Participatory Approach for improving Irrigation efficiency through Micro irrigation technology in Kerala State-A case study

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KEYWORDS

Micro irrigation, Demonstration, Participatory, Vegetable Farmers and Kerala

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ABSTRACT

A Project entitled "Farmer Participatory Action Research Programme(phase II)" with the funding from Ministry of Water Resources, New Delhi was implemented in Palakkad district of Kerala by Regional Agricultural Research Station(RARS) Pattambi, one the Research Stations under Kerala Agricultural University. Micro irrigation has been included as a component of demonstration under the programme.The objective of the demonstration is to show the relative advantage of Micro irrigation technology compared to traditional technology adopted by the farmers. The project was implemented in 2012. Initially Groups comprising 10 farmers in a village (Elavancherry) was formed. Vegetable crops mainly Snake gourd and Bitter gourd is the predominant crop in the selected village.Participatory approach was adopted in the selection of varieties. For the first time the farmers preferred adoption of Hybrid seed compared to Hybrid derivative adopted so far. The interventions included in the project was broadly classified as Technological interventions and Facilitative activities.Based on the initial survey conducted in the farmers field, Micro irrigation systems were installed in the farmers field which served as a Demonstration unit. Fertigation units were also provided to the farmers. Further knowledge on use of liquid fertilizers were also provided. The results of Demonstration of a farmer revealed the yield of crops could be doubled by adoption of Micro irrigation technology in vegetables. Saving in water, Electricity, Labour requirement , Fertilizer cost and plant protection cost were noticed by adoption of the new technology. Vegetable and Fruit Promotion Counicl of Kerala(VFPCK) a autonomous institution promoted and supported by State Government of Kerala facilitated the farmers in procurement and marketing of their produce. The total cost of cultivation of Bitter gourd and Snake gourd was found to be Rs.3,54,985/ha and Rs.3,31,985/ha respectively.The Benefit cost ratio worked out was found to be 1: 2.38 for bitter gourd and 1: 2.17 for Snake gourd. The results of Mulching experiment conducted in the farmer field showed an increase in yield and income. Facilitative activities like Exposure tours, Market support and Training programmes helped the farmers to get more yield .The implementation of the project not only resulted in Economic benefit to the farmers but also resulted in social benefits like one of the farmer in the group was honoured with the Best Vegetable farmer of the State (Kerala) by the VFPCK. Further the farmer also bagged the Best Vegetable Farmer of the Panchayat. This paper discusses the factors responsible for successful adoption of Micro irrigation technology by the farmer.Aoption of hybrid seed variety coupled with Hi-tech farming methods like micro irrigation technology with fertigation, mulching and assured market support helped the farmer to reap maximum benefit.The objective of the project could be achieved by the collaborative effort of Kerala Agricultural University, State department of Agriculture and Vegetable and Fruit Promotion Council of Kerala.

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I INTRODUCTION

Water is becoming a scare resource in the world as well as in India. Water provides life supporting system for human beings , plants and animals. Experts fear that shortage of water is likely to be so acute in future that next world war may well be fought over disputes relating to sharing of water resources among various countries. In India , even if the potential utilizable volume of water were fully tapped, nearly 50 % of the cultivable area would be rainfed..National Commission for Integrated Water Resource Development plan has projected the water requirement for irrigation to grow by more than 50 per cent in the next 50 years. In other sectors, the growth will be even faster. Irrigation sector is the main consumer of water. Prediction show that in future percentage of water use by agriculture sector will come down from the present 83 % to about 68% while the usage by domestic, industries, and others will increase.Fifty per cent of the increased demand for irrigation water by 2025 can be met by

increasing effectiveness of irrigation (IWMI,2001). A ten per cent improvement in water –use efficiency would be adding some 14 M ha of gross irrigation area in India (Saleth, 1996).

Water resources of Kerala

The Kerala State receives an average annual rainfall of about 3000 mm but with high variability. The demand for water in Kerala is mainly for drinking, agriculture, power generation and aquaculture as well as for prevention of salt-water intrusion .Currently 71 per cent is used for irrigation , 18 per cent for domestic use and the rest is for other purposes.However , kerala is one of the States with lowest per capita water availability among the Indian states. Basak (1998) reported the per capita water availability in Kerala was only 69 per cent of that of the country in 1981 though the general perception is contrary to this. Moreover, the water availability shows a steady decline over the years since 1901. It was 59,206 L/day in 1901 which got reduced to 11,062 L/day in 2001. The decline is sharper in surface water than rain and ground water levels. Thus, there is a widening gap between population growth(demand) which is positive and supply of water which is negative. Hakkim (2013) reported that Kerala has land, water and environmental features that are unique in the country. Steep and undulating topography , highly uneven rainfall, high population density,one of the lowest per capita water availability and the fact that majority of the State's river hardly carry any water during the summer months illustrate the need for adopting proper water conservation techniques. Kerala is frequently facing severe drought followed by acute water scarcity for the last two decades,The major consumer of water resources is irrigation with about 70% of the total resources being used by this sector.Compared to National average, unit land of Kerala receives 2.5 times more rainfall but the same unit of land has to support 3.6 times more population, Hence, for self sufficiency , unit land of Kerala has to produce 3.6 times more food and biomass and also has to provide 3.6 times more water. .Micro irrigation technologies are reported to have an irrigation efficiency of 70-85 per cent under ideal conditions in Kerala (Suseela and Devadas, 2006) . The water requirement of many crops is often very high.(Table 1) . The irrigation requirement in the command areas varies according to the soil and climatic conditions. Moreover many of the major /medium irrigation projects are now catering to the requirement of the domestic sector, limiting the supply to agriculture(Devi, 2002). Thus , the irrigation efficiency in these conventional systems are reported as 25-40 per cent only.

Table 1. Water requirement of Important crops of Kerala

Crop	Water requirement(mm)
Rice	900-2500
Tomato	600-800
Pea	350-500
Banana	1200-2200
Pineapple	700-1000
Pulses	200-250
Brinjal	550-600
Chillies	750-800
Bhindi	550-600

Source: Personal Communications with Scientists

Irrigation Practices in Kerala

In Kerala, the gross irrigated area (GIA) during 2008-09 was 4.58 lakh ha, which forms 16.95 per cent of the gross cropped area. The corresponding values for net irrigated area are 3.99 lakh ha and 18.95 per cent of net cropped area.Of the NIA of 3.99 lakh ha , 25.62 per cent is irrigated by the canal system (both private and government) . Tanks constitute 9.96 per cent and the highest share is accounted by wells. Density of open wells in Kerala is very high with around 200 wells/Km2 in the midland and low land (CWRDM,1995). Other sources like Surangams in northern Kerala and natural streams of Waynad constitute the rest.

Micro irrigation and its advantages

Micro irrigation is defined as the process of minimizing the inputs for plant growth like water , fertilizer, power/energy ,Labour, Pesticide and Chemicals etc, and maximizing the output which is the yield from the crop. It is the application of water in the effective root zone, drop by drop,for a longer duration of time , under low pressure, with a network of PVC or HDPE pipes, LLDPE lateral tubes, Emitters or Drippers, with proper Filtration system and with necessary Fertigation /fertilizer application equipment.The Advantages of Micro irrigation as revealed by Suresh (2013) are:water saving, increased yield,uniformity of produce, early maturity,longer shelf life, labour saving, fertigation efficiency, energy saving, reduction in weed growth, maintenance of soil health and possibility of irrigating in night time in the load shedding areas

Present Scenario of Micro irrigation in India

Micro irrigation is used extensively in many water scare countries like Israel, Arabian states, Mexico etc,, In India its development is slow as compared to other developing countries. Micro irrigated area in India grew slowly but steadily.While it covered just 1000 ha when this was launched in 1985 , it made progress in the following decades. Though India had large irrigated area of 69 Mha , yet it has only 4-5 Mha ie., less than 7% under Micro irrigationExperiments and farm trials have been going in India from 1970 onwards. Progressive farmers in Andhra Pradesh, Karnataka, Kerala, Maharashtra and Tamil Nadu adopted this method in the late 70's. From a mere 1500 ha's in 1985 , the area under microirrigation has really gained momentum in recent years.A report of Central Water Commission, Ministry of Water resources (2012) says that among the top five states using Micro irrigation it was found that adoption is more seen in Maharashtra (35 %) followed by Andhra Pradesh (24%) Karnataka(13%), Gujarat (12 %) and Tamil Nadu (9%) .Rane (2011) also reported that the area under micro irrigation is very low in Kerala (15885 ha-0.6% of cultivable area) when compared to states such as Maharashtra, Karnataka, Gujarat and Tamil nadu

Kumar et al.,(2009) reported that the Western Ghat areas in Kerala, Karnataka,Maharashtra and Goa provide a very favourable environment for the adoption of micro irrigation devices due to the presence of tree and fruit crops and plantations crops-coconut, arecanut, coffee , tea, mango and banana.

Prospects of Micro irrigation in Kerala as reported by Indira Devi et al.(2012) is given below:

- Saline water in coastal areas limit their crop production prospects to a large extent. Micro irrigation methods provide the scope for utilizing the saline water for crop production
- The technology is considered to be more efficient in space management as the per capita average land holding size is only 0.27 ha (Farm guide 2009)
- The major sources of water for irrigation in Kerala are open wells where the suspended particles are low. This is favourable for micro-irrigation, as it does not cause clogging.
- Pollution of water bodies and groundwater with pesticides is often reported from various parts of Kerala. The soils of Kerala are highly porous and the leaching loss is very high. In micro

irrigation method, the water supplied is equivalent to consumptive use by plant at a pace equivalent to the absorption rate.

- Since the subsidy provided for adoption of micro irrigation by the Agriculture department has been increased from 50% to 90% during 2010-11 and 2012, more farmers are coming forward to adopt micro irrigation

Farmer Participatory Action Research Programme(FPARP)

The report on "More Crop and Income per Drop of Water" submitted on 2nd October 2006 recommended to initiate 5000 Farmer Participatory Action Research Programmes(FPARP) throughout the country with the help of Agricultural Univerisities/ ICAR Institutes /Engineering colleges /WALMIs etc., for demonstrating the technologies available on shelf to the farmers for increasing the productivity and profitability of Agriculture through generating synergy among water , crop, agronomic practices, soil nutrients, crop variety and implements. Kerala Agricultural University has been selected as one of the Institutes by the Project Implementation Team to implement the Farmer Participatory Action Research Programme(Phase I and PhaseII).Regional Agricultutral Research Station , one of the oldest Rice Research Station under the Kerala Agricultural University which has acclaimed name and fame in Rice research through the Rice varieties with triplets 'Ptb' took up the work on popularizing System of Rice Intensification and Micro irrigation technology through the Farmer Participatory Action research Programme. The Project was funded by Ministry of Water Resources for a period of two years from 2010 to 2012.

Vegetable and Fruit Promotion Council of Kerala(VFPCK)

The farmers faced lot of problems in marketing of the Vegetable produce. Until 2000 the profit of the vegetable produce does not benefit the grower nor the consumer but the middlemen.The Kerala Government , realizing the seriousness of this problem formed the Vegetable fruit promotion Council of Kerala to help farmers market the produce themselves. The council developed a new group marketing system that is production centred and farmer-participatory. Under this the farmers in different villages all through the State were formed into self help groups called Swasraya Karshaka Samithi(SKS). Each Samithi has 20-25 farmers as members, who are responsible for sourcing and marketing the produce. Every two years the Samithi elects new office bearers.VFPCK has Presently 600 farmers are members of the SKS and about 150 non member farmers also utilize its benefit. Traders are informed on daily basis to come to the spot and inspect the produce.To add additional support for bargaining the Market Information Centre(MIC) has been started which gives details on the daily market prices of all vegetables collected from different markets in Kerala and even outside the State. The council provides account books and proper authorized platform weighing scales, furniture , Telephone connection, land and building for all the Samithis across the State. Some of the Samithis have achieved an annual turnover of more than Rs 1 crore a year in the past.There is no waiting period or credit . For every Rs.100 a farmer is paid Rs.95. Out of the remaining balance Rs Three is paid as bonus during festival times like Onam and Rs. 2 is used as administrative expense. Unlike the traditional system of Agricultural extension, in VPFCK the dissemination of information is routed through farmers. Three farmer leaders called Master Farmers (MFs) are selected in each Samithi and are trained to lead each group. They lead farmers in the areas of production, credit and marketing. The membership enables farmers access to credit, training and to technical advise from Council staff, but benefits have gone beyond production related aspects.An MoU was signed with 11 banks in the State for disbursement of credit to farmers. The Samithi assesses the credit –worthiness and credit requirements of its members through a participatory credit planning session.Prompt payment within the prescribed period is guaranteed as there is a collective effort in recovery from among debtors traders. This helps them to reduce transportation expenses and save time.

II MATERIALS AND METHODS

The demonstration on Micro irrigation were intiated in 2012 and continued till 2013. Farmers with some awareness were selected and were also given exposure through Exposure visits and training were imparted on use and maintenance aspect. The Demonstration was conducted by involving the Agricultural Officers of State Department of Agriculture who played a facilitative role in identifying innovative farmers and monitoring of the fields along with Scientist of Regional Agricultural Research Station. The demonstrations were conducted in Palakkad districts of Kerala.About 20 farmers representing 3 villages were included for the demonstration. However as a case study the data pertaining to one innovative farmer , Mr. Unnikrisnan from Elavancherry who has bagged the Best Vegetable farmer of Kerala State in 2012 is presented in this paper. The farmer has adopted Inland dripper for his farm with fertigation unit. The principal crops grown by the farmer includes Bitter gourd and Snake gourd.The farmers in the village were adopting traditional flood system of irrigation and adopting local variety for vegetable cultivation. For the demonstration purpose drip fertigation units of Netafim company was introduced in the farmers field after an initial survey. 10 per cent of the systems cost was borne by the farmer as Farmers contribution.The farmer has also adopted Plastic mulching in one hectare of his land.

III RESULTS AND DISCUSSION

The interventions under the project fall in two categories viz., Technological intervention and Extension intervention.

A.Technological interventions

The Technological interventions include the conduct of soil testing in the farmers field and recommendation of need based fertilizers, conduct of demonstration on drip fertigation in Bitter gourd and Snake gourd, Providing a part of water soluble fertilizer for the fertigation unit for small scale demonstration and Conduct of Mulching demonstration in the farmers field using Plastic Mulches of 50 Micron thickness.

B.Extension interventions

The extension interventions included in the project were Conduct of training at different stage of the crop, Conduct of Exposure visit to Jain irrigation unit , at Udumalpet and visit to Precision farming project being implemented by Tamil Nadu Agricultural University, Coimbatore at Dharmapuri distirct of Tamil Nadu, Periodic review meeting to seek their problems and give need based solutions by inviting experts from the University Based on the demonstrations conducted the Economics of Bitter gourd and Snake gourd was worked out on comparison with the traditional method of cultivation being practised by the farmers.

Table 2.Cost of cultivation for Bitter gourd under drip fertigation method of cultivation Per ha/season

S.NO	Particulars	Cost incurredRs/ha	Per cent
1	Land preparation	22125	6.06
2	Planting and Trailing cost	85625	23.46
3	Fertilizer application cost	152360	41.74
4	Weeding cost	8750	2.40
5	Irrigation cost	13125	3.60
6	Plant protection cost	20000	5.48
7	Harvesting cost	63000	17.26
	Total cost	364985	100.00

Source: Based on survey

The results presented in Table 1 on Cost of cultivation of bitter gourd revealed that nearly half of the cost was spent on Fertilizers(41.74 per cent) followed by planting(23.46 per cent) and Harvesting(17.26 per cent) cost . The total cost of cultivation works out to Rs 3,64,985 per hectare.

Table 3.Cost of cultivation for Snake gourd under drip fertigation method of cultivation (per ha per season)

S.NO	Particulars	Cost incurredRs/ha	Per cent
	Land preparation	22125	6.66
2	Planting and Trailing cost	72625	21.87
3	Fertilizer application cost	137360	41.38
4	Weeding cost	8750	2.64
5	Irrigation cost	13125	3.95
6	Plant protection cost	15000	4.52
7	Harvesting cost	63000	18.98
	Total cost	331985	100.00

Source: Based on survey

The results presented in Table 2 on Cost of cultivation of Snake gourd revealed that nearly half of the cost was spent on Fertilizers cost (41.38 per cent) followed by planting and trailing cost (21.87 per cent) and Harvesting cost (18.98 per cent). The total cost of cultivation works out to Rs 3.31. 985

The reason for fertilizer cost accounting to nearly 42 per cent in Snake gourd and Bitter gourd is due to the adoption of more organic manure application like Farm yard manure, Ground nut cake , Poultry manure, Bone meal , neem cake and water soluble fertilizers. The second rank occupied for planting and trailing cost is due to the high cost of Hybrid seed which costs around Rs 6500 per Kg. Further the Trailing cost which requires Bamboo poles, String and rope also makes the farmer to invest in such cost as it is absolutely necessary for the growth of crop.

Table 4. Comparison of returns in Bitter gourd(Maya) under Traditional and drip fertigation method of cultivation

Parameter	Method of cultivation	
	Traditional method	Drip fertigation method
Yield(t/ha)	37.5	50
Establishment of MI system /season	-	5000
Maintenance of Micro irrigation system	-	7500
Cost of cultivation (Rs/ha)	370125	364985
Total cost of cultivation	370125	377485
Gross income (Rs/ha)	675000	900000
Net income (Rs/ha)	304875	522515
B:C ratio	1.82	2.38

Source: Based on survey

A comparison of net income from Bitter gourd crop under traditional and drip fertigation irrigation system is depicted in Table4. A perusal of table shows that adoption of drip fertigation method gives higher yield to the tune of 87 per cent increase in yield compared to traditional method of cultivation. It is seen that a B: C ratio of 2.38 was obtained using drip fertigation method compared to 1.82 in the case of traditional method of cultivation.

Table5.Comparison of returns in Snake gourd under Traditional method and drip fertigation method of cultivation

Parameter	Method of cultivation	
	Traditional method	Drip fertigation method
Yield(t/ha)	30	60
Establishment of MI system /season	-	5000
Maintenance of Micro irrigation system	-	7500
Cost of cultivation (Rs/ha)	313095	331985
Total cost of cultivation	313095	331985
Gross income (Rs/ha)	360000	720000
Net income (Rs/ha)	46905	375515
B:C ratio	1.15	2.17

Source: Based on survey

A comparison of net income from Snake gourd crop under traditional and drip fertigation irrigation system is depicted in Table5. A perusal of table shows that adoption of drip fertigation method gives higher yield to the tune of 100 per cent increase in yield compared to traditional method of cultivation. It is seen that a B: C ratio of 2.17 was obtained using drip fertigation method compared to 1.15 in the case of traditional method of cultivation.

Table 5. Cost economics of Mulching in Bitter gourd

Sl.No	Particulars	Black LLDPE film	Control
1	Cost of cultivation (Rs/ha)	354985.00	370125
2	Cost of mulch film per season	10000.00	-
3	Yield of produce (Kg/ha)	50000.00	37500
4	Market price (Rs./Kg)	18	18
5	Revenue(Rs/ha)	900000.00	675000
7	Total expenditure	355985.00	370125
8	Net income	544015	304875
9	Benefit cost ratio	2.53	1.823

Source: Based on survey

Data from table 5 reveal that the net income by adoption of mulching material in drip fertigation plot is about Rs 5,44.015 and Rs 3,04,875 . A benefit cost ratio of 2.53 is attained. However the farmer opined that the mulching technique adopted did not create a visible impact in yield compared to what he got by adoption of drip fertigation method.The cost economics of mulching is an important aspect. In a leveled field if mulching is to be done then the film area required will be almost equal to that of field itself. In fields with ridges and furrows mulching material required will be sizably more than the field area. However mulching is carried out in strips covering 50-60% of field area. In the present era of minimizing rainfall conserving moisture with mulching transgresses the plan of economic analysis in the sense that the real cost analysis would be even meaningless in the case of a precious commodity like water.

IV. Conclusion and recommendations

From the demonstrations conducted it can be concluded that Drip fertigation in vegetables like Snake gourd and Bitter gourd is definitely promising.The Farmer who has got the award for the Best Vegetable farmer in the State is convinced about the technology and is ready to continue the adoption on his own. However the problem with respect to the technology is that many farmers cannot adopt the technology as majority of the farmers in Kerala are small and marginal farmers and many factors like high cost of the Micro irrigation system, Complexity of technology and socio economic issues like lack of access to credit facilities, fragmented land holdings. Palanisamy et al. (2012) also reported that many farmers in Kerala are Marginal.Further it is also seen in Kerala that one innovative farmer has devised a micro irrigation technology of his own which is less complex and low cost but the acceptance among the farmer is low because it does not come under the Government of Kerala subsidy norms prescribed. As far as farmers are concerned a general opinion is that the installation charges, cost of pump set and overhead water tank is not included in the subsidy cost which thereby hinder the rate of adoption. Other factors such as approved drip irrigation agencies which are not present in adequate number in a particular district, lack of after sale service and lack of knowledge on use and maintenance turned out to be a demotivating factor among the farmers who adopt micro irrigation

ACKNOWLEDGEMENT

The financial assistance from Central Water Commission, Ministry of Water Resources, Government of India for the FPARP project (II Phase) is acknowledged. The author and Principal Investigator of the Project is also thankful to the Kerala Agricultural University, State Department of Agriculture and Vegetable and Fruit Promotion of kerala for the support throughout the project and the Demonstrating farmers who adopted and continue to adopt the technology in the years to come.

REFERENCES

Basak, P. (1998). Water resources of Kerala-Myths and realities. In: Water Scenario of Kerala. Eds: E.J.James, K.N.Ramani, and P.S. Harikumar. State Committee on Science, Technology and Environment, Government of Kerala, Thiruvananthapuram. Pp1-6.

CWRDM (Centre for Water Resources Development and Management).(1995). Water atlas of Kerala. Publication , Kozhikode, Kerala

Farm guide. (2009).Farm Information Bureau, Government of Kerala

Hakkim.A. (2013). Role of Micro irrigation and Fertigation in Hi-Tech Farming, Proceeding of National Seminar on Hi-tech Farming- Marching towards Attaining Sustainability, Jan 21-22,2013, Jointly organized by Precision Farming Develoment Centre, State Horticulture Mission,Kerala and National Committee on Plasticulture Applications in Horticulture, New Delhi: 100-109.

Indira Devi ,P, Shanmugasundaram, B and Prema,A. (2012). Micro-Irrigation : Economics and Outreach in Kerala, In: Micro irrigation Economics and Outreach , Eds: K. Palanisami, S.Raman and Kadiri Mohan. MacMillan Publishers India Ltd, New Delhi pp: 94-119

IWMI(International Water Management Institiute). (2001). Basin level use and Productivity of Water: Examples from South Asia, Research Report 49. Columbo, Sri Lanka

Kumar, D., Sharma, B and Singh, O.P. (2009). Water saving and yield enhancing micro irrigation technologies; How far can they contribute to water producitivity in Indian agriculture? In : Strategic Analyses of the National River Linkding Project (NRLP) of India Series 1. India's Water Future: Scenarios and Issues. Eds: Upali A. Amarasinghe, Tushaar Shah and R.P.S. Malik. International Water Management Institute. Columbo,Srilanka.

Palanisami, k., Kadiri Mohan , Kakumanu, K.R. and Raman .S. (2012). Spread and Economics of Micro-irrigation in India:Evidences from different States. Eds: K. Palanisami, S.Raman and Kadiri Mohan. MacMillan Publishers India Ltd, New Delhi pp: 258-266

Rane, N.B. (2011) . Development , Scope and Future Potential of Fertigation in India. Proceedings of National Seminar on Advances in Micro irrigation, Feb 15-16,2011, NCPAH, Ministry of Agriculture, GOI: 44-54.

Report of Central Water commission (2012) . History of Irrigation Devlopment and Management in India. Ed: Rangachari, Kanjilia, Gupta A.C. and Baweja. M.L. New Delhi: pp162

Saleth, R.M. (1996). Water Institutions in India: Economics , Law and Policy. Commonwealth Publishers, New Delhi.

Suresh .A. (2013). Operation , Maintenance and Trouble shooting of Micro Irrigation stems Proceeding of National Seminar on Hi-tech Farming- Marching towards Attaining Sustainability, Jan 21-22,2013, Jointly organized by Precision Farming Develoment Centre, State Horticulture Mission,Kerala and National Committee on Plasticulture Applications in Horticulture, New Delhi: 90-92.

Suseela, P and Devadas, V.S.(2006). Micro irrigation. Agronomic Research Station, Kerala Agricultural University , Chalakudy, Kerala