/continuation of drip irrigation, benefits of drip irrigation, drip irrigation subsidy scheme etc. Principal Agricultural Officer, Deputy Directors, Assistant Directors and Agricultural Officers of the concerned districts participated in the discussions.

Under this project, a *Drip Irrigation Manual* was published during December 2011 (Madhava Chandran *et al*, 2011) containing the results of various drip irrigation projects, including this project, carried out by CWRDM in Kerala and reported work on drip irrigation in the state by Central Plantation Crops Research Institute (CPCRI), Kasaragod and Kerala Agricultural University (KAU).

As envisaged under the project, drip irrigation seminars were organized in Kozhikode and Thrissur districts, involving officials of Agriculture Department, farmers adopting drip irrigation and traditional irrigation methods and representatives from drip irrigation firms. *Drip Irrigation Manual* was released by the Vice Chancellor of Calicut University, Prof. (Dr.) M. Abdul Salam, who inaugurated the seminar. Presentation by experts was followed by discussion among farmers, department officials and representatives from drip irrigation firms and experts, which was helpful in generating useful information on various aspects of drip irrigation technique.

4. Results and Discussion

4.1. *Socioeconomic profile of farmers adopting drip irrigation*

Table 1 gives details of the age of drip irrigation adopters in the two districts under study. 26.7% each of farmers fall in the age group of 51-60 years and 71-80 years in Kozhikode district. In Thrissur district, 30.8% farmers fall in the age group of 41-50 years, followed by 25.6% farmers in 51-60 years. In the both the districts, the number of farmers in the lowest age group (up to 40 years) and the upper most age group of 81-90 years is significantly less (Table 1).

Table 1. Age of farmers adopting drip irrigation

Kozhikode District		Thrissur District	
Age group (years)	Farmers (%)	Age group (years)	Farmers (%)
35-40	6.6	31-40	2.6
41-50	16.7	41-50	30.8
51-60	26.7	51-60	25.6
61-70	16.7	61-70	25.6
71-80	26.7	71-80	10.3
81-90	6.6	81-90	5.1
	100		100

It can be made out from Table 2 that in both the districts, majority of the farmers have education between 8th and 10th standard (SSLC). It is a positive trend that about 30% of farmers in both the districts have completed their Degree course. This highlights the educational status of people in Kerala, which is reported to be the highest in the country. Higher level of education is helpful for farmers to have better awareness on innovations such as high yielding crop varieties, improved irrigation techniques, fertilizers/plant protection etc.

Table 2. Education of farmers adopting drip irrigation

Kozhikode District		Thrissur District	
Education	Farmers (%)	Education	Farmers (%)
Up to 4th std	3.3	Up to 4th Std	5.1
5th- 7th std	6.7	5th-7th Std	5.1
8th std -SSLC	46.7	8th Std -SSLC	43.6
Pre-degree/ Plus Two	13.3	Pre-degree/ Plus two	12.9
Degree	30.0	Degree	33.3
	100		100

With regard to farming experience, even though the data of Kozhikode farmers does not show any perceptible trend, in the case of Thrissur farmers, the number mostly decreases with an increase in their farming experience (Table 3). With regard to the most experienced farmers, in both the districts, the proportion is the lowest (6.8% in Kozhikode and 7.7% in Thrissur) among all the categories of farming experience.

Table 3. Farming experience of farmers adopting drip irrigation

Kozhikode District		Thrissur District	
Farming experience (years)	Farmers (%)	Farming experience (years)	Farmers (%)
5 - 10	13.3	1 - 10	25.6
11 - 20	10.0	11 - 20	18.0
21 - 30	23.3	21 - 30	20.5
31 - 40	10.0	31 - 40	15.4
41 - 50	13.3	41 - 50	12.8
51 - 60	23.3	51 - 60	7.7
61 - 70	6.8		100
	100		

It can be inferred from the data presented in Table 4 that In Kozhikode district, 66.7% of drip irrigation farmers has landholding size of 0.2 to 1.5 ha, while in Thrissur district, 76.8% come in this landholding category. Out of this, in Thrissur, majority of the farmers (46.1%) have small landholdings in the range of 0.2 to 0.5 ha only, while in Kozhikode, majority (26.7%) is having landholding of 0.5 to 1.0 ha.

Table 4. Land holding size of farmers adopting drip irrigation

Kozhikode District		Thrissur District	
Land holding (ha)	Farmers (%)	Land holding (ha)	Farmers (%)
0.2 - 0.5	16.7	0.2 - 0.5	46.1
0.5 - 1.0	26.7	0.5 - 1.0	25.6
1.0 - 1.5	23.3	1.0 - 1.5	5.1
1.5 - 2.0	10.0	1.5 - 2.0	10.3
>2.0	23.3	>2.0	12.9
	100		100

In Kerala, agriculture is not remunerative for many of the crops, except for cash crops like rubber, tea, coffee, cardamom etc. This is mainly due to the high labour charges (up to Rs 500/man day) and low crop productivity of crops. Low market value of the produce, an outcome of lack of proper marketing strategies, is also another factor contributing to the uneconomical farming system in the state. Due to this, farmers usually go in for other occupations also such as business, employment in Government /private enterprises etc. for earning non-farm income. This is also supported by the data presented in Table 5, which shows that the maximum proportion of drip irrigation farmers in both the districts earn non-farm income in the range of 75 to 100%. Under the non-remunerative farming system existing in the state, it can be postulated that non-farm income will be required for many of the farmers to adopt costly techniques like drip irrigation.

Table 5. Non-farm income source of farmers adopting drip irrigation

Kozhikode District		Thrissur District	
Share of income from non-farm sources (%)	Farmers (%)	Share of income from non-farm sources (%)	Farmers (%)
Nil	10.0	< 25	7.7
< 25	23.3	25-50	7.7
25-50	13.3	50-75	12.8
50-75	10.0	75-100	71.8
75-100	43.4		
	100		100

4.2. *Adoption of Drip irrigation*

4.2.1. Drip irrigation adoption index

As mentioned under 'Methodology', drip irrigation adoption index of farmers was quantified as a composite weighted score of eight items of adoption. Table 6 shows the drip adoption index of farmers in Kozhikode and Thrissur districts. It can be inferred from the table that in Kozhikode district, about 73% farmers have drip irrigation adoption index in the range of 53.2 to 79.1% of the maximum possible index value. However, in Thrissur district, about 77% farmers have adoption index in the lower range of 34.2 to 60.9% of the maximum possible index value only. Hence, in this study, Thrissur lags behind Kozhikode district in drip irrigation adoption index of farmers. The factors contributing to this have been explained in this report in terms of differences between the two districts with respect to adoption of various items of drip irrigation adoption.

Table 6. Drip irrigation adoption index of farmers

Kozhikode District		Thrissur District	
Drip adoption index*	Farmers (%)	Drip adoption index*	Farmers (%)
53.2-74.3	53.3	34.2-48.9	35.9
76.0-79.1	20.0	51.4-60.9	41.0
80.3-85.2	23.4	62.9-75.4	12.8
89.9	3.3	76.6-89.5	10.3
	100		100

* % of maximum possible adoption index

Table 7 gives details of the crop-wise drip irrigation adoption index of farmers in the two districts. '*t*' test showed significant difference in adoption index of farmers between the districts with respect to all the crops (Table 7). The mean adoption index of farmers for all the crops is higher in Kozhikode, when compared to Thrissur district. This finding also supports the trend in adoption index of farmers in Kozhikode district presented in Table 6.

However, it may be seen from Table 7 that there is not much difference in crop-wise adoption index of farmers in each district. 't' test also did not show significant difference in adoption index of farmers among different crops in both the districts. This indicates that there is no significant variation in adoption of various items of drip irrigation (considered in the quantification of drip irrigation adoption index in this study) between widely spaced crops like coconut and closely spaced crops like banana and arecanut, despite the fact that drip irrigation is comparatively more costly for the latter category of crops. This is an appreciable trend, since, due to the generally un-profitable nature of farming in Kerala, there is a possibility of farmers reducing their area brought under drip irrigation, number of drip irrigation components installed under the system, emitters used etc. in order to save on cost, especially in closely spaced crops. This finding may also be interpreted to mean that farmers, who are interested to adopt drip irrigation, are willing to

follow the guidelines of the drip irrigation firms/Agriculture Department on the number of drip irrigation components to be installed under the system, emitters to be used etc.

Table 7. Crop-wise drip irrigation adoption index of farmers

Crop	Mean drip irrigation adoption index*		*t stat*
	Kozhikode District	Thrissur District	
Coconut	74.7	57.4	-6.6201[a]
Arecanut	74.9	57.8	-4.9926[a]
Nutmeg	77.2	55.6	3.6403[b]
Banana	72.5	57.2	-2.4578[c]

* % of maximum possible adoption index [a-] Significantly different at $p<0.001$

[b-] Significantly different at $p<0.01$ [c-] Significantly different at $p<0.05$

For Kozhikode and Thrissur districts, Table 8 and Table 9 reveal the crop-wise proportion of farmers adopting three items considered for quantification of adoption index of farmers in this study, namely, (i) area of adoption of drip irrigation, (ii) number of drip irrigation components installed, and (iii) type of emitters used. With respect to the other five items considered for quantification of drip irrigation adoption index, namely, (i) number of years of adoption of drip irrigation (ii) utilizing subsidy for drip irrigation installation (iii) practicing fertigation along with drip irrigation (iv) applying fertilizers directly to soil while adopting drip irrigation, and (v) continuation of drip irrigation, since arecanut, nutmeg and banana are cultivated by the farmers under this study as an intercrop under coconut in both the districts, all the farmers reporting adoption of these five components for coconut report them for these intercrops also. This may be contributing to the almost similar adoption index of farmers observed for different crops in each district (Table 7). The analysis of the other three items used for quantification of drip irrigation adoption index is given in the following paragraphs.

It is evident from Table 8 that in Kozhikode district, other than nutmeg (wherein, all the farmers are adopting drip irrigation in their entire cultivated area, thus contributing to the marginally higher drip irrigation adoption index for nutmeg farmers shown in Table 7),

there is not much variation among the other crops in the proportion of farmers falling within different categories of area brought under drip irrigation. This indicates that farmers have not gone in for a marked reduction in the extent of area under drip irrigation for closely spaced crops like arecanut and banana (which have a higher drip installation cost on account of the close spacing), when compared to a comparatively widely spaced crop like coconut. This may be attributed as a reason for the almost similar adoption index of farmers observed for different crops in Kozhikode district (Table 7).

With regard to the number of drip irrigation components installed, Table 8 reveals that for three out of four crops, 50 to 54.5% (comparable proportion) of farmers in Kozhikode district have installed six drip irrigation components. Similarly, the number of farmers who have installed four drip irrigation components is comparable for the three crops. Same is the case with respect to adoption of five drip irrigation components also (Table 8). This is another reason for the almost similar adoption index of farmers observed for various crops in the district (Table 7). Similarly, the proportion of farmers who have installed different types of emitters for the crops (except nutmeg) is also mostly comparable in Kozhikode district (Table 8). This could be the third reason for the trend in adoption index of farmers observed for different crops in Kozhikode district (Table 7). In the case of farmers cultivating nutmeg, a lower proportion (66.6%) of farmers are using a combination of pressure compensating emitters and micro tubes (which was given the maximum score in this study, on account of the fact that this combination of emitters will help to economize on the cost of drip installation – which has been mentioned in the explanation given on type of emitters used presented in Table 25), when compared to farmers cultivating other three crops (Table 8). However, Table 8 shows that a markedly higher percentage of nutmeg farmers are adopting both pressure compensating emitter and ordinary emitter (which have been given the next two higher scores after the above mentioned combination), compared to farmers drip irrigating other crops. This would have resulted in a slightly higher drip irrigation adoption index for nutmeg farmers than coconut/arecanut/banana farmers (Table 7).

Table 9 shows that, except in the case of nutmeg, the proportion of farmers coming within different ranges of area of drip adoption (i.e.; 100%, 50 to 75% and less than 50% of cultivated area) is comparable in Thrissur district. This may be contributing to the more or less similar adoption index of farmers cultivating different crops in the district (Table 7). In nutmeg, unlike in the case of Kozhikode farmers, even though all the Thrissur farmers are adopting drip irrigation in their entire cultivated area (Table 9), this has not led to a significant increase in the adoption index value for nutmeg farmers in Thrissur district (when compared to farmers cultivating other crops). It may be noted that the percentage of nutmeg farmers installing only one drip irrigation component in Thrissur district works out to about 69%, when compared to a range of 46 to 49% farmers in the case of the other three crops (Table 9). Hence, even though all the farmers cultivating nutmeg are adopting drip irrigation in their entire cultivated area in Thrissur ditrict, the lowest drip component score obtained in the study for installing only one component in their drip irrigation system (as mentioned above) by a comparatively more percentage (69%) of nutmeg farmers could have resulted in a lower drip adoption index of 55.6 in the case of nutmeg farmers, as observed in Table 7.

Table 8. Crop-wise adoption of items of drip irrigation adoption index (Kozhikode district)

Crop	Farmers (%)			Farmers (%)			Farmers (%)			
	Area of adoption*			No. of drip irrigation components installed			Type of emitter used			
	100	50-75	<50	6	5	4	PCE+MT	PCE	OE	MT
Coconut	71.4	14.4	14.2	53.6	28.6	17.8	85.6	3.6	3.6	7.2
Arecanut	77.3	14.2	8.5	54.5	27.3	18.2	82.0	4.5	4.5	9.0
Nutmeg	100	-	-	33.3	33.3	33.3	66.6	16.7	16.7	-
Banana	75.0	12.5	12.5	50.0	30.0	20.0	100	-	-	-

*% of cultivated area

PCE- Pressure compensating emitter

OE- Ordinary emitter

MT- Micro tube

Table 9. Crop-wise adoption of items of drip irrigation adoption index (Thrissur district)

Crop	Farmers (%)			Farmers (%)					Farmers (%)				
	Area of adoption*			No. of drip irrigation components installed					Type of emitter used				
	100	50-75	<50	5	4	3	2	1	PCE+MT	PCE	OE	MT	JDS
Coconut	88.6	11.4	-	5.7	14.2	2.9	28.6	48.6	5.0	15.0	40.0	-	40.0
Arecanut	80.0	20.0	-	6.7	6.7	6.7	33.3	46.6	13.3	13.3	73.4	-	-
Nutmeg	100	-	-	7.7	-	15.4	7.7	69.2	7.6	15.3	23.3	-	53.8
Banana	90.0	10.0	-	9.1	9.1	9.1	27.3	45.5	9.1	9.1	63.6	9.1	9.1

*% of cultivated area

PCE- Pressure compensating emitter

OE- Ordinary emitter

MT- Micro tube

JDS- Jet Distribution System

In order to explain the variation in crop-wise adoption index between the two districts observed in Table 7, difference in adoption score for various items of drip irrigation adoption index between the districts for all the crops was analyzed through 't' test. The results, which are significant, are presented below.

The score for number of drip irrigation components installed shows significant difference between Kozhikode and Thrissur farmers for coconut, arecanut, nutmeg and banana farmers (Table 10 to Table 13 respectively).

Similarly, the score of farmers for the type of emitters used also shows significant difference between Kozhikode and Thrissur districts for all the above crops (Table 14 to Table 17). But, the score for years of drip irrigation adoption has significant difference between the two districts in the case of nutmeg only (Table 18).

Table 10. District wise score for number of drip irrigation components installed by coconut farmers

Detail	District		t stat
	Kozhikode	Thrissur	
Mean drip components score*	79.31	42.04	-8.8701[a]

* % of maximum possible score

[a] Significantly different at $p<0.00$

Table 11. District wise score for number of drip irrigation components installed by arecanut farmers

Detail	District		t stat
	Kozhikode	Thrissur	
Mean drip components score*	78.91	40.65	-6.8790 [a]

* % of maximum possible score

[a] Significantly different at $p<0.00$

Table 12. District wise score for number of drip irrigation components installed by nutmeg farmers

Detail	District		t stat
	Kozhikode	Thrissur	
Mean drip components score*	73.81	42.85	-2.8014 [a]

* % of maximum possible score

[a] Significantly different at $p<0.01$

Table 13. District wise score for number of drip irrigation components installed by banana farmers

Detail	District		t stat
	Kozhikode	Thrissur	
Mean drip components score*	78.57	38.57	-4.0097 [a]

* % of maximum possible score

[a] Significantly different at $p<0.00$

Table 14. District wise score for type of emitters used by coconut farmers

Detail	District		t stat
	Kozhikode	Thrissur	
Mean type of emitter score*	93.96	61.71	-6.4327 [a]

* % of maximum possible score [a] Significantly different at $p<0.00$

Table 15. District wise score for type of emitters used by arecanut farmers

Detail	District		t stat
	Kozhikode	Thrissur	
Mean type of emitter score*	91.25	63.63	-3.6470 [a]

* % of maximum possible score [a] Significantly different at $p<0.00$

Table 16. District wise score for type of emitters used by nutmeg farmers

Detail	District		t stat
	Kozhikode	Thrissur	
Mean type of emitter score*	83.33	54.54	2.3612 [a]

* % of maximum possible score [a] Significantly different at $p<0.05$

Table 17. District wise score for type of emitters used by banana farmers

Detail	District		t stat
	Kozhikode	Thrissur	
Mean type of emitter score*	100.00	62.00	-4.6146 [a]

* % of maximum possible score [a] Significantly different at $p<0.00$

Table 18. District wise score for years of drip adoption of nutmeg farmers

Detail	District		t stat
	Kozhikode	Thrissur	
Mean years of adoption score*	79.17	34.09	-5.0652 [a]

* % of maximum possible score [a] Significantly different at $p<0.00$

It can be seen from the data presented in Table 28 that, while all the farmers in Thrissur district are continuing adoption of drip irrigation during the period of this study, only about 43% of farmers in Kozhikode district are continuing drip adoption. Hence, this component of drip irrigation adoption is not contributing to the comparatively higher trend of higher adoption index of Kozhikode farmers, as observed in Table 6.

Since all the farmers in Thrissur district are continuing drip irrigation adoption, they have score of 100 for this component of drip irrigation adoption, while farmers in Kozhikode district have a comparatively lower score for all the crops (Table 19 to Table 22). Table 19 to 22 also shows that there is a highly significant difference in the score for continuation of drip irrigation adoption between Thrissur and Kozhikode drip adopters for coconut, arecanut, nutmeg and banana.

Table 19. District wise score for continuation of drip irrigation adoption of coconut farmers

Detail	District		t stat
	Kozhikode	Thrissur	
Mean continuation of adoption score*	70.68	100.00	6.9306 [a]

* % of maximum possible score

[a] Significantly different at $p<0.00$

Table 20. District wise score for continuation of drip irrigation adoption of arecanut farmers

Detail	District		t stat
	Kozhikode	Thrissur	
Mean continuation of adoption score*	73.81	100.00	3.6686 [a]

* % of maximum possible score

[a] Significantly different at $p<0.00$

Table 21. District wise score for continuation of drip irrigation adoption of nutmeg farmers

Detail	District		t stat
	Kozhikode	Thrissur	
Mean continuation of adoption score*	75.00	100.00	3.1154 [a]

* % of maximum possible score

[a] Significantly different at $p<0.00$

Table 22. District wise score for continuation of drip irrigation adoption of banana farmers

Detail	District		t stat
	Kozhikode	Thrissur	
Mean continuation of adoption score*	66.67	100.00	4.1833 [a]

* % of maximum possible score

[a] Significantly different at $p<0.00$

From the above discussion, it may be inferred that the comparatively higher score obtained for the following items of adoption of drip irrigation by farmers in Kozhikode district explain the higher crop-wise adoption index of farmers observed in Kozhikode district, when compared to Thrissur district (Table 7):

a. Number of drip irrigation components installed by the farmers
b. Type of emitters used by the farmers
c. Continuation of drip irrigation adoption by the farmers

The comparatively higher adoption index of Kozhikode farmers has also been analyzed with respect to the proportion of farmers adopting various items considered for quantification of drip irrigation adoption index such as area of adoption, number of drip irrigation components installed by the farmers etc. The inference is given below.

Area under drip irrigation

From Table 23, it can be made out that while about 87% of Kozhikode farmers have drip irrigation area in the range of 80 to 100% of their cultivated area, the corresponding figure for Thrissur district is only about 54% farmers. This is one of the reasons why Kozhikode farmers possess a comparatively higher drip adoption index than Thrissur farmers, as observed in Table 6.

Table 23. Area under drip irrigation

Kozhikode district		Thrissur district	
Area under drip irrigation*	Farmers (%)	Area under drip irrigation*	Farmers (%)
44 to 58	13.3	12 – 25	10.3
80 to 92	26.7	40 – 55.5	23.1
		62.5 – 75	12.8
100	60.0	80 - 100	53.8
	100		100

*% of cultivated area

Number of drip irrigation components installed

It can be inferred from Table 24 that in Thrissur district, 17.9% farmers use five components in their drip irrigation system, compared to 16.7% farmers in Kozhikode district. However, in Thrissur, 56.4% farmers use only two components of drip system, while, in Kozhikode, 63.4% farmers are using six drip irrigation components. This is another reason why Kozhikode farmers have a comparatively higher drip adoption index than Thrissur farmers (Table 6)

Table 24. Number of drip irrigation components installed

Kozhikode district		Thrissur district	
No. of drip irrigation components installed	Farmers (%)	No. of drip irrigation components installed	Farmers (%)
1	Nil	1	5.2
2	Nil	2	56.4
3	3.3	3	12.7
4	13.3	4	2.6
5	16.7	5	17.9
6	63.4	6	5.2
7	3.3		100
	100		

Type of emitters used

Table 25 gives details of the type of drip irrigation emitters used by farmers in the two districts. Use of emitters connected to micro tubes helps in cutting down the cost of installation of drip irrigation by avoiding looping of laterals around the plants, thereby reducing the length of laterals. Hence, a higher score was given for this type of an emitter combination in this study.

It may be observed from Table 25 that while 86.7% of farmers in Kozhikode district are using both pressure compensating and micro tube emitters, only 10.3% farmers in Thrissur district use this. This can be attributed as another reason for Kozhikode farmers having a comparatively higher drip adoption index than Thrissur farmers (Table 6).

Table 25. Type of emitters used

Kozhikode district		Thrissur district	
Type of emitter used	Farmers (%)	Type of emitter used	Farmers (%)
Pressure compensating emitter	3.3	Pressure compensating emitter	38.5
Both pressure compensating emitter and Micro tube	86.7	Both pressure compensating emitter and Micro tube	10.3
Micro tube	10.0	Micro tube	5.1
	100	Ordinary emitter	33.3
		Micro jet	12.8
			100

One farmer in Thrissur district has fabricated an indigenous type of emitter, which has been termed as "micro sprayer" (Fig.1), and grouped under the category of 'ordinary emitters' in this study. The details of the emitter are explained below.

One end of a micro tube with 2 mm internal diameter and 3.5 cm length is sealed using a candle flame. The micro tube is then bent in the middle of its length and a

slit is inserted here using a blade. The open end of the micro tube is inserted into the drip irrigation lateral line. Water is applied through the slit as a spray.

According to the farmer, clogging of this emitter is minimal, since water is delivered as a spray under pressure. The cost also works out to Rs 2.50/- per emitter only. For coconut, the farmers use six such emitters per plant and four emitters per plant for arecanut. A drip irrigation agency called 'Haritha' located at Perimpilavu in Thrissur district procures this emitter from the farmer and supplies it to other farmers during installation of drip irrigation system. They claim that this type of emitter is popular among farmers.

The address of the farmer, who has fabricated the "micro sprayer" emitter is – Shri. Padmanabhan. K., Karunagath House, Thalassery P.O., Deshamangalam, Thrissur District, Kerala (Land phone: 0488-4278531. Mobile: 09656650558).

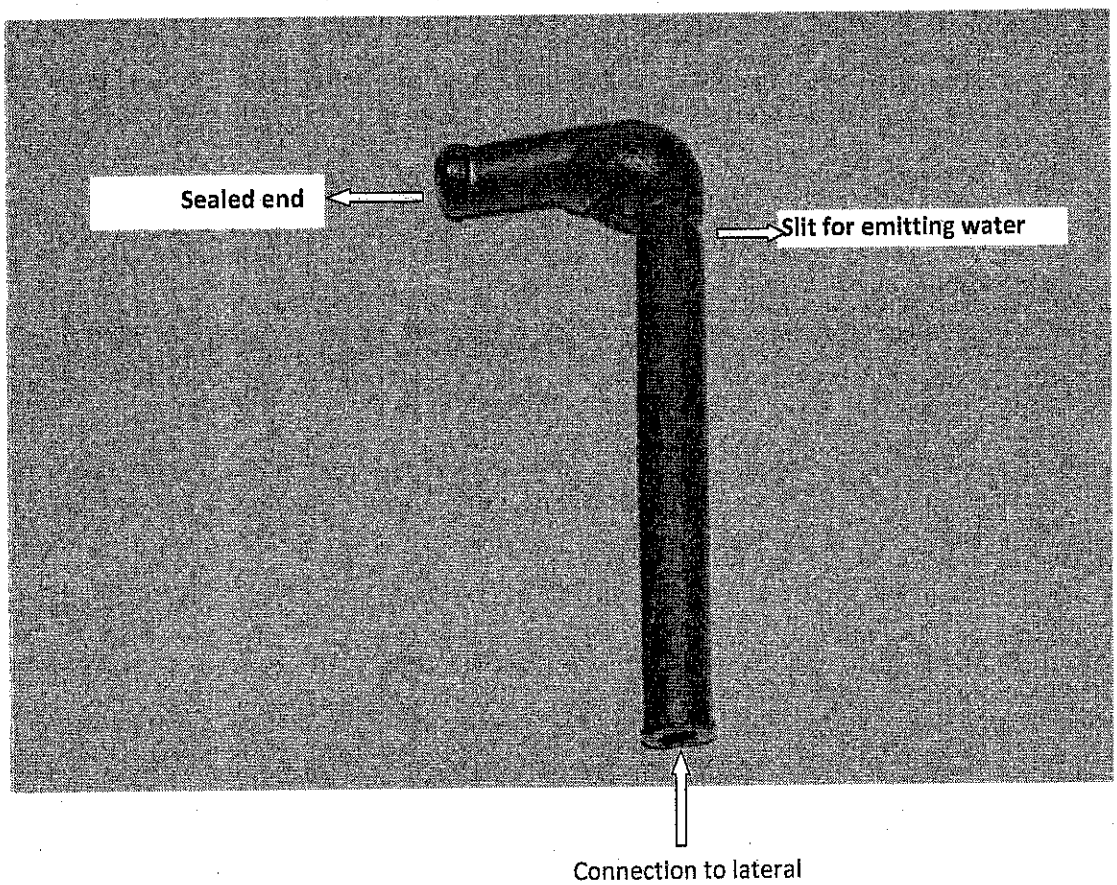

Fig.1. Micro sprayer emitter

Availing subsidy for drip irrigation adoption

From Table 26, it is evident that there is no significant difference between the two districts with regard to the number of farmers availing drip irrigation subsidy from the Agriculture Department. Hence, this component of drip irrigation adoption does not contribute to the comparatively higher adoption index of Kozhikode farmers (Table 6).

Table 26. Farmers availing subsidy for drip irrigation adoption

Kozhikode district		Thrissur district	
Availing subsidy	Farmers (%)	Availing subsidy	Farmers (%)
Yes	96.5	Yes	92.3
No	3.5	No	7.7
	100		100

Period of adoption of drip irrigation

It may be made out from Table 27 that drip irrigation adopters in Thrissur lag behind Kozhikode farmers in terms of the number of years of drip irrigation adoption. About 63% of Kozhikode farmers have a period of adoption ranging from 4 to 13 years, while 59% of Thrissur farmers have an adoption period of 1 to 3 years. This has also contributed to a lower adoption score for Thrissur drip irrigation farmers (Table 6).

Table 27. Period of drip irrigation adoption

Kozhikode district		Thrissur district	
Period of drip irrigation adoption (years)	Farmers (%)	Period of drip irrigation adoption (years)	Farmers (%)
< 1	3.4	1 - 3	59.0
1 - 3	26.6	4 - 6	18.0
4 - 6	26.6	7 - 9	2.6
7 - 9	6.8	10 - 13	10.2
10 - 13	30.0	14 - 17	2.6
14 - 17	6.7	18-20	5.0
		>20	2.6
	100		100

Continuation of drip irrigation

Table 28 reveals that while all the farmers in Thrissur district are continuing adoption of drip irrigation during the period of this study, the figure for Kozhikode is only about 43% farmers. Hence, this component of drip irrigation adoption is not contributing to the comparatively higher adoption index of Kozhikode farmers (Table 6).

Table 28. Continuation of drip irrigation

Kozhikode district		Thrissur district	
Continuing drip irrigation	Farmers (%)	Continuing drip irrigation	Farmers (%)
Yes	43.3	Yes	100
No	56.7		
	100		

Adoption of fertigation under drip irrigation

None of the farmers in the two districts were found to practice fertigation through drip irrigation due to the cost involved in installing the fertigation unit.

Direct soil application of fertilizers while practicing drip irrigation

Fertilizer application along with irrigation will contribute to both yield increase and better nutrient use efficiency. Hence, even if farmers are not installing a fertigation unit under drip irrigation due reasons such as cost involved etc., it will be useful if they can do conventional spot application of fertilizers in the soil in split doses while adopting drip irrigation. Considering this, the item, namely, direct soil application of fertilizers by farmers while practicing drip irrigation was included for quantification of drip adoption index in this study.

However, Table 29 shows that only 3.3% of drip adopters are practicing this in Kozhikode district, while none of the drip irrigation farmers adopt this technique in Thrissur district. One of the reasons for this is their unawareness on the higher water and nutrient use efficiency, which can be achieved through such a system of fertilizer application. Generally, farmers in Kerala apply fertilizers for crops during the rainy

season. The Agriculture Department should orient their extension programmes towards increasing the adoption of split application of fertilizers along with drip irrigation among farmers, in addition to emphasizing on water saving property of the irrigation technique. Since this practice will contribute to significant yield increase, when compared to adoption of drip irrigation alone, it can be expected to be an important factor for improving adoption of drip irrigation technique among farmers, in the long run.

Table 29. Direct soil application of fertilizers while practicing drip irrigation

Kozhikode district		Thrissur district	
Continuing drip irrigation	Farmers (%)	Continuing drip irrigation	Farmers (%)
Direct soil application of fertilizers while practicing drip irrigation	3.3	Direct soil application of fertilizers while practicing drip irrigation	Nil

4.2.2. Influence of socio economic characteristics on drip irrigation adoption index of farmers

The influence of socioeconomic characteristics such as age, education etc. on drip irrigation adoption index of farmers was analyzed through "*t*' test. Only the data of Thrissur farmers showed significant influence of some categories of certain variables on drip irrigation adoption index, and not for Kozhikode drip irrigation farmers. The results of significant *'t'* tests are presented below.

Regarding age of farmers, significant difference in adoption index was observed between two categories only, namely, 71 to 80 years and < 70 years (considered as one group for analysis) in Thrissur district. The mean drip irrigation adoption index of the former category of farmers is 64.38, while it is only 54.11 for the latter age group (Table 30). Since significant influence of other age categories on adoption has not been observed, it may be inferred that, by and large, age is not an important factor influencing drip irrigation adoption in Thrissur district.

Table 30. Influence of age on drip irrigation adoption index of farmers (Thrissur District)

Details	Farmers with age of		t stat
	<70 years	71-80 years	
Mean drip irrigation adoption index*	54.11	64.38	2.0301 [a]

* % of maximum possible adoption index

[a] Significantly different at $p<0.10$

Significant difference in adoption index was observed between the farming experience categories, namely, 1 to 10 years and 51 to 60 years, 11 to 20 and 51 to 60 years, 21 to 30 and 51 to 60 years, 31 to 40 and 51 to 60 years, and also between 41 to 50 years and 51 to 60 years in Thrissur district (Table 31, 32, 33, 34 and Table 35 respectively). This indicates that farming experience is an important factor contributing to drip irrigation adoption in Thrissur district.

It can be made out from the tables cited above that the mean drip irrigation adoption index of farmers with experience of 51 to 60 years is very high (78.77), while farmers under all the other farming experience categories mentioned above have a lower adoption index, ranging from 49.62 to 59.69 only. The data presented in Table 3 had shown that 51 to 60 years farming experience category is one among the two categories having the maximum proportion (23.3%) of farmers, while the other is 21 to 30 years category(23.3% farmers).

Hence, the results indicate that farming experience contributes to adoption of drip irrigation. The Agriculture Department can undertake demonstration programs on micro irrigation techniques like drip irrigation in the plots of experienced and progressive farmers in different locations in Kerala. The drip irrigation scheme of the department reportedly has facilities for such demonstrations, which should be implemented on a large scale in various districts of the state for facilitating awareness creation, which will help in adoption of such improved irrigation methods.

Table 31. Influence of farming experience on drip irrigation adoption index of farmers (Thrissur District)

Details	Farmers with experience of		*t stat*
	1-10 years	51-60 years	
Mean drip irrigation adoption index*	49.62	78.77	2.2009 [a]

* % of maximum possible adoption index

[a] Significantly different at $p<0.00$

Table 32. Influence of farming experience on drip irrigation adoption index of farmers (Thrissur District)

Details	Farmers with experience of		*t stat*
	11-20 years	51-60 years	
Mean drip irrigation adoption index*	51.56	78.77	2.3060 [a]

* % of maximum possible adoption index [a] Significantly different at $p<0.00$

Table 33. Influence of farming experience on drip irrigation adoption index of farmers (Thrissur District)

Details	Farmers with experience of		*t stat*
	21-30 years	51-60 years	
Mean drip irrigation adoption index*	59.69	78.77	2.6215 [a]

* % of maximum possible adoption index [a] Significantly different at $p<0.10$

Table 34. Influence of farming experience on drip irrigation adoption index of farmers (Thrissur District)

Details	Farmers with experience of		*t stat*
	31-40 years	51-60 years	
Mean drip irrigation adoption index*	54.05	78.77	2.3646 [a]

* % of maximum possible adoption index [a] Significantly different at $p<0.01$

Table 35. Influence of farming experience on drip irrigation adoption index of farmers (Thrissur District)

Details	Farmers with experience of		*t stat*
	41-50 years	51-60 years	
Mean drip irrigation adoption index*	56.40	78.77	2.4469 [a]

* % of maximum possible adoption index [a] Significantly different at $p<0.01$

As far as landholding size is concerned, in Thrissur district, significant difference in drip irrigation adoption index was observed only between two categories - 0.2 to 0.5 ha and 1.5 to 2.0 ha (Table 36). Since significant influence of other landholding categories on drip irrigation adoption has not been observed, landholding size of farmers cannot be considered as a factor influencing drip irrigation adoption in Thrissur district.

Table 36. Influence of landholding size on drip irrigation adoption index of farmers (Thrissur District)

Details	Farmers with landholding size of		*t stat*
	0.2-0.5 ha	1.5-2.0 ha	
Mean drip irrigation adoption index*	53.21	69.31	2.08596 [a]

* % of maximum possible adoption index [a] Significantly different at $p<0.05$

However, in Thrissur district, non-farm income of farmers is found to be an important factor influencing drip irrigation adoption by farmers. There exists significant difference in adoption index between farmers under various categories of non-farm income, namely, < 25% and 25 to 50%, < 25% and 50 to 75%, and between 25 to 50% and 50 to 75% (Table 37, 38 and 39 respectively). It can be observed from these tables that farmers with < 25% non-farm income have a comparatively lower drip adoption index (44.72) than 25 to 50% category (53.53) and 50 to 75% category of non-farm income (62.52). This means that farmers getting more income from occupations other than agriculture are economically better placed to adopt costly irrigation methods like drip irrigation. This is relevant in a state like Kerala, having an

unprofitable farming system for many of the farmers. Further, one of the problems reported by both farmers and officials in this study is that even 90% subsidy provided for drip irrigation by the Government works out to only about 50 to 60 % of the actual expenses at the field level, since cost of installation of drip irrigation system is not covered under this. This is a drawback of the institutional mechanism related to the drip irrigation scheme of the Government. Under the above circumstances, it is only logical that higher income farmers are in a comparatively better position to adopt irrigation systems like drip irrigation than farmers having less income.

Table 37. Influence of non-farm income source on drip irrigation adoption index of farmers (Thrissur District)

Details	Farmers with non-farm income of		*t stat*
	< 25%	25-50%	
Mean drip irrigation adoption index*	44.72	53.53	2.44691[a]

* % of maximum possible adoption index

Table 38. Influence of non-farm income source on drip irrigation adoption index of farmers (Thrissur District)

Details	Farmers with non-farm income of		*t stat*
	<25%	50-75%	
Mean drip irrigation adoption index*	44.72	62.52	2.77644[a]

* % of maximum possible adoption index [a] Significantly different at $p<0.05$

Table 39. Influence of non-farm income source on drip irrigation adoption index of farmers (Thrissur District)

Details	Farmers with non-farm income of		*t stat*
	25-50%	50-75%	
Mean drip irrigation adoption index*	53.53	62.52	2.44691[a]

* % of maximum possible adoption index [a] Significantly different at $p<0.05$

4.2.3. Categorization of drip irrigation adoption index of farmers based on socio economic characteristics

Drip irrigation adoption index of farmers was categorized as High, Medium and Low, considering mean adoption index and standard deviation value. Accordingly, majority of the drip irrigation farmers in both the districts are found to have medium adoption index (Table 40). It can be made out that, under the 71- 80 age group, 87.5% of farmers in Kozhikode district have medium adoption index, when compared to only 25% farmers in Thrissur district. Similarly, all the farmers under 81-90 years group in Kozhikode district have medium adoption index, when compared to only 50% farmers in Thrissur district. This implies that, in Kozhikode district, 62.5% more farmers in the age group of 71- 80, and 50% more farmers in the age group of 81-90 years have medium adoption index (which is the prominent adoption index category of farmers in this study), when compared to Thrissur farmers.

Even though Table 40 shows that in the lower age group categories of less than 70 years, equal or more number of farmers in Thrissur district (0%, 6.7%, 27.5% and 10% respectively for the first four age groups shown in Table 40) have medium adoption index than Kozhikode farmers, this difference in percentage of farmers is significantly less than the difference observed with respect to 71-80 and 81-90 years age groups between Kozhikode and Thrissur farmers (as highlighted in the previous paragraph). Hence, this trend of the two age groups may be considered as contributing to higher adoption index of farmers in Kozhikode district, when compared to Thrissur district (Table 6). However, educational status of farmers is not showing such perceptible trend (Table 41).

Table 42 reveals that, in the case of farming experience categories 51-60 years and 61-70 years, in Kozhikode district, 85.7% and 100% more farmers respectively have medium adoption index, when compared to Thrissur farmers. This difference in percentage between the districts is also significantly higher than the higher percentage of farmers observed in three out of five lower experience categories in Thrissur district than Kozhikode district (In Thrissur district- 15% more farmers exist under 5-10 years experience group, 4.7% more farmers under 11-20 years and 50% more farmers under 31-40 years group). In the 21-30 years experience category

also, 8.9% more farmers in Kozhikode have medium adoption index than Thrissur farmers.

Hence, as in the case of two categories of age, the above mentioned trend for the two farming experience categories can also be considered as contributing to higher adoption index of farmers in Kozhikode district, when compared to Thrissur district (Table 6).

As far as landholding size is concerned, it can be seen from Table 43 that under three out of five categories of landholdings, namely, 0.5 to 1 ha, 1.5 to 2 ha and > 2 ha, 27.5%, 8.3% and 20% more of drip irrigating farmers respectively have medium adoption index (the adoption index category under which, majority of farmers in this study fall) in Kozhikode district, when compared to Thrissur district. This can also be considered as a factor contributing to higher adoption index of farmers in Kozhikode district, when compared to Thrissur district (Table 6).

From Table 44, it can be inferred that under all the categories of non-farm income, more farmers in Kozhikode district have medium adoption index than Thrissur farmers. Hence, this can be considered as a major factor contributing to higher adoption index of farmers observed in Kozhikode district, when compared to Thrissur district (Table 6).

Table 40. Age wise categorization of drip irrigation adoption index of farmers

Age group (years)	Farmers (%) under different categories of adoption index*					
	High	High	Medium	Medium	Low	Low
	Kozhikode district	Thrissur district	Kozhikode district	Thrissur district	Kozhikode district	Thrissur district
35-40	Nil	Nil	100.0	100.0	Nil	Nil
41-50	Nil	8.3	60.0	66.7	40.0	25.0
51-60	12.5	10.0	62.5	90.0	25.0	Nil
61-70	Nil	10.0	80.0	90.0	20.0	Nil
71-80	12.5	75.0	87.5	25.0	Nil	Nil
81-90	Nil	50.0	100.0	50.0	Nil	Nil

* Categorized based on mean plus / minus one standard deviation

Table 41. Education wise categorization of drip irrigation adoption index of farmers

Education	Farmers (%) under different categories of adoption index*					
	High	High	Medium	Medium	Low	Low
	Kozhikode district	Thrissur district	Kozhikode district	Thrissur district	Kozhikode district	Thrissur district
Up to 4th std	Nil	Nil	100.0	100	Nil	Nil
4th-7th std	Nil	100	100.0	Nil	Nil	Nil
8th - SSLC	7.1	5.9	85.8	82.4	7.1	11.7
Pre Degree/ Plus two	Nil	20.0	50.0	80.0	50.0	Nil
Degree	11.1	23.1	66.7	69.2	22.2	7.7

* Categorized based on mean plus / minus one standard deviation

Table 42. Farming experience wise categorization of drip irrigation adoption index of farmers

Farming experience (years)	Farmers (%) under different categories of adoption index*					
	High	High	Medium	Medium	Low	Low
	Kozhikode district	Thrissur district	Kozhikode district	Thrissur district	Kozhikode district	Thrissur district
5 - 10	Nil	Nil	75.0	90.0	25.0	10.0
11 - 20	33.3	14.3	66.7	71.4	Nil	14.3
21 - 30	Nil	25.0	71.4	62.5	28.6	12.5
31 - 40	33.3	16.7	33.3	83.3	33.3	Nil
41 - 50	Nil	Nil	100	100	Nil	Nil
51 - 60	Nil	100	85.7	Nil	14.3	Nil
61 - 70	Nil	-	100	-	Nil	-

* Categorized based on mean plus / minus one standard deviation

Table 43. Landholding wise categorization of drip irrigation adoption index of farmers

Landholding size (ha)	Farmers (%) under different categories of adoption index*					
	High	High	Medium	Medium	Low	Low
	Kozhikode district	Thrissur district	Kozhikode district	Thrissur district	Kozhikode district	Thrissur district
0.2-0.5	Nil	5.6	80.0	88.9	20.0	5.6
0.5-1.0	12.5	30	87.5	60.0	Nil	10.0
1.0-1.5	14.3	Nil	57.1	100.0	28.6	Nil
1.5-2.0	Nil	75	33.3	25.0	66.7	Nil
>2.0	Nil	Nil	100.0	80.0	Nil	20.0

* Categorized based on mean plus / minus one standard deviation

Table 44. Non-farm income wise categorization of drip irrigation adoption index of farmers

Share of income from non-farm sources	Farmers (%) under different categories of adoption index*					
	High	High	Medium	Medium	Low	Low
	Kozhikode district	Thrissur district	Kozhikode district	Thrissur district	Kozhikode district	Thrissur district
Nil	Nil	66.7	100.0	33.3	Nil	Nil
<25	Nil	Nil	71.4	66.7	28.6	33.3
25-50	25.0	40.0	75.0	40.0	Nil	20.0
50-75	Nil	10.7	100.0	85.7	Nil	3.6
75-100	7.7	-	69.2	-	23.1	-

* Categorized based on mean plus / minus one standard deviation

4.2.4. Relationship between drip irrigation adoption item scores and adoption index

To study the relationship between drip irrigation adoption item scores and adoption index, correlation was worked out between the weighted adoption score of the drip adoption item (expressed as a % of maximum possible weighted score of the item) and weighted adoption index (expressed as a % of the maximum possible weighted adoption index) in the two districts. Since none of the farmers are practicing fertigation in the two districts, all of them have the same score for this item of drip irrigation adoption. Hence, it was not possible to work out correlation for this item. Similarly, in Thrissur district, since all the farmers are continuing drip irrigation, and none of the farmers are adopting direct soil application of fertilizers while practicing drip irrigation, correlation could not be worked out for these two items of drip irrigation adoption also in the case of the farmers of the district.

The results reveal that number of drip irrigation components installed, type of emitter used and number of years of drip irrigation adoption show high correlation with adoption index of farmers in Kozhikode and Thrissur districts (Table 45 and Table 46), indicating the comparatively higher influence of these items on drip irrigation adoption of farmers.

Table 45. Correlation between adoption item scores and drip irrigation adoption index (Kozhikode district)

Sl. No.	Item	Correlation *(r)*
1	Area under drip	0.3142
2	No. of drip irrigation components	0.6912
3	Type of emitter	0.6658
4	Subsidy utilization	0.2292
5	Years of drip irrigation adoption	0.5043
6	Continuation of drip irrigation	0.0932
7	Direct soil application of fertilizers while practicing drip irrigation	0.0724

Table 46. Correlation between adoption item scores and drip irrigation adoption index (Thrissur district)

Sl. No.	Item	Correlation *(r)*
1	Area under drip	0.2131
2	No. of drip irrigation components	0.8711
3	Type of emitter	0.8739
4	Subsidy	0.1968
5	Years of drip irrigation adoption	0.8360

4.2.5. Reasons for adopting drip irrigation

The reasons for adopting drip irrigation system, according to the importance assigned to them by the farmers, were collected using the interview schedule. The relative importance of these reasons was ranked using the Garrett Ranking Technique (Garrett and Woodworth, 1977), which is used to rank a set of factors as perceived by the sample respondents, based on certain criteria. In this method, the order of merit assigned by the respondents to various factors is converted into scores using a formula.

The ranked reasons are shown in Table 47 for farmers of Kozhikode and Table 48 for farmers of Thrissur district. It can be made out from these tables that the most important reason to adopt drip irrigation in both the districts is the difficulty of farmers to adopt more water consuming traditional irrigation methods due to water scarcity. This is one of the main reasons why only about 20 % of cropped area under coconut, the main upland crop of Kerala, and 35% of the cropped area under arecanut is irrigated in the state (Farm Guide, 2011. Department of Agriculture, Government of Kerala). Table 47 and Table 48 reveal that in both the districts, farmers attribute higher labour requirement under traditional irrigation methods as the second important reason for adopting drip irrigation. It can also be made out from the tables that high productivity and income from cultivation acted an incentive to adopt the costly system of drip irrigation in the case of both Kozhikode and Thrissur farmers. Good crop yield

obtainable through drip irrigation has also been a factor motivating farmers in both the districts to go in for the irrigation technique (Table 47 and Table 48).

It is interesting to note that in both the districts, subsidy provided by the Agriculture Department has not been a prominent factor in the adoption of drip irrigation, since this has been ranked as the fifth reason only in Kozhikode, while it is the sixth reason for adoption in Thrissur district (Table 47 and Table 48). During discussions with the officials of the Agriculture Department and from the two seminars organized under the project, it has been observed that some problems exist with regard to the subsidy component under the drip irrigation scheme of the department. This may be the reason why subsidy provided for drip installation has not contributed much to drip irrigation adoption in the study areas. This is an institutional factor contributing to less adoption of drip irrigation in Kerala.

Table 47. Reasons for adopting drip irrigation (Kozhikode district)

Sl. No.	Reason	Rank*
1.	Unable to adopt traditional surface irrigation methods due to water scarcity	1
2.	Surface irrigation methods involve more labour, which is costly	2
3.	High productivity and income from cultivation became an incentive to adopt drip irrigation	3
4.	Good crop yield, which is comparable to yield obtained under surface irrigation, can be obtained through drip irrigation	4
5.	Subsidy provided by the Agriculture Department	5
6.	Difficulty to adopt surface irrigation methods on sloping land	6

* Ranked using Garrett Ranking Technique

Table 48. Reasons for adopting drip irrigation (Thrissur district)

Sl. No.	Reason	Rank*
1.	Unable to adopt traditional surface irrigation methods due to water scarcity	1
2.	Surface irrigation methods involve more labour, which is costly	2
3.	Drip irrigation saves time, when compared to surface irrigation methods	3
4.	High productivity and income from cultivation became an incentive to adopt drip irrigation	4
5.	Good crop yield, which is comparable to yield obtained under surface irrigation, can be obtained through drip irrigation	5
6.	Subsidy provided by the Agriculture Department	6
7.	Drip irrigation can be managed by the farmer himself, without depending on labourers	7
8.	Difficulty to adopt surface irrigation methods on sloping land	8

* Ranked using Garrett Ranking Technique

4.2.6. Constraints in continuing drip irrigation

Constraints reported by the farmers in continuing adoption of drip irrigation, which have been ranked using Garrett Ranking Technique, are shown in Table 49 for Kozhikode and Table 50 for Thrissur district. Clogging of emitters and laterals is ranked as the second important constraint in Thrissur, while it is the most important constraint in continuing drip irrigation adoption for Kozhikode drip irrigation farmers. Clogging is an important universal problem under drip irrigation. To overcome this, depending on the quality of water, efficient filtration using sand/gravel filters etc. may be necessary. However, as observed in this study, none of the farmers have installed such advanced filtering units. This is be due to the high cost of such filters, which, many farmers in Kerala will not be ready to adopt under the existing non remunerative nature of farming.

Other constraints reported by farmers (Table 49 and Table 50) include damage to the drip system due to falling of coconuts, rodents etc., high cost of drip irrigation

components, non availability of components, difficulty to do inter cultivation when drip system is there in the field, lack of after sales service from drip irrigation firms, difficulty to fold the pipes during rainy season, lack of sufficient awareness/ technical assistance from the Agriculture Department etc.

Based on discussions with the Agriculture Department officials carried put under this project in various districts of Kerala, it has been understood that sufficient training programs are not arranged for farmers and officials on drip irrigation. This can be considered as an institutional deficiency in the drip irrigation scheme of the department. Hence, both farmers and officials are not properly aware of various aspects of the irrigation technique, which is an important drawback in improving its adoption in the state. This is the situation, even when, provision exists under the drip irrigation scheme of the Government for capacity building through training/seminars. Since many of the officials are also not made aware about the technical aspects of drip irrigation system through training, they are not in a position to impart the required assistance to farmers on aspects such as design, operation and maintenance of the system. This is a limitation for farmers adopting an improved technique like drip irrigation.

Difficulty to fold the pipes during rainy season reported by farmers is an important issue in Kerala, where, unlike many parts of the country, about six months of rainy season exists. During this prolonged non-irrigation period, drip irrigation pipes, emitters and other accessories cannot be left in the field. This is mainly because the pipes and accessories get buried under weed growth during the rainy season, and labourers, who do weeding, may accidentally cause damage to them. This problem may be overcome to a great extent by using buried pipe system in drip irrigation, which, however, is costlier than the surface system. This can also offset the following problems which have been reported by the farmers, namely, damage to the drip system due to falling of coconut/rodents, and difficulty to do inter cultivation when drip system is there in the field. However, under the existing situation, where, farmers already incur considerable expenditure even after getting subsidy for drip installation, this does not appear to be a feasible proposition in Kerala for many farmers.

As already mentioned, the following constraints in continuing drip irrigation have also been reported by farmers, namely, non availability of drip irrigation components in the market and lack of after sales service from drip irrigation firms (Table 49). Since the level of adoption of drip irrigation in Kerala is not up to the expected level, firms dealing with irrigation systems would normally concentrate more on irrigation systems like sprinklers, which have a comparatively better market than drip irrigation. This problem can be addressed only if the irrigation equipment firms are able to achieve an increase in their market base for drip irrigation system. This requires efforts on the part of the Agriculture Department to work out suitable strategies for increasing adoption of the irrigation technique among farmers in the state.

Table 49. Constraints in continuing drip irrigation (Kozhikode district)

Sl. No.	Constraint	Rank*
1.	Clogging of emitters and laterals	1
2.	Non availability of drip irrigation components in the market	2
3.	Lack of after sales service from drip irrigation firms	3
4.	Difficulty to fold pipes during rainy season	4
5.	Damage to pipes due to falling coconuts, rodents etc.	5
6.	High cost for replacement of drip irrigation components	6
7.	Lack of sufficient awareness programs/technical assistance from the Agriculture Department	7
8.	Difficulty to maintain proper pressure in the pipes/emitters for getting the required discharge	8

* Ranked using Garrett Ranking Technique

Table 50. Constraints in continuing drip irrigation (Thrissur district)

Sl. No.	Constraint	Rank*
1.	Damage to pipes due to falling coconuts, rodents etc.	1
2.	Clogging of emitters and laterals	2
3.	High cost for replacement of drip irrigation components	3
4.	Difficulty to do inter cultivation when drip irrigation system exists	4
5.	Lack of sufficient awareness programs/technical assistance from the Agriculture Department	5
6.	Difficulty to fold pipes during rainy season	6

* Ranked using Garrett Ranking Technique

4.2.7. Relationship between reasons and adoption of drip irrigation

The first and second ranked reasons for adoption of drip irrigation through Garrett ranking technique, namely, water scarcity and more labour requirement for surface irrigation methods (Table 47 and Table 48) were considered for analyzing their influence on drip irrigation adoption index, and on various items of adoption index of farmers through *'t'* test. Water scarcity was mentioned as the reason for adoption of drip irrigation by about 61% of farmers in Kozhikode and about 69% of farmers in Thrissur district. More labour requirement for surface irrigation methods was reported as the reason by about 63 % of farmers in Kozhikode and about 92% of farmers in Thrissur district.

Significant *'t'* values were obtained in the case of drip irrigating farmers of Thrissur district only. The results are presented in Table 51, 52 and Table 53.

There is significant difference in adoption index of farmers mentioning the two reasons in Thrissur district (Table 51). The mean adoption index of farmers mentioning water scarcity as the reason for drip adoption is 61.78, while it is only 50.82 for farmers citing more labour requirement for surface irrigation methods as the reason. This implies that in Thrissur district, farmers facing water scarcity are more innovative with respect to adoption of drip irrigation.

Similarly, the two reasons were found to influence the following items of drip adoption namely, number of components used in the drip system and years of drip adoption by the farmers. It is evident from Table 52 that there is significant difference in drip components score among farmers mentioning the two reasons. The mean drip components score is only 32.4 in the case of farmers mentioning more labour requirement for surface irrigation methods, while it is 51.1 for farmers mentioning water scarcity as the reason for drip adoption (Table 52). This means that farmers in Thrissur district, who are concerned about more labour charges required for adoption of irrigation, are also conservative from an economic point of view with regard to the number of components installed in drip irrigation system.

In the case of farmers citing more labour requirement for surface irrigation methods as the reason for drip irrigation adoption, the average score for years of drip irrigation adoption is only 26.67, while the score is almost double (51.31) in the case of farmers citing water scarcity as the reason for adoption (Table 53). This indicates that farmers, who have been facing water scarcity, have adopted drip irrigation earlier than those who have adopted drip irrigation on account of more labour requirement for adopting surface irrigation methods. The statistical significance of the two reasons on the score of farmers for years of drip irrigation adoption is also evident from Table 53.

Table 51. Influence of reasons for adoption of drip irrigation on adoption index of farmers (Thrissur district)

Details	Reasons for adopting drip irrigation		*t* stat
	Water scarcity	More labour requirement under surface irrigation methods	
Mean drip irrigation adoption index* of farmers mentioning the reason	61.78	50.82	2.6974 [a]

* % of maximum possible adoption adoption index

[a] Significantly different at $p<0.01$

Table 52. Influence of reasons for adoption of drip irrigation on drip components score of farmers (Thrissur district)

Details	Reasons for adopting drip irrigation		*t* stat
	Water scarcity	More labour requirement under surface irrigation methods	
Mean drip components score* of farmers mentioning the reason	51.13	32.38	2.8831[a]

* % of maximum possible score

[a] Significantly different at $p<0.01$

Table 53. Influence of reasons for adoption of drip irrigation on years of adoption score of farmers (Thrissur district)

Details	Reasons for adopting drip irrigation		*t* stat
	Water scarcity	More labour requirement under surface irrigation methods	
Mean years of adoption score* of farmers mentioning the reason	51.31	26.67	2.9543[a]

* % of maximum possible score

[a] Significantly different at $p<0.01$

4.3. *Perceptions on drip irrigation among farmers practicing surface irrigation methods*

Data was collected using an interview schedule (Annexure II) from 50 randomly selected farmers in both Kozhikode and Thrissur districts, who are practicing traditional surface irrigation methods for their upland crops. The socio economic characteristics of these farmers in the two districts are furnished in Table 54 to Table 58.

It can be made out from Table 54 that majority of the farmers practicing surface irrigation are within the age of 40 to 60 years in both the districts. However, unlike Thrissur district, in Kozhikode, there are farmers in the lower age group of 28 to 40 years also. With regard to drip irrigating farmers, 56.4% in Thrissur district and 43.4%

farmers in Kozhikode district were found to be in the age group of 40 to 60 years (Table 1).

Table 54. Age of farmers practicing surface irrigation

Kozhikode district		Thrissur district	
Age group (years)	Farmers (%)	Age group (years)	Farmers (%)
28 - 40	11.4	40 - 50	31.7
40 - 50	28.6	50 - 60	31.7
50 - 60	25.7	60 - 70	22.0
60 - 70	25.7	70 - 80	12.2
70 - 84	8.6	80 - 86	2.4
	100		100

Table 55 shows the educational status of the farmers practicing surface irrigation. Similar to drip irrigating farmers, in both the districts, majority of the surface irrigation farmers have education between 8th standard and 10th standard (SSLC). However, farmers having Degree qualification is only 14.3% in Kozhikode and 17.1% in Thrissur (Table 55), while about 30% of drip irrigating farmers in both the districts was found to have completed their Degree course (Table 2).

Table 55. Education of farmers practicing surface irrigation

Kozhikode district		Thrissur district	
Education	Farmers (%)	Education	Farmers (%)
5th to 7th std	14.3	4th std	4.9
8th std to SSLC	51.5	5th to 7th std	17.1
Pre-Degree	11.3	8th std to SSLC	43.9
Degree	14.3	Pre-Degree	14.6
PG	5.7	Degree	17.1
Nil	2.9	PG	2.4
	100		100

Data in Table 56 shows that the maximum proportion of farmers practicing surface irrigation in Kozhikode district (42.9%) are in the 8 to 30 years experience category,

while the maximum proportion of farmers (46.4%) in Thrissur district have experience of 21 to 40 years.

Unlike drip irrigating farmers, where, in the case of Thrissur district, the number was found to decrease with an increase in their farming experience (Table 3), no perceptible trend can be established with regard to the experience of surface irrigators from the data shown in Table 56.

Table 56. Farming experience of farmers practicing surface irrigation

Kozhikode district		Thrissur district	
Farming experience (years)	Farmers (%)	Farming experience (years	Farmers (%)
8-20	20.0	1-10	17.0
21-30	22.9	11-20	9.8
31-40	17.1	21 - 30	22.0
41-50	22.9	31 - 40	24.4
51-63	17.1	41 - 50	14.6
	100	51 - 60	9.8
		61 - 70	2.4
			100

In Thrissur district, majority of the surface irrigation farmers (65.9%) have landholding size of 0.2 to 0.5 ha, while, in Kozhikode majority (31.4%) fall in the landholding range of 0.5 to 1 ha. (Table 57). A similar trend was observed in the case of drip irrigation farmers also. In Thrissur district, majority of the drip irrigating farmers (46.1%) were found to have small landholdings of 0.2 to 0.5 ha only, while in Kozhikode, majority (26.7%) were having landholding of 0.5 to 1.0 ha (Table 4).

Table 57. Landholding size of farmers practicing surface irrigation

Kozhikode district		Thrissur district	
Landholding (ha)	Farmers (%)	Landholding (ha)	Farmers (%)
0.2-0.5	28.6	0.2-0.5	65.9
0.5-1.0	31.4	0.5-1.0	19.5
1.0-1.5	28.6	1.0-1.5	9.8
1.5-2.0	5.7	1.5-2.0	2.4
> 2	5.7	>2	2.4
	100		100

Table 58 shows the non-farm income of farmers practicing surface irrigation for their crops. It may be observed that in Kozhikode district, 54.3% farmers earn non-farm income of 75 to 100%. Similarly, majority of the surface irrigators (58.5%) in Thrissur district are also earning non-farm income in the range of 75 to 100%.

In the case of drip irrigating farmers also, maximum number of them in both the districts were found to earn non-farm income in the range of 75 to 100% (Table 5). Unlike drip irrigation, where the labour involvement for irrigation is comparatively less, traditional surface irrigation methods like basin, furrow etc. incur much labour expenses, especially because farmers in Kerala generally practice these methods frequently using considerable quantity of water for crops like coconut, arecanut, banana etc. As already mentioned, labour is very costly in Kerala. The problem of cost is further aggravated in the state due to un-availability of agricultural labourers.

Under the above circumstances, for incurring cultivation expenses, farmers may have to earn income from sources other than agriculture, since it is not remunerative for most of the crops in Kerala. From this perspective, the trend of non-farm income generation by surface irrigating farmers observed in this study appears to be logical.

Table 58. Non-farm income source of farmers practicing surface irrigation

Kozhikode district		Thrissur district	
Share of income from non-farm sources (%)	Farmers (%)	Share of income from non-farm sources (%)	Farmers (%)
<25	11.4	<25	7.3
25-50	14.3	25-50	4.9
50-75	20.0	50-75	29.3
75-100	54.3	75-100	58.5
	100		

Crops irrigated and irrigation method adopted under surface irrigation

Table 59 shows that more than 90% of the farmers, who are adopting surface irrigation, irrigate coconut crop in the two districts. Similarly, in both the districts, more than 90% of the farmers are adopting basin irrigation method for coconut (Table 60), the main crop grown in uplands in Kerala. This is a welcome trend, since irrigation in

basins taken around widely spaced coconut palms is the recommended practice by the Agriculture Department. This method ensures water availability to the effective root zone, thus avoiding wasteful water application. It can be made out from the data presented in Table 59 and Table 60 that arecanut farmers in Thrissur district adopt furrow irrigation, which is the recommended method for a closely spaced crop like arecanut. However, in Kozhikode district, all the farmers are adopting basin irrigation, indicating that arecanut farmers in the district are not adopting furrow irrigation, the recommended method for the crop.

Table 59. Crops irrigated through surface irrigation

Kozhikode district		Thrissur district	
Crop	Farmers (%)	Crop	Farmers (%)
Coconut	97.1	Coconut	92.6
Arecanut	2.9	Arecanut	5.0
	100	Nutmeg	2.4
			100

Table 60. Irrigation methods adopted under surface irrigation

Kozhikode district		Thrissur district	
Irrigation method	Farmers (%)	Irrigation method	Farmers (%)
Basin	100	Flooding	2.4
		Furrow	5.0
		Basin	92.6
			100

Reasons for not irrigating the entire cultivated area through surface irrigation

In Kozhikode district, only 40% of farmers practicing surface irrigation are irrigating their entire cultivated area, while the figure for Thrissur district is 87.8%. The reasons for not able to irrigate the full area were elicited from the farmers, which is presented in Table 61.

In both the districts, about 40 to 48% farmers report water scarcity as the reason (Table 61). The experience of the investigators of this project in the field of irrigation management has revealed that many farmers in Kerala apply excess quantity of water than the crop water requirement through surface irrigation methods. One of the reasons for this is their unawareness on the quantity to be applied and the frequency

of irrigation to be adopted. This is because the Agriculture Department is not able to provide them sufficient information through training programmes, which is evident from the responses obtained during discussions with farmers/officials. Further, farmers themselves do not show much interest to be aware of these aspects.

Two things, which need attention, should be considered in the above context. One is that the Agriculture Department should formulate suitable extension strategies for technology transfer on scientific irrigation management to farmers including demonstration cum trial on irrigation scheduling in farmers' fields, in association with research organizations. Similarly, the department should promote adoption of water saving micro irrigation methods like drip irrigation, which requires application of daily crop water requirement only.

Table 61. Reasons for not irrigating the entire cultivated area through surface irrigation methods

Kozhikode district		Thrissur district	
Reason	Farmers (%)	Reason	Farmers (%)
Water scarcity	47.6	Water scarcity	40.0
No need of irrigation for rubber	38.0	Due to diseases, coconut and arecanut cultivation is not profitable. Hence, not irrigating these crops.	40.0
No need of irrigation for tapioca	4.8	No need of irrigation for rubber	20.0
No need of irrigation for ginger and turmeric	4.8		100
No need to irrigate crops other than banana and coconut	4.8		
	100		

Awareness on drip irrigation among farmers practicing surface irrigation

Table 62 reveals that about 83% of farmers practicing traditional surface irrigation in Kozhikode district are aware of drip irrigation. However, 74% farmers are not interested in adopting the system (Table 63). The reasons include high cost of the system, unawareness on technical aspects of the irrigation method, losing interest since some farmers discontinued their drip irrigation, availability of adequate water,

and difficulty to carry out inter cultivation when drip system exists in the field (Table 64).

Similarly, about 73% of farmers practicing traditional surface irrigation in Thrissur district are not interested in adopting drip irrigation, even though about 80% of the farmers reported awareness on this irrigation technique. This is an important factor to be taken note of. Considering the fact that water scarcity is an important deterrent for farmers in continuing water consuming surface irrigation methods, the alternative for achieving higher crop productivity is through adoption of micro irrigation methods like drip irrigation. However, from the results presented above, it is clear that awareness on the technique alone will not help much in promoting adoption of its adoption. Considering the reasons for not interested in adopting drip irrigation reported by Thrissur farmers (Table 65), it is evident that there are other constraints in adoption such as the high cost of drip system, difficulty in getting subsidy/loan for drip installation etc. Hence, institutional measures such as timely and adequate level of government subsidy for drip irrigation adoption (which includes cost of installation drip irrigation system and cost of pump set with low horse power, which can cater to the small landholdings generally prevalent in Kerala), adequate technical backup/after sales service and training to farmers on drip installation/maintenance should be ensured to motivate more farmers in Kerala to adopt this water saving irrigation technique.

From the data presented in Table 64 and 65, it is clear that high cost of drip irrigation system has been ranked as the fourth reason for not showing interest in adopting drip irrigation by Thrissur farmers, while it is ranked as the most important reason by Kozhikode farmers. It was observed that about 87.8% of farmers practicing surface irrigation in Thrissur district are having non-farm income in the range of 50 to 100%, while in Kozhikode, only 74.3% of the farmers have non- farm income in this range (Table 58). This may be the reason why Thrissur farmers do not attribute the high cost of drip irrigation system as an important factor contributing to lack of interest in the irrigation technique.

Table 62. Awareness on drip irrigation among farmers practicing surface irrigation

Awareness on drip irrigation	Farmers (%)	
	Kozhikode district	Thrissur district
Yes	82.8	80.5
No	17.2	19.5
	100	100

Table 63. Interest of farmers practicing surface irrigation to adopt drip irrigation

Awareness on drip irrigation	Farmers (%)	
	Kozhikode district	Thrissur district
Yes	25.7	26.8
No	74.3	73.2
	100	100

Table 64. Reasons for not interested in adopting drip irrigation by farmers practicing surface irrigation (Kozhikode district)

Reason	Rank*
High cost of drip irrigation system	1
Unawareness on technical aspects of drip irrigation	2
De-motivated, since some farmers discontinued drip irrigation in their landholdings	3
Adequate water avaialabilty	4
Difficulty to carry out intercultivation when drip system exists in the field	5

*Ranked using Garrett Ranking Technique

Table 65. Reasons for not interested in adopting drip irrigation by farmers practicing surface irrigation (Thrissur district)

Reason	Rank*
Unawareness on technical aspects of drip irrigation	1
Difficulty in getting subsidy/loan for drip irrigation	2
Adequate water avaialabilty	3
High cost of drip irrigation system	4
Difficulty to carry out intercultivation when drip system exists in the field	5

*Ranked using Garrett Ranking Technique

4.4. *Perceptions of Agriculture Department officials on drip irrigation*

Under this project, focused group discussions were held with the officials of the Agriculture Department in different districts of Kerala on various aspects of drip irrigation. One day seminar on drip irrigation was also organized at Kozhikode during December 2011 and at Thrissur during January 2012. Photographs of the seminars and group discussions are shown in Plate 1 to Plate 7.

In Kozhikode, 60 farmers and 30 officials of the Agriculture Department from the district participated in the seminar, while in Thrissur, 30 farmers and 35 officials from the district participated. In both the districts, participating farmers included both drip irrigation adopters and those who irrigate through surface irrigation methods. The officials were Principal Agricultural officer of the district, Deputy Directors, Assistant Directors and Agricultural officers. Presentation of various topics by experts was followed by discussions among farmers, officials and experts in the seminars.

The responses obtained from the group discussions and seminars are presented below.

On the whole, officials mentioned the following main strategies, which were adopted for identifying/motivating farmers to adopt drip irrigation:

1. Invited application from interested farmers

2. Training programs were conducted at Block / Grama Panchayath level

3. Awareness on drip irrigation scheme was given through the Grama sabha and through news papers

4. Progressive farmers were identified and drip irrigation was promoted

However, in most of the districts, the officials reported that drip irrigation adoption is not satisfactory, even though good adoption was reported in Palakkad district during 2010-2011, when subsidy was increased to 90%. Palakkad faces comparatively more water availability problem during summer than other districts. Hence, this trend of better adoption of water saving drip irrigation technique under higher levels of subsidy is logical.

The reasons of adoption of drip irrigation, constraints in adoption, and constraints in continuation of drip irrigation by farmers, which have been reported by the officials in common from various districts, are given in Table 66 to Table 68. The districts reporting them are also shown in these tables.

It can be made out from Table 66 that water scarcity, labour/water saving feature of drip irrigation, possibility of yield increase through adoption of drip irrigation, and 90 % subsidy presently provided by the Agriculture Department are the factors reported by officials from different districts, which are contributing to adoption of drip irrigation among farmers in Kerala. From this, it can be inferred that the acceptability of drip irrigation to farmers is not due to water scarcity and water saving alone, but also because of higher crop yield, which they perceive from adopting the irrigation technique. This is an important aspect to be considered by the Agriculture Department in promoting drip irrigation. The extension orientation of the Department should concentrate on higher yield and income, which can be obtained through adoption of drip irrigation for crops, in addition to water saving. Available data on improvement in crop yield under drip irrigation should be provided to farmers by the Department through sufficient number of training programs/workshops. It may be noted that lack of awareness among farmers on drip irrigation technique has been cited by the Department officials as a constraint in its adoption. Similarly, lack of technical knowhow for Agricultural officers on the design and maintenance of drip irrigation is another reported constraint (Table 67). This highlights the requirement of more extension programs such as training/workshops, demonstration programs etc. for both farmers and officials on various aspects of the irrigation technique. Improved

knowledge on the part of farmers and proper technical back up from the Agriculture Department officials will contribute to improvement in adoption of the irrigation technique.

Table 66.Reasons for adoption of drip irrigation reported by Agriculture Department officials

Sl. No.	Reason	Reported by officials from
1	Water scarcity	Palakkad, Kozhikode and Kannur districts
2	Labour saving technique	Palakkad, Kannur and Kasaragod districts
3	Water saving technique	Kannur and Kasaragod districts
4	Possibility of increase in yield through adoption of drip irrigation	Kannur and Kasaragod districts
5	Subsidy of 90% presently provided to farmers	Thiruvananthapuram, Kollam and Kasaragod districts

The major constraints regarding adoption of drip irrigation reported by officials are shown in Table 67, and explanation related to these constraints is given below.

1. Lack of sufficient awareness among farmers:

   More number of training programs/workshops/demonstration plots on drip irrigation is necessary to overcome this problem.

2. Since installation cost of drip irrigation system is not included in the subsidy provided to farmers, they have to incur considerable expenditure:

   It has been already mentioned in this report that one of the problems in the drip irrigation scheme is that the 90% subsidy provided for drip irrigation by the Government works out to only about 50 to 60 % of the actual expenses at the field level, since cost of installation of drip irrigation system is not covered under this. As far as majority of the states in India are concerned, most of the farmers have big landholdings and adopt remunerative cropping patterns. For them, installation cost for drip irrigation will not become a major constraint in its adoption. But the situation is different in Kerala. Except for farmers cultivating cash crops like rubber, tea, coffee, cardamom etc., farming is not profitable for majority of the farmers in

the state on account of factors such as small sized landholding, high input/labour costs, lack of remunerative market price for the produce etc. This has also been substantiated by experts working in this field. Under such conditions, we cannot expect farmers in Kerala to be willing to spend on installation cost of drip irrigation. Hence, a situation specific modification in the subsidy norms for drip irrigation will go a long way in improving its adoption. This is an important institutional change required in the policy related to the subsidy scheme of drip irrigation.

3. Lack of sufficient number of authorized dealers of drip irrigation:

   From discussion with the drip irrigation agencies, it has been understood that this is mainly because of the low market reach of drip irrigation. They were of the opinion that significantly more number of farmers adopts sprinkler than drip irrigation. The solution to this is to have schemes/programs by the Government to improve drip irrigation adoption.

4. Delay in getting administrative sanction for drip irrigation subsidy scheme, resulting in lack of sufficient time to identify drip adopters:

   This is the usual administrative delay observed in some of the Government programs. Hence, streamlining the subsidy scheme for making available the required money in time for Krishi Bhavans can help to improve drip irrigation adoption.

5. Lack of technical knowhow for Agricultural officers on the design and maintenance of drip irrigation:

   Once again, this highlights the requirement of training/workshops for the officials also. This is especially important for an improved irrigation technique like drip, where, technical aspects related to components, design/maintenance etc. are involved, unlike traditional surface irrigation methods.

6. Nonpayment of subsidy for drip irrigation system installed on leased land:

   This is an important constraint nowadays, when more and more farmers in Kerala have started cultivation on leased lands and marketing of crops like banana and vegetables on group basis, especially in districts like Palakkad and Thrissur.

7. Ineligibility of farmers for subsidy for drip irrigation system installed by un-authorized drip irrigation agencies:

   Under the farming system with low returns existing for many of the farmers in Kerala, it will be a motivating factor if subsidy is granted by the Agriculture Department for adopting drip irrigation using comparatively low cost drip irrigation components available in the market, provided a mechanism is instituted to ensure certain minimum standards for the components. This will help to improve drip irrigation adoption in Kerala. For example, farmers are interested in purchasing drip components at cheaper rates from Coimbatore district neighbouring Kerala. Such a facility will also be a solution to the high cost of drip irrigation components, cost variation between drip irrigation dealers, and less number of authorized dealers in Kerala, which have been reported by the officials as constraints in adoption of drip irrigation (Table 67).

8. 90% subsidy provided to farmers works out to less than 90% of the present cost of the system, since the calculation is based on earlier cost estimates:

   Periodic revision of cost estimates is necessary under the drip irrigation subsidy program. This is very important for a state like Kerala, where the nature of farming does not project a favourable picture for many farmers.

Table 67. Constraints in adoption of drip irrigation reported by Agriculture Department officials

Sl. No.	Constraint	Reported by officials from
1	Lack of sufficient awareness among farmers	Thiruvananthapuram and Kollam, Thrissur, Palkkad and Malppuram districts
2	Lack of sufficient number of authorized dealers of drip irrigation	Thiruvananthapuram, Kollam, Palakkad, Malppuram, Kozhikode and Kannur districts
3	No subsidy is paid for drip irrigation system installed on leased land.	Palakkad, Kasaragod, and Thrissur districts
4	Subsidy is not paid for drip irrigation system, which is not installed by authorized drip irrigation agencies	Palakkad, Kollam and Kasaragod districts
5	Since installation cost of drip system is not included in the subsidy provided to farmers, farmers have to incur considerable expenditure	Thiruvananthapuram, Kollam, Palakkad,Thrissur, Malappuram, Kozhikode, Kannur and Kasaragod districts
6	Cost of pump set and tank is not included in the subsidy provided to farmers	Kollam,Malappuram and Kasaragod districts
7	Variation in cost of components between agencies	Malappuram,Kasaragod districts
8	Farmers get subsidy only after paying the installation cost	Kollam and Kasaragod districts
9	Even though 90% subsidy exists now, this works out to only about 60%, since the calculation is based on earlier cost estimates	Palakkad, Malappuram and Thrissur districts
10	Subsidy decreases when area increases.	Palakkad,Malappuram and Thrissur districts
11	Delay in getting administrative sanction for drip irrigation subsidy scheme. This also results in lack of sufficient time to identify drip irrigation adopters	Thiruvananthapuram, Kollam , Palakkad, Malppuram, Kozhikode and Kannur districts
12	High cost of drip irrigation components supplied by the drip irrigation agencies. Cheaper components are available in the market	Thiruvananthapuram and Palakkad districts
13	Lack of technical knowhow for Agricultural officers on the design and maintenance of drip irrigation	Thiruvananthapuram, Kollam, Thrissur, Kannur and Kasaragod districts
14	Lack of need analysis among farmers on drip irrigation	Thiruvananthapuram and Kollam districts
15	There is a wrong notion among some farmers and officers that farmers with only large holdings/ high income can adopt drip irrigation.	Palakkad and Kasaragod districts

Table 68 gives the constraints in continuation of drip irrigation reported by the Agriculture Department officials. They include lack of sufficient after sales service from drip irrigation agencies, clogging of emitters, damage to pipes due to falling of coconut, rodent attack etc., and the difficulty of farmers to remove drip irrigation system from the field during each rainy season, which extends for about 6 months in Kerala.

Table 68 Constraints in continuing drip irrigation reported by Agriculture Department officials

Sl. No.	Constraint	Reported by officials from
1	Lack of sufficient after sales service from drip irrigation agencies	Kollam, Malappuram, Kozhikode and Kannur districts
2	Clogging of emitters	Thiruvananthapuram, Kollam, Kozhikode ,Kannur and Kasaragod districts
3	Damage to pipes due to falling of coconut, rodent attack etc.	Thiruvananthapuram and Kannur districts
4	Farmers have to remove drip irrigation system from the field during each rainy season	Thiruvananthapuram, Kollam, Kannur and Kasaragod districts

Plate 1. Release of the *Drip Irrigation Manual* by Prof. (Dr) M. Abdul Salam, Vice Chancellor, Calicut University at the seminar on Drip irrigation organized at Kozhikode

Plate 2. Seminar on Drip Irrigation organized at Kozhikode

Plate 3. Seminar on Drip Irrigation organized at Thrissur

Plate 4. Focused group discussion with officials of Agriculture Department in Thiruvananthapuram

Plate 5. Focused group discussion with officials of Agriculture Department in Kollam

Plate 6. Focused group discussion with officials of Agriculture Department in Palakkad

Plate 7. Focused group discussion with officials of Agriculture Department in Kasaragod

In order to analyze the adoption trend of drip irrigation in Kerala, letters were sent by the Coordinator of this project to the Principal Agricultural officers of all the districts in the State, followed by reminders, requesting details of number of drip irrigation adopters during the past five year period. The information provided by the Principal Agricultural officers of the districts, who have responded, is given in Table 69.

It can be made out from Table 69 that, except for Palakkad district, where 363 farmers have adopted drip irrigation during 2010-11, in all the other reporting districts, adoption level is low. During group discussion with Agriculture Department officials of Palakkad district under this project, it was pointed out that since 90% subsidy is being provided from 2010-11 onwards, farmers have formed groups and started taking land on lease for cultivating crops like vegetables and banana, and they have also adopted drip irrigation for these crops utilizing the subsidy provided. These farmers reportedly have a marketing system, which ensures higher price for the produce.

The Agriculture Department can promote such type of group approaches for crops like vegetables, banana etc. in the command areas of irrigation projects in Kerala during the second or third crop seasons (when irrigation water is released under irrigation projects in the state) and provide subsidy for promoting drip irrigation adoption to these farmers. Even though most of the irrigation projects in Kerala have been designed for rice cultivation, due to its non profitability, farmers in the command areas are significantly shifting to crops like banana and vegetables, which provide comparatively higher returns. Hence, a scheme for promoting drip irrigation through subsidy to these farmers on a group basis can be expected to yield better results than individual farmer level orientation alone, like what is being presently done by the Department under their drip irrigation scheme. This will ultimately help in inculcating a sense of collective farming among the farmers, which will be necessary under the programme of irrigation management transfer to farmers being implemented by the Government for command area development through Participatory Irrigation Management (PIM). It may be noted that group farming, which was introduced earlier, was not very successful in Kerala primarily on account of the non-remunerative nature of rice farming in the state.

Table 69. Number of farmers adopting drip irrigation reported by the Agriculture Department from various districts in Kerala

District	Year of reporting	No. of drip irrigation adopters
Thiruvananthapuram	2006-07	7
	2008-09	39
	2010-11	26
Alappuzha	2010-11	29
Kottayam	2009-10	8
	2010-2011	74
Palakkad	2010-11	363
Malappuram	2006-07	70
	2007-08	34
	2008-09	49
	2009-10	38
	2010-11	42

Along with the data on number of farmers adopting drip irrigation in Malappuram district, the Principal Agricultural officer of the district had also sent the details regarding the target of drip irrigation adoption and actual achievement (in hectares) during 2007-08 in different districts of Kerala. This was shown in a separate sheet as - Micro Irrigation Progress Report 2007- 08. The details are given in Table 70. It can be inferred from the table that in 13 out of 14 districts in Kerala, the achievement of drip irrigation adoption in relation to the target is in the range of 0.08 to 3.12% only during 2007- 08. Only Idukki district shows 97.8% target achievement. Considering the state as a whole, Table 70 reveals that only 6.71% of the target in drip irrigation adoption has been achieved during 2007- 08.

From the above discussion, it can be summarized that, considering the number of farmers cultivating upland crops such as coconut, arecanut, banana etc., which have potential for adoption of drip irrigation, the extent of adoption in majority of the districts in Kerala is not satisfactory, even when subsidy is being offered to farmers for drip irrigation adoption. In the Economic Review, 2003 of Govt. of Kerala, it is reported that the coverage of drip and sprinkler irrigation in Kerala is very low. Govt.

of India (2004) reports that adoption of drip irrigation during 2004 in Kerala is only 1.5% of the cultivated area. Rane (2011) was also of the opinion that the area under micro irrigation, which includes drip irrigation, is very low in Kerala (15885 ha - which works out to 0.6% of the cultivated area in the state).

The adoption of other agricultural practices is also not up to the expected levels in Kerala. The Kerala State Planning Board, in its Economic Review for 2010, mentions that the present level of adoption by farmers suggests the need to enhance technology adoption in coconut (the main upland crop in Kerala) (Source: www.spb.kerala.gov.in).

Fertilizer is an important agricultural input, for which, the Agriculture Department gives subsidy to farmers. A study by Bastine et al (1991) conducted in some districts of Kerala among farmers cultivating coconut has revealed that majority of the farmers do not apply fertilizers. The study also reports that only 6.51% of farmers cultivate coconut hybrids along with other cultivars, 24% farmers adopt correct plant spacing, and only 3% farmers apply green manure for the crop. Unawareness on the recommended technologies, lack of conviction in the recommendations and lack of sufficient capital are the major constraints in the adoption of the techniques reported in this study.

Hence, a concerted effort is required by the Agriculture Department in Kerala to improve adoption of water saving micro irrigation practices, along with other recommended agronomic practices like crop varieties, fertilizer application, plant protection etc. This will help in achieving considerable improvement in crop production and income for farmers in the state, which is very much necessary for Kerala farmers in the present context. For this, the Department can initiate schemes involving research and development organizations working in the field of agriculture, thus enabling pooling of expertise in terms of research, training, implementation and evaluation of the schemes implemented in order to achieve the objective of improving adoption of agricultural practices by farmers.

Table 70. District wise target and achievement of drip irrigation adoption during 2007-08

Sl. No.	District	Drip irrigation adoption during 2007-08		
		Target (ha)	Achievement (ha)	Target achieved (%)
1	Thiruvananthapuram	1805.55	35.18	1.93
2	Kollam	2093.64	22.33	1.05
3	Pathanamthitta	937.97	8.18	0.85
4	Alappuzha	336.95	8.93	2.67
5	Kottayam	1433.47	22.90	1.60
6	Idukki	986.80	965.78	97.80
7	Ernakulam	1421.48	27.23	1.90
8	Thrissur	1413.12	17.51	1.27
9	Palakkad	1285.00	Nil	Nil
10	Malappuram	2112.38	66.15	3.12
11	Kozhikode	1036.00	0.83	0.08
12	Wayanad	1634.00	Nil	Nil
13	Kannur	779.14	8.16	1.02
14	Kasaragod	348.00	Nil	Nil
	Total	17623.50	1183.18	6.71

4.5. *Yield of crops under drip irrigation and surface irrigation methods*

Data collected from farmers under this project on crop yield under drip irrigation, in comparison to un-irrigated conditions and traditional surface irrigation is given in Table 71 for Kozhikode and Table 72 for Thrissur district. The influence of drip irrigation in improving crop productivity is evident from the data.

In Kozhikode district, coconut farmers are able to get 86 nuts per palm year through adoption of drip irrigation, while surface method of irrigation, which uses more water than drip irrigation, gives only 74 nuts per palm per year. Similarly, surface irrigation for arecanut gives 3.5 Kg of dried nut per palm per year, whereas, drip irrigation is giving a yield of 4.4 Kg dried nut per palm per year (Table 71). It can be calculated from the data shown in Table 71 that about 64% and 75% more yield is obtainable through drip irrigation in arecanut and coconut respectively, when compared to un-

irrigated conditions. It can be inferred from the yield data of farmers in Thrissur district presented in Table 72 that, when compared to surface irrigation, drip irrigation results in 19.11% improvement in yield for coconut, 13.3% for arecanut and 47.1% for nutmeg.

The effect of drip irrigation on yield of crops such as coconut, arecanut and banana have been reported based on other studies carried out by CWRDM in Kerala (CWRDM, 1988; CWRDM, 1989). The relevance of drip irrigation for various crops in Kerala from an agronomic and social point of view has also been observed in another study by CWRDM (Madhava Chandran *et al*, 2005).

Hence, even though drip irrigation is a costly method, over a period of time after installation of the system, farmers will be able to make up the extra expenditure incurred towards installation through higher yield and income obtained. The Agriculture Department should initiate steps to transfer such positive results of drip irrigation on crop yields to farmers, without restricting to the advantage of water saving alone, which is found to be the present focus of the Department with respect to this technology. Further, as already mentioned earlier, farmer participatory action research projects on drip irrigation, which can be undertaken by the Agriculture Department in association with research organizations in farmers' plots, should document yield/ income improvement and economic benefits from drip irrigation for various crops in Kerala. These plots should be utilized as model demonstration units for farmers/officials, and field visits to the plots should be incorporated in the training/seminars organized by the department. There should also be a mechanism for farmers to do an audit of the drip irrigation technique after exposure to these demonstration plots. For this, they have to be provided with proper guidance on the methodology to be adopted. Policy decisions, which will enable these type of initiatives, are useful not only for improving irrigation water use efficiency through such water saving irrigation methods, but also for community development from a socio economic perspective through farmer participatory approaches.

Table 71. Yield of crops under drip irrigation* (Kozhikode district)

Crop	Crop yield under		
	Un-irrigated condition**	Surface method of irrigation**	Drip irrigation
Coconut	44 nuts/palm/year	-	77 nuts/palm/year
Coconut	-	74 nuts/palm/year	86 nuts/palm/year
Arecanut	2.2 Kg dried nut/palm/year	-	3.6 Kg dried nut/palm/year
Arecanut	-	3.5 Kg dried nut/palm/year	4.4 Kg dried nut/palm/year

*Average yield of farmers reporting

** Crop yield under un-irrigated/surface irrigated condition before adoption of drip irrigation

Table 72. Yield of crops under drip irrigation* (Thrissur district)

Crop	Crop yield under	
	Surface method of irrigation**	Drip irrigation
Coconut	68 nuts/palm/year	81 nuts/palm/year
Arecanut	3.0 Kg dried nut/palm/year	3.4 Kg dried nut/palm/year
Nutmeg	8.5 Kg/plant/year	12.5 Kg/plant/year

*Average yield of farmers reporting

** Crop yield under surface irrigated condition before adoption of drip irrigation

4.6. *Evaluation of hydraulic characteristics of drip irrigation system*

Drip irrigation is an efficient irrigation method, which can achieve an efficiency of up to 90%. However, inadequate design, faulty installation, improper management etc. may lead to poor performance of the system. This may result in non uniform application of water, leading to either excess or deficit irrigation. Hence, it is important that the hydraulic characteristics of drip irrigation systems are evaluated in the field to improve their performance. Emission uniformity under drip irrigation is used as a parameter to evaluate whether water is uniformly applied to individual plants by the system. If a system has low uniformity, some plants will be over watered, while others will be increasingly stressed. Cultivated areas receiving less water and more water will get reduced crop yield and/or have reduced crop quality.

Under this project, studies were carried out in Kozhikode and Thrissur districts to evaluate the performance of drip irrigation systems laid out by farmers in the field with respect to the hydraulic characteristics of the systems. In Thrissur district, a comparison was also made between drip irrigation and conventional surface irrigation methods with regard to the quantity of irrigation water saved through drip irrigation.

Evaluation was done by calculating the distribution of dripper flow rates in terms of Emission Uniformity (EU) . Five micro irrigation uniformity classifications, ranging from excellent to unacceptable, recognized by the American Society of Agricultural Engineers (ASAE, 1996) is the standard practice used to evaluate the performance of different types of drip irrigation systems. The results obtained are discussed below.

Under the questionnaire survey of the project, data was collected on the irrigation management practices adopted by farmers and hydraulic aspects related to drip irrigation system. Data on irrigated area, type of crop, topography, irrigation network (pump, pipe diameters, pipe length etc.) and the irrigation schedule followed were collected from the farmers. The crops considered were coconut, arecanut and banana. Discharge of emitters was measured from the emitters fixed on laterals located at the head, middle and tail reaches of the main line. The type of data collected from the field is given in Table 73.

Table 73. Data collected for evaluation of drip irrigation system

Sl.No.	Data	Unit
1	Irrigated area	ha
2	Type of crop	-
3	Topography	m
4	Depth of water at source	m
5	Power of pump	HP
6	Pumping duration	Hours per day
7	Type of filter	-
8	Length of pipes(main pipe, sub main and laterals)	m
9	Material of pipes	-
10	Type of emitters	-
11	Emitter discharge	lph
12	Pressure gauge reading	Kg/cm^2

Farmers, who are drip irrigating coconut, arecanut and banana were randomly selected for field data collection. Data on crops cultivated, range of average emitter discharge, number of emitters per plant and hours of operation are given in Table 74. The table shows that in Thrissur and Kozhikode districts, the emitter discharge rates are almost similar, in the range of 20 to 38 litres per hour for coconut. However in the case of arecanut, the discharge rate in Thrissur is only 8 to 12 litres per hour, whereas, in Kozhikode, it ranges from 11 to 35 litres per hour. In the case of banana, in Thrissur district, the rate is about 4 litres per hour, while, for nutmeg it is about 27 litres per hour.

The emitter discharge rates are normally fixed based on the soil intake rate, as well as the movement of water within the soil, which in turn, depends on the soil texture. The normal practice is to use emitters with medium to low discharge rate (2 to 4 lph) in sandy or course textured soils and medium to high discharge rate (4 to 8 lph) in clayey or fine textured soils. In Kozhikode, the soil in almost all the fields is sandy. Hence, low or medium discharge emitters are more suitable. However Table 74

reveals that for coconut, arecanut etc., the discharge rates are extremely high. This can lead to percolation loss beyond the root zone.

The data on number of emitters per plant and hours of operation are also given in Table 74. This data was used for computing the quantity of water applied through drip irrigation by the farmers for various crops (shown in Table 75 and 76). The number of emitters varies from one for banana, arecanut and nutmeg to 5 emitters for coconut in the two districts (Table 74). The number of emitters used by CWRDM in a demonstration project on drip irrigation in Kerala (CWRDM, 1989) was 4, 2 and 2 emitters per plant respectively for coconut, arecanut and banana.

Table 74. Summary of drip irrigation evaluation data collected

District	Crop	Emitter discharge (lph)	No. of emitters per plant	Hours of operation (hrs/day)
Thrissur	Coconut	20 - 38	4 - 5	0.5 – 2.0
	Arecanut	8 - 12	1 - 2	1.0 – 4.0
	Banana	4	1	0.6
Kozhikode	Coconut	20 - 35	2 - 4	1-2
	Arecanut	11 - 35	1	1-2
	Nutmeg	27	1	1

4.6.1. Irrigation application efficiency

The amount of water applied through drip irrigation in the farmers' plots was estimated using the following formula:

$V = t * d * n$

V = volume of water applied through drip irrigation (l/plant/day)

t = Hours of operation (hrs/day)

d = Average discharge of emitters (lph)

n = No: of emitters per plant

The water requirement for each crop was worked out based on KAU recommendation (KAU, 2006) and material collected from internet (http: //www. ncpahindia.com/pfdc-details.php; http: //www. kau.edu/rarspilicode.htm). Field application efficiency (%) was calculated by dividing crop water requirement by the amount of water applied through drip irrigation.

Water requirement of different crops, range of application efficiency and excess/ deficit of water application are shown in Table 75 and 76. It can be seen from the these tables that 33% of farmers in Thrissur are applying water for coconut with an efficiency of almost 100 % , where as in Kozhikode, only 17 % farmers are having high efficiency under their drip irrigation system. This mean that 67 % of farmers in Thrissur and 83 % of farmers in Kozhikode district are drip irrigating coconut with low efficiency ranging from 26 % to 60 %. As far as arecanut is concerned, both in Thrissur and Kozhikode, high irrigation efficiency of 84 % is there. In the case of banana also, which is drip irrigated in Thrissur, high efficiencies have been obtained. However, these high application efficiencies are based on the average application in the field, and hence, have to be viewed with caution. Table 75 and 76 indicate that the farmers do not have proper understanding of the water requirement of coconut, and hence, they are applying water up to almost three times of the actual requirement of 57 litres per plant per day. Lack of knowledge on irrigation requirement of coconut, coupled with systems with inadequate control mechanisms are the main cause for this low efficiency. In the case of arecanut and banana, the application is slightly less than that of the actual water requirement (ie; 33 and 20 litres per plant per day respectively). Discussion with farmers has revealed that they have adopted the above rates of application by choice, and not based on scientific advice given by the authorities.

Table 75. Application efficiency under drip irrigation system (Thrissur District)

Sl. No	Crop	Crop water requirement (l/plant/day)	Quantity of water applied (l/plant/day)	Application efficiency (%)	Excess(-)/ Deficit (+) (l/plant/day)	Farmers (%)
1	Coconut	57	43 to 51	100	-6 to -14	33 %
2	Coconut	57	104 to 220	26 to 55	47 to 163	67 %
3	Arecanut	30	22	100	- 8	50 %
4	Arecanut	30	30	100	0	50 %

Table 76. Application efficiency under drip irrigation system (Kozhikode District)

Sl. No	Crop	Crop water requirement (l/plant/day)	Quantity of water applied (l/plant/day)	Application efficiency (%)	Excess (-)/ Deficit (+) (l/plant/day)	Farmers (%)
1	Coconut	57	57	100	-2	17 %
2	Coconut	57	70 to 120	50 to 60	13 to 63	83 %
3	Arecanut	30	36	84	3	67 %
4	Arecanut	30	22	100	-9	33 %
5	Banana	20	18	100	-2	100%

4.6.2. Emission uniformity

For calculating emission uniformity, laterals located at the head, middle and tail reaches of the mainline of drip irrigation systems were selected, and emitter discharge was measured. Discharge was measured using a measuring cylinder and stop watch. Pressure in these laterals was also monitored using a pressure gauge. Flow data from these emitters was used to compute Emission Uniformity (EU) using the following formula suggested by Farouk A. Hassan (Source: http://www.trickle-l.com/new/archives/eeu.html):

EU = (Average of the lowest quarter/Average discharge rate) * 100

Table 77 and 78 shows the emission uniformity calculated for the drip irrigation systems evaluated in the two districts

Table 77 shows that EU of micro sprayer (the emitter locally fabricated by a farmer in Thrissur district) in 17% of the plots is greater than 90 %, which falls under the "excellent" category of water distribution under drip irrigation throughout the field, and between 80 % and 90 % for 50 % of the plots, which is an indication of "good" water distribution. For the remaining 33 % of plots, EU of micro sprayer is between 70% and 80%, indicating that water distribution is "fair".

In the case of farmers using micro tubes with ordinary emitters in Thrissur district, EU of all the plots is found to be between 70% and 80%, showing "fair" water distribution (Table 77). The table also shows that EU of both ordinary emitter and pressure compensating emitter for all the plots is between 80% and 90%, which is again an indication of good water distribution throughout the plots.

Table 77 shows that variation in pressure and discharge for all type of emitters is within the acceptable range of 40% and 20% respectively. In the case of pressure compensating emitter, even though the pressure variation is found to be very low, the discharge variation is high. This might be attributed to clogging of emitters or improper functioning of the emitter itself due to manufacturing defects.

It can be made out from Table 78 that in Kozhikode district, all the farmers using pressure compensating emitter have a relatively high efficiency of 70% to 80 %, whereas, majority of the famers (67%) using ordinary emitter and all the farmers using micro tube emitter have relatively less emission uniformity of 60% to 70% .

On the whole, other emitters under this study have shown better emission uniformity than micro sprayer emitter, which is expected, since the company emitters are hydraulically designed. Even though the drip systems under the study are not found to be hydraulically designed, the emission uniformities obtained are relatively good (fair to excellent). This trend can be mainly attributed to small sized plots (< 0.4ha) of farmers under this study.

Table 77. Emission uniformity of emitters (Thrissur district)

Sl.No.	Type of emitter	EU (%)	Variation in discharge (%)	Pressure variation (%)	Farmers (%)
1	Micro sprayer	> 90	4	12	17
2	Micro sprayer	80 - 90	11 to 19	10 to 20	50
3	Micro sprayer	70 - 80	20 to 28	20 to 40	33
4	Micro tube with ordinary emitter	70 - 80	20	40	100
5	Ordinary emitter	80 - 90	16	4	100
6	Pressure compensating emitter	80 - 90	14	4	100

Table 78. Emission uniformity of emitters (Kozhikode district)

Sl. No.	Type of emitter	EU (%)	Variation in discharge (%)	Pressure variation (%)	Farmers (%)
1	Micro tube with ordinary emitter	70-80	12 to 21	10 to 14	67
2	Micro tube with ordinary emitter	60-70	41 to 57	30 to 42	33
3	Pressure compensating emitter	70-80	21	47	100
4	Micro tube	60-70	17	31	100

Table 79 gives details of quantity of water applied through conventional and drip methods of irrigation for coconut, arecanut and banana by farmers, which was collected for comparison in Thrissur district. It can be made out from the table that the quantity of water applied by farmers adopting conventional method of irrigation is more, compared to farmers adopting drip irrigation. It can also be seen that rate of irrigation for coconut through drip method is in excess than the required irrigation rate of 57 litres/palm/day suggested by Kerala Agricultural University (Source: http://www.kau.edu/rarspilicode.htm). However, it can be inferred from the data

presented in Table 79 that for arecanut and banana, the rate of irrigation by drip irrigating farmers in this study is less than the suggested irrigation rate of 30 l/plant/day for arecanut (Kerala Agricultural University, 2006) and 20 l/plant/day for banana (Source: http://www.ncpahindia.com/pfdc-details.php).

Table 79. Quantity of water applied by farmers through conventional irrigation and drip irrigation

Sl.No	Type of crop	Conventional irrigation litres/plant/day	Drip irrigation litres/plant/day
1	Coconut	436	116
2	Arecanut	148	26
3	Banana	42	18

Lack of awareness among farmers on the quantity of water to be applied through drip irrigation for various crops is evident from the results presented above. In this context, it will be useful on the part of Agriculture Department as well as drip irrigation firms, who install the system in farmers' fields to provide them sufficient awareness on this, along with other aspects such as maintenance of the drip irrigation system etc. This is more relevant in the case of an irrigation method like drip irrigation, which is promoted to save water by applying the crop water requirement on a daily basis.

5. Summary

i. Drip irrigation adoption index of farmers under this study in Thrissur district is less than that of farmers in Kozhikode district. In Kozhikode, 73% of drip irrigation adopters have adoption index in the range of 53.2 to 79.1% of the maximum possible index value, while in Thrissur, 77% farmers have adoption index in the lower range of 34.2 to 60.9% of the maximum possible index value.

ii. Categorization of the drip irrigation adoption index based on mean and standard deviation values reveals that majority of the farmers in both the districts have medium adoption index.

iii. Statistically significant difference in adoption index of farmers exists between the districts with respect to all the crops cultivated. The mean adoption index of farmers for all the crops is higher in Kozhikode, when compared to Thrissur district.

iv. The comparatively higher score obtained for number of drip irrigation components installed, type of emitters used, and continuation of drip irrigation adoption by farmers in Kozhikode district contribute to the higher crop-wise adoption index of these farmers, when compared to farmers in Thrissur district.

v. Between the two districts, for all the crops, statistically significant variation is observed with respect to the number of drip irrigation components used, type of emitters used, and continuation of drip irrigation by the farmers.

vi. Score for number of drip irrigation components installed, type of emitters used and number of years of drip irrigation adoption show high correlation with adoption index of farmers in Kozhikode and Thrissur districts, indicating the comparatively higher influence of these items on drip irrigation adoption by farmers.

vii. There is no statistically significant difference in adoption index of farmers cultivating different crops in both the districts. This indicates that despite the fact that drip irrigation is comparatively more costly for closely spaced crops, there is no significant variation between widely spaced crops like coconut and closely spaced

crops like banana in the adoption of different items of drip irrigation adoption index such as area of drip irrigation adoption, number of components used in the drip irrigation system, emitters used etc. by the farmers. This implies that they are willing to follow the guidelines/suggestions of the drip irrigation firms/Agriculture Department on drip irrigation system.

viii. For drip irrigation adopters in Thrissur district, statistically significant difference in adoption index was observed only between two categories of age of farmers, namely, 71 to 80 years and < 70 years. Since significant influence of many age groups on drip irrigation adoption is not observed in Thrissur district, and because age did not exhibit statistically significant influence on adoption index of farmers in Kozhikode district, this variable cannot not considered as a factor influencing drip irrigation adoption in the study.

ix. Farming experience is found to be an important factor contributing to drip irrigation adoption in Thrissur district. Statistically significant difference in adoption index was observed between the farming experience categories, namely, 1 to 10 years and 51 to 60 years, 11 to 20 and 51 to 60 years, 21 to 30 and 51 to 60 years, 31 to 40 and 51 to 60 years, and also between 41 to 50 years and 51 to 60 years in the district.

x. Since significant influence of most of the landholding categories on drip irrigation adoption index of farmers is not observed in Thrissur district, and there is no significant influence of this variable on adoption index of farmers in Kozhikode district, landholding size cannot be considered as a factor influencing drip irrigation adoption in this study.

xi. However, non-farm income of farmers in Thrissur district is found to be an important factor influencing drip irrigation adoption by farmers. There exists statistically significant difference in adoption index between farmers under the following categories of non-farm income, namely, < 25% and 25 to 50%, < 25% and 50 to 75%, and between 25 to 50% and 50 to 75%. This implies that farmers getting more income from occupations other than agriculture is economically better placed to adopt costly irrigation methods like drip irrigation.

This is relevant in a state like Kerala, where many farmers operate non remunerative farming.

xii. The most important reason for farmers to adopt drip irrigation in both the districts is the difficulty to practice water consuming traditional irrigation methods due to water scarcity. In both the districts, farmers attribute higher labour requirement under traditional irrigation methods as the second important reason for adopting drip irrigation. High productivity and income from cultivation and good crop yield obtainable through drip irrigation have also acted as incentives for farmers to go in for the micro irrigation technique. However, subsidy provided by the Agriculture Department has not been an important contributing factor in the adoption of drip irrigation in both the districts.

xiii. Clogging of emitters and laterals, which is a serious problem under drip irrigation, has been ranked as an important constraint in continuation of drip irrigation by farmers in both the districts. Other constraints include damage to the drip system due to falling of coconuts, rodents etc., high cost of drip irrigation components, non availability of components, difficulty to do inter cultivation when drip system is there in the field, lack of after sales service from drip irrigation firms, difficulty to fold the pipes during rainy season, lack of sufficient awareness/ technical assistance from the Agriculture Department etc.

xiv. The following reasons for adoption of drip irrigation, namely, water scarcity, and more labour requirement for practicing surface irrigation methods exert statistically significant influence on drip irrigation adoption index of farmers in Thrissur district. The mean adoption index of farmers mentioning water scarcity as the reason for drip adoption is 61.78, while it is 50.82 for farmers citing more labour requirement as the reason for adoption. This implies that farmers facing water scarcity are more innovative in adoption of drip irrigation.

xv. The above mentioned reasons also significantly influence the number of components used in the drip system and years of drip irrigation adoption by farmers in Thrissur district. The analysis has revealed that in this district, farmers,

who are concerned about more labour charges required for adoption of irrigation, are also conservative from an economic point of view with regard to the number of components installed in the drip irrigation system. Similarly, farmers, who have been facing water scarcity, have adopted drip irrigation earlier than those who have adopted it due to more labour requirement for practicing surface irrigation methods.

xvi. In both the districts, farmers reported yield increase under drip irrigation, when compared to surface method of irrigation as well as un-irrigated conditions for coconut, arecanut and nutmeg.

xvii. More than 90% of the farmers adopting surface irrigation irrigate coconut in the two districts under study. Similarly, in both the districts, more than 90% of the farmers are adopting the recommended method of basin irrigation for coconut. Arecanut farmers in Thrissur district adopt furrow irrigation, which is the recommended method for the crop. However, in Kozhikode district, all the arecanut farmers are adopting basin irrigation.

xviii. In both the districts, about 40 to 48% of farmers report water scarcity as the reason for not able to irrigate their entire cultivated area through surface irrigation methods. Water scarcity is also an outcome of excess water application by farmers, mainly due to their unawareness on the quantity to be applied and the frequency of irrigation to be adopted. The farmers in this study also mentioned that the Agriculture Department is not able to provide them sufficient information on these aspects through training and other capacity building programmes.

xix. A good majority of the farmers practicing traditional surface irrigation in both the districts are aware of drip irrigation technique. However, majority of them are not interested in adopting drip irrigation due to factors such as high cost of the system, difficulty in getting subsidy/loan for drip installation, unawareness on technical aspects of the irrigation method, losing interest since some farmers discontinued their drip irrigation, availability of adequate water, difficulty to carry out inter cultivation when drip irrigation system exists in the field etc.

xx. Water scarcity, labour/water saving feature of drip irrigation, possibility of yield increase through adoption of drip irrigation and subsidy of 90% being presently provided by the Agriculture Department are the factors reported by officials from different districts, which are contributing to adoption of drip irrigation in Kerala. However, officials from most of the districts were of the opinion that the extent of adoption of the irrigation technique is not satisfactory. This is also substantiated from the data on number of drip irrigation adopters in various districts obtained under this project from the Agriculture Department. Unawareness among farmers on drip irrigation technique, lack of technical knowhow for agricultural officers on the design and maintenance of drip irrigation, considerable expenditure incurred by farmers even after getting subsidy since installation cost of drip irrigation system is not included in the subsidy, lack of sufficient number of authorized dealers of drip irrigation, delay in getting administrative sanction for drip irrigation subsidy scheme resulting in lack of sufficient time to identify drip irrigation adopters, nonpayment of subsidy for drip irrigation system installed on leased land, ineligibility of farmers to avail subsidy for drip irrigation system installed by un-authorized agencies, 90% subsidy presently provided working out to less than 90% of the present cost of the system at the field level, since the calculation is based on earlier cost estimates etc. are the constraints in adoption of drip irrigation reported by the Agriculture Department officials.

xxi. The constraints in continuation of drip irrigation reported by the Agriculture Department officials include lack of sufficient after sales service from drip irrigation agencies, clogging of emitters, damage to pipes due to falling of coconuts/rodent attack etc., and the difficulty of farmers to remove drip irrigation system from the field during each rainy season, which extends for about 6 months in Kerala.

6. Suggestions

Taking into consideration the results of the study carried out under this project, the following suggestions are enlisted for increasing adoption of drip irrigation among farmers in Kerala:

i. In a state like Kerala, where farming is primarily on small land holdings and is not remunerative for many of the farmers, drip irrigation subsidy scheme can incorporate the installation cost of drip irrigation system also. Such a policy decision will help to enhance the rate of adoption of the irrigation technique in the state. Similarly, ensuring facilities for payment of subsidy for drip irrigation system installed on leased land, and for systems installed by agencies other than those who are authorized by the Department will be useful to promote drip adoption, provided a mechanism is instituted to ensure certain minimum standards for the drip irrigation components installed in the system. These institutional changes are necessary in Kerala, where, the present rate of drip irrigation adoption is low.

ii. The Agriculture Department can undertake farmer participatory demonstration cum trials on micro irrigation techniques like drip irrigation, involving various drip irrigation manufacturers/firms and research organizations in various locations in the plots of experienced and progressive farmers. The drip irrigation scheme of the Department is understood to have facilities for such demonstrations. These plots should be utilized as model demonstration units for farmers/officials, and field visits to the plots should be incorporated in the training/seminars organized by the department. There should be mechanisms to document yield/income improvement and economic benefits (such as Benefit: Cost ratio) from drip irrigation from these plots. There should be a mechanism for farmers to audit the drip irrigation technique after exposure to these demonstration plots, with proper guidance on suitable methodology to be adopted for this. Policy decisions, which will enable these type of initiatives, are useful not only for improving irrigation water use efficiency through such water saving irrigation methods, but also for community development from a socio economic perspective through farmer participatory approaches.

iii. Sufficient number of training/workshops and other awareness programmes covering all aspects of drip irrigation can be arranged by the Agriculture Department for both farmers and officials for awareness creation. Field visits to the drip irrigation demonstration plots should be made part of the training programme.

iv. Awareness on drip irrigation technique alone will not help much in promoting its adoption. Measures such as timely and adequate level of government subsidy for drip irrigation adoption and adequate technical backup/after sales service to farmers on drip irrigation installation/maintenance should be ensured.

v. The acceptability of drip irrigation to farmers is not due to water scarcity and water saving alone, but also because of higher crop yield, which they perceive from adopting the irrigation technique. This aspect can be considered by the Agriculture Department in promoting drip irrigation. The extension orientation of the Department can concentrate on higher yield and income, which can be obtained through adoption of drip irrigation for crops, in addition to water saving. Available data on improvement in crop yield under drip irrigation can be provided to farmers by the Department through training programs/workshops etc.

vi. The Agriculture Department can take steps to enlist more number of authorized dealers of drip irrigation for the benefit of farmers.

vii. Periodic revision of cost estimates of drip irrigation system, according to the changes in market price of pipes and accessories may be ensured.

viii. The Agriculture Department can document adoption rate of micro irrigation systems including drip irrigation, crop-wise, district wise and year wise. Similarly, preparation of estimate of potential for drip irrigation adoption in different districts may be carried out. This will serve as a useful data base for planning related to promotion of micro irrigation techniques.

ix. The Agriculture Department should promote group farming approaches for remunerative crops like vegetables, banana etc. in the command areas of irrigation projects in Kerala during the second or third crop seasons, when irrigation water is released under irrigation projects in the state. Subsidy should

also be provided for promoting drip irrigation adoption to these farmers. This can be expected to yield better results than individual farmer level orientation alone, like what is being presently adopted by the Department under their drip irrigation scheme. This can also help in inculcating a sense of collective farming among the farmers, which is very much necessary under the programme of irrigation management transfer to farmers through PIM, which is being envisaged by the Government of Kerala for command area development.

x. A concerted effort can be made by the Agriculture Department in Kerala to improve adoption of other recommended agronomic practices like crop varieties, fertilizers, mulching, plant protection etc., along with water saving micro irrigation methods like drip irrigation by farmers. Measures for value addition and proper marketing of the farmer's produce should also be instituted. These strategies are necessary for achieving the much required improvement in crop production and income for farmers in order to sustain in the farming sector in Kerala. For achieving this, the Department can initiate schemes involving research and development organizations working in the fields of agriculture and water management, thus enabling pooling of expertise in terms of research, training, implementation and evaluation of the schemes implemented.

7. Comparison of the conclusions of the study with current thinking

i. Despite the fact that drip irrigation is comparatively more costly for closely spaced crops, there is no significant variation observed in this study between widely spaced crops like coconut and closely spaced crops like banana in the adoption of different items of drip irrigation adoption index such as area of drip irrigation adoption, number of components used in the drip irrigation system, emitters used etc. by the farmers. This implies that they are willing to follow the guidelines/suggestions of the drip irrigation firms/Agriculture Department on drip irrigation system.

For closely spaces crops, due to the comparatively higher cost of the system, farmers may be hesitant to adopt all the components of drip irrigation. However the finding mentioned above disproves this belief in the study areas.

ii. The important reasons for adoption of drip irrigation in this study are the difficulty to practice water consuming traditional irrigation methods due to water scarcity, higher labour requirement under traditional irrigation methods and high productivity and income from cultivation and good crop yield obtainable through drip irrigation.

This is in agreement with the actual field level situation existing in Kerala.

However, subsidy provided by the Agriculture Department has not been an important contributing factor in the adoption of drip irrigation in both the districts under this study.

This finding goes against the general thinking in official circles that subsidy is an important factor contributing to drip irrigation adoption by farmers.

iii. Clogging of emitters and laterals, damage to the drip system due to falling of coconuts, rodents etc., high cost of drip irrigation components, non availability of components, difficulty to do inter cultivation when drip system is there in the field, lack of after sales service from drip irrigation firms, difficulty to fold the pipes during rainy season and lack of sufficient awareness/ technical assistance from the Agriculture Department are the important constraints in continuation of drip irrigation by farmers in this study.

These are some of the field level problems existing among many farmers in Kerala.

iv. Under this study, farmers reported yield increase under drip irrigation, when compared to surface method of irrigation as well as un-irrigated conditions for coconut, arecanut and nutmeg.

However, the perception among some farmers is that even though water use efficiency (yield per unit quantity of water applied) will be more under drip irrigation system for crops, it may not contribute to a higher yield than conventional irrigation methods.

v. A good majority of the farmers practicing traditional surface irrigation in both the districts under this study are aware of drip irrigation technique. However, majority of them are not interested in adopting drip irrigation due to reasons such as high cost of drip irrigation system, difficulty in getting subsidy/loan for drip installation, unawareness on technical aspects of the irrigation method, difficulty to carry out inter cultivation when drip irrigation system exists in the field etc.

These are some of the factors contributing to low adoption of drip irrigation by farmers in the State.

vi. Officials from the districts under this study were of the opinion that the extent of adoption of the irrigation technique is not satisfactory.

This observation is also confirmed from the data on number of drip irrigation adopters in various districts, which has been obtained from the Agriculture Department report under this research project, and presented in this final report.

8. Publications under the project

Susha, P. A., Basil, B., Sushanth, C. M., Madhava Chandran, K. and George Mammen (2010). Irrigation management practices adopted by farmers under coconut based cropping system: An analysis. *Proceedings of 22nd Kerala Science Congress,* January 2010, KFRI, Thrissur, Kerala: 86-87.

Madhava Chandran, K., Sushanth, C.M., George Mammen, Surendran, U. and Joseph, E.J (2011). *Drip Irrigation Manual.* Centre for Water Resources Development and Management (CWRDM), Kozhikode, Kerala, December 2011. 80p.

Hredhya Haridas, Susha, P. A., Madhava Chandran, K., George Mammen and Sushanth, C. M. (2012). A study on drip irrigation technique in Kerala. *Proceedings of 24th Kerala Science Congress,* January 2012, RRRI, Kottayam, Kerala: 18-19.

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