



Research Paper

Water use efficiency under coconut based different irrigation methods

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ABSTRACT : The quantity of water required for producing 1000 nuts in FM group, MSM group and DM group was 0.05Ha-m, 0.02Ha-m and 0.03 Ha-m, respectively. On the basis of nut yield per Ha-m and water used for producing 1000 nuts, the per cent water saved in modern methods over traditional one was worked out which indicated water use efficiency. The water use efficiency (nut yield/Ha-m) was found to be more in micro-sprinkler irrigation method (43173) followed by drip (38923) and flood irrigation method (22268). Water saved in modern irrigation methods was to the extent of 60 per cent in micro-sprinkler method and 40 per cent in drip irrigation method. Irregular supply of electricity was the major problem of farmers using flood method of irrigation (71.42%). Other major problems in flood irrigation method were shortage of water in summer season (31.43%) and unavailability of raw material (57.14%). Most important problem of farmers using micro sprinkler irrigation method was that of weed.

KEY WORDS : Cost of irrigation, Water use efficiency, Constraints

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INTRODUCTION

The agriculture is major consumer of water, which accounts for more than 90 per cent of total water use. The allocation of water to agriculture will get reduced to 75 to 80 per cent in another 15 to 20 years as the demand of water for industries and domestic purpose increases. The total utilisable quantum of water is estimated to be nearly 105 million hectare meters and even with the full utilization of this potential; nearly half of our cultivated area will remain unirrigated. So, this remaining area will continue to depend upon rainfall. Hence, it is necessary to economise the use of water in agriculture. This could be achieved by introducing advanced and sophisticated methods of irrigation like drip and sprinkler with improved water management practices. The overall irrigation efficiency is very low in our country due to loss of irrigation water during conveyance and field application (Rane, 1985). Therefore, there is a great scope in saving large quantities of water to estimate water use efficiency under different methods of irrigation and problem faced by the farmers using different methods of irrigation.

MATERIALS AND METHODS

A cross sectional sample of 90 farmers was selected from Ratnagiri district (M.S.). They were classified according to methods of irrigation as Flood irrigation method, Micro-sprinkler method and Drip irrigation method. The data collected for the agricultural year 2009-10 were analyzed by using suitable statistical tools and standard cost concepts to draw meaningful conclusions. In each irrigation structure, irrigation water used was estimated.

Estimation of quantity of irrigation water in flood irrigation method:

Following formula was used for estimation of quantity of irrigation water in flood method of irrigation:

$$Q = \frac{H.P. \times 75}{H} \times \frac{n}{100}$$

where,

Q = Discharge of pump (lit/sec)

H.P.= Horse power of the pump

n = efficiency of the pump (%)

H = total head (m)

Estimation of quantity of irrigation water in drip irrigation method:

Farmers were asked about the (a) Horse power (H.P.) of engine, (b) length of suction and delivery pipe, (c) horse power of running of engine for one irrigation for particular coconut, (d) number of drippers, (e) number of irrigations and (f) interval between two irrigations and (g) water discharge per dripper per hour.

The following form of formula was used for estimation of quantity of irrigation water in drip irrigation method:

$$I = Q_e \times T \times n \times D$$

where,

I = Irrigation water applied per plant per week (Lit)

Q_e = Discharge of emitter (Lit/hr)

T = Time for which system is operated (hr)

N = Number of emitters per plant

D = Number of days in week when irrigation is given

Estimation of quantity of irrigation water in sprinkler irrigation method:

For estimation of irrigation water in sprinkler irrigation, the farmers were asked about the (a) Horse power (H.P.) of engine, (b) length of suction and delivery pipe, (c) number of sprinklers, (d) Horse power of running engine, (e) number of irrigations and (f) interval between two irrigations.

The following form of formula was used for estimation of quantity of irrigation water in micro-sprinkler irrigation method:

$$I = Q_s \times T \times n \times D$$

where,

I = Irrigation water applied per plant per Week (Lit)

Q_s = Discharge of micro sprinkler (Lit/hr)

T = Time for which system is operated (hr)

n = Number of micro- sprinklers per plant

D = Number of days in week when irrigation is given

Estimation of returns:

The physical yield obtained from coconut and other crops in the systems is valued at the average price received by the farmers. Further, the total gross returns received from all the crops in the system are converted into coconut equivalent yield by using the following formula:

$$\text{Coconut equivalent yield (nuts)} = \frac{\text{Gross returns from coconut based cropping system (Rs.)}}{\text{Price of a coconut (Rs.)}}$$

RESULTS AND DATA ANALYSIS

The findings obtained from the present study are presented below:

Identification of irrigation methods in coconut based cropping system:

One of the objectives of study was to identify different irrigation methods along with their capital investment in coconut based cropping systems in the study area. Accordingly, the information on different irrigation methods adopted by coconut growers is presented in Table 1.

Flood method of irrigation as well as sprinkler and drip method of irrigation are the methods commonly used for irrigation of horticultural crops in Konkan region. It is seen from Table 1 that, in all three different irrigation methods were observed in study area in coconut based cropping system. Out of which, majority (35 growers) of respondents were found to adopt flood method of irrigation, which accounted to 39 per cent of total number of respondents. Another major irrigation method found was Micro-sprinkler irrigation, which was adopted by 30 coconut growers, which accounted to 33 per cent of total number of respondents. Another type of irrigation method found to be adopted by 25 coconut growers was drip irrigation method, which accounted to 28 per cent of total number of respondents. Flood method of irrigation was used where there was ample quantity of available water.

Cropping pattern of respondents:

Cropping pattern of coconut growers is one of the important determinants for deciding income, consumption and employment of the farm family. Allocation of farm resource is also decided by the cropping pattern adopted on a particular farm. The cropping pattern of the selected respondents was studied and the information is given in Table 2.

It is seen from Table 2 that, perennial crops dominated the cropping pattern of the respondents. The average gross cropped area with the coconut growers using flood irrigation method was 0.79 ha. Out of which, perennial horticultural crops occupied 69.62 per cent area (0.55ha). Average area under *Kharif* paddy was 0.13 ha. (16.45%). Very meagre area was allotted to

Table 1 : Classification of sample farmers

Sr. No.	Irrigation method	No. of farmers	Percentage
1.	Flood method (FM)	35	39
2.	Micro-sprinkler method (MSM)	30	33
3.	Drip method (DM)	25	28
	Total	90	100

Rabi crops(13.92%). The area under coconut was observed 0.32 ha (40.50%).

The average gross cropped area with the coconut growers using sprinkler irrigation was 1.12ha. of which area under mixed coconut orchard was 0.50 ha (44.64%). The area under all perennial crops together accounted for 81.25 per cent of total cropped area. The proportion of area under *Kharif* paddy was 12.5 per cent (0.14 ha.). The per farm gross cropped area with the coconut growers using drip method of irrigation was 1.42 ha., of which, *Kharif* paddy and all *Rabi* crops occupied 10.56 per cent and 8.45 per cent of the gross cropped area, respectively. The area under all the perennial horticultural crops was 1.15 ha (80.98%). Of the perennial crops, the area under coconut mixed orchard was 0.63 ha.

The analysis of cropping pattern indicated that mango, cashew and coconut/ areca nut are the major crops with the sample farmers, and this is obvious because the study area is near to seashore in which, these crops are grown by majority of farmers. On the contrary, the soils nearer to the seashore are not most suitable for paddy cultivation. Therefore, proportion of area under paddy is minimum. The cropping intensity calculated as per the methodology-adopted turn out to be 116 per cent in FM, 106 per cent in MSM and 109 per cent in DM Group.

Cost of irrigation per annum:

In the present study water utilized by the coconut growers was measured in terms of Ha-m. Therefore cost incurred for bailing the entire water quantity and cost per unit of water was worked out and presented in Table 3.

The annual cost of irrigation is the sum total of fixed and variable cost. Out of the total cost on irrigation, the share of amortized cost of investment was 68.63 per cent, 79.73 per cent and 79.80 per cent in FM group, MSM group and DM group, respectively. The per unit cost of irrigation water (cost Rs./Ha-m of water) was Rs.21666, Rs 49110 and Rs.39412 in FM, MSM and DM groups, respectively.

Table 4 shows that, total number of bearing coconut palms in FM group, MSM group and DM group was 131, 141 and 121, respectively. Coconut based cropping system consists of other crops like areca nut, black pepper, nutmeg and some other fruit crops like banana, sapota, jackfruit etc. Average age of orchard was found to be 48, 47 and 50 years in FM group, MSM group and DM group, respectively.

Water use efficiency:

Water use efficiency plays a vital role in any irrigation system, which implies the productivity per unit of water consumed in irrigated crop system. Table 5 indicates the

Table 2 : Cropping pattern

Sr. No.	Particulars	Flood method (FM)	Micro-sprinkler method (MSM)	Drip method (DM)
1.	Kharif crops:			
	Paddy	0.13 (16.45)	0.14 (12.5)	0.15 (10.56)
2.	Rabi crops:			
	(a) Vegetables	0.06	0.05	0.07
	(b) Pulses	0.05	0.02	0.05
	Total of <i>Rabi</i> crops (a+b)	0.11 (13.92)	0.07 (6.25)	0.12 (8.45)
3.	Perennial crops:			
	Mango	0.10	0.23	0.34
	Cashew	0.13	0.18	0.18
	Coconut/ coconut mixed	0.32 (40.50)	0.50 (44.64)	0.63 (44.37)
	Total of perennial crops (a+b+c+d)	0.55 (69.62)	0.91 (81.25)	1.15 (80.98)
	Gross cropped area	0.79 (100)	1.12 (100)	1.42 (100)
	Net cultivated area	0.68	1.05	1.3
	Cropping intensity (%)	116	106	109

Figures in parentheses are percentage to gross cropped area

Table 3 : Cost of irrigation per annum

Sr. No	Particulars	FM	MSM	DM
1.	Annual amortized cost of investment	10112 (68.63)	20361 (79.73)	20442 (79.80)
2.	Variable cost	4621 (31.36)	5176 (20.26)	5176 (20.20)
	Current repairs to pump	668 (4.53)	564 (2.20)	515 (2.01)
	Electricity charges	3953 (26.83)	4612 (18.06)	5365 (20.94)
3.	Annual total cost of irrigation	14733 (100.00)	25537 (100.00)	25618 (100.00)
4.	Quantity of water bailed out (Ha-m)	0.68	0.52	0.65
5.	Cost of irrigation water /Ha-m	21666	49110	39412

detailed information regarding water use efficiency in different irrigation methods.

Table 5 revealed that water use efficiency under MSM group and DM group was more than triple as compared to traditional method of irrigation. Coconut equivalent yield in FM group, MSM group and DM group was 15142, 22450 and 25300 nuts, respectively. The quantity of water consumed for producing this nut yield was 0.68 Ha-m, 0.52 Ha-m and 0.65 Ha-m in FM group, MSM group and DM group, respectively. Considering this, the coconut equivalent yield per ha-m was estimated and it came to 22268 nuts, 43173 nuts and 38923 nuts in FM group, MSM group and DM group, respectively. Thus, the quantity of water required for producing 1000 nuts in FM group, MSM group and DM group was 0.05Ha-m, 0.02Ha-m and 0.03 Ha-m, respectively. On the basis of nut yield per Ha-m and water used for producing 1000 nuts, the percent water

saved in modern methods over traditional one was worked out which also indicates water use efficiency. The water saved in MSM was about 60 per cent and that in DM 40 per cent indicating efficient use of water over traditional method.

Problems faced by farmers using different irrigation methods:

The constraints faced by farmers while using different irrigation methods are given in Table 6. The constraints were grouped under eleven major groups.

Irregular supply of electricity was the major problem of farmers using flood method of irrigation (71.42%). Other major problems in flood irrigation method were shortage of water in summer season (31.43%) and unavailability of raw material (57.14%). Most important problem of farmers using micro sprinkler irrigation method was that of weed. In sprinkler irrigation 100 per cent farmers opined about the problem of

Table 4 : Per hectare plant population in coconut based cropping system in different irrigation methods

Sr. No.	Crops	FM	MSM	DM
1.	Coconut palm			
	Bearing	131	141	121
	Non-bearing	92	76	51
	Total	223	217	172
2.	Areca nut palm			
	Bearing	1425	538	1026
	Non-bearing	756	185	225
	Total	2181	723	1251
3.	Black pepper vine	10	13	16
4.	Nutmeg	2	3	2
5.	Average age of orchard (years)	48	47	50

Table 5 : Water use efficiency in different irrigation methods

Sr. No.	Particulars	FM	MSM	DM
1.	Quantity of water used for irrigation (ha-m)	0.68	0.52	0.65
2.	Coconut equivalent yield (nuts)/ha	15142	22450	25300
3.	Water use efficiency (nut yield /Ha-m)	22268	43173	38923
4.	Per cent increase in water use efficiency over TMI	-	94	75
5.	Water used per 1000 nuts (Ha-m)	0.05	0.02	0.03
6.	Water saved in modern irrigation methods over traditional method (%)	-	60	40

Table 6 : Constraints faced by farmers in adoption and operation of different irrigation methods

Sr. No.	Particulars	Frequency of farmers facing the constraints in		
		FM (n=35)	MSM (n=30)	DM (n=25)
1.	Timely unavailability of labours	10 (28.57)	20 (66.67)	20 (80.00)
2.	Shortage of water in summer season	11 (31.43)	5 (16.66)	3 (12.00)
3.	Unavailability of raw material	20 (57.14)	20 (66.67)	18 (72.00)
4.	Difficulty in purchasing the components	-	15 (50.00)	10 (40.00)
5.	Difficulty in repairing	8 (22.85)	10 (33.33)	5 (20.00)
6.	Irregular supply of electricity	25 (71.42)	17 (56.67)	14 (56.00)
7.	Problem of weeds	-	30 (100.00)	5 (20.00)

weed. Other problems faced by more than 50 per cent farmers in this method were unavailability of raw material (66.67%), difficulty in purchasing the components (50%) and irregular supply of electricity (56.67%). In drip irrigation major problems were unavailability of raw material (72.00%) and irregular supply of electricity (56.00%). Other problems like shortage of water, problem of weed etc were minor (less than 50%). Before adopting micro sprinkler and drip method farmers faced the problem of unavailability of labour on time to the extent of 66.67 per cent and 80.00 per cent, respectively.

Narayanamoorthy (1997), Prasanna (1998) and Kalyankumar (2010) have also made some observations related to the present investigation.

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