DRIP IRRIGATION SYSTEM FOR RABI CROPS OF MANIPUR

Project Report

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Manipur Science and Technology Council
Central Jail Road, Imphal – 795 001

Contents

Project at a Glance

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No.ST(MPR)/DP/2K3/289

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5. Broad Area of the project : Demonstration of Proven Technologies

6. Specific Area : Transfer of Technology

7. Project Duration : 3 Years

8. Date of Commencement : 1st April, 2004

9. Date of Completion : 31st May, 2007

1. INTRODUCTION

Manipur falls under the Eastern Himalayan agro-climatic zone with two broad topographic divisions viz., plains and hills. The valley is often referred to as the bowl of the state. Manipur is within the monsoon belt of the country with sub-tropical to semi-temperate climate in the valley and semi-temperate to temperate climate in the higher altitudes. The average rainfall of the state is about 1246 mm with heavy precipitation during June and July. Since the water for cultivation of the crops is restricted to monsoon, most of the farmers are bound to paddy cultivation and the lands are left fallow in the rabi season. Moreover, the topography of the land is sloppy, the ground water potential is very low and at the same time the availability of ground water is limited to certain specific area. Hence, after the monsoon, there is always scarcity of water during rabi season in the state. Though few farmers grow rabi vegetables in some parts of the state, the production does not meet the requirement. Necessary efforts were made to overcome the deficit production by using irrigation potentials and introduction of high yielding varieties and various types of fertilizers. In spite of all these efforts, the production of rabi crops is insufficient may be due to lack of technology inputs in giving water to the plants as most of the farmers are irrigating their field by flooding method or by giving water to each plant manually. The flooding method of irrigation causes wastage of the scarce water due to evaporation and there is no control over the quantity of water actually required by the crop. And the manual method of giving water to each plant takes quite a long time and at the same time there is no possibility of mass cultivation due to need of huge manpower.

The production of Rabi Crops in Manipur is insufficient mainly due to lack of giving suitable irrigation methods/practices to the crops. Moreover, there is scarcity of water during rabi season and most of the farmers have the idea of only flooding method of irrigation or manual method of watering each and every plant. The present project has been formulated to introduce drip irrigation system to the farmers of the state to highlight them the advantages of this type of irrigation method. Though this method is familiar to the Agriculturists/Scientists in the state, the actual operation in the field have never been practiced and demonstrated to the farmers.

2. OBJECTIVES

i) To substitute the flooding method/manual method of giving water to each plant by drip irrigation system

ii) To eliminate land levelling in undulating/hilly region.

iii) To maximise utilization of available water

iv) To increase the cultivable area and yield of the crops.

3. METHODOLOGY

3.1 Selection of Site

For installation of drip irrigation system for demonstration to the farmers as well as for observation of yields of different crop under drip irrigation system project sites are to be selected depending upon the following criteria :

i) The site should have a minimum cultivable area of 0.5 acres.

ii) The site may be available on lease till the project is completed.

iii) The site must be close to a perennial source of water

iv) The site must be free from land disputes

3.2 Identification of Suitable Crop

The crops to be grown in a particular site was selected depending upon the type of soil and location of the site (valley or hill). The selection of suitable crop was made using existing agricultural norms and by studying the past experiences of the suitability of crop in the adjoining areas of similar soil type. The details of two crops viz., brinjal and chilli are described in this section.

3.2.1 Brinjal

Brinjal or eggplant, as it is also known, is extremely popular and one of the extensively grown vegetable crops in India and other part of the world. It is adapted in all lands except at higher altitudes and can be grown throughout the year. Being seasonal in nature, the actual area under brinjal cultivation in India is not known. Brinjal has been used as one of the staple vegetables which has high nutritive value. Besides, brinjal is also used as raw

material in pickle making and dehydration industries. Brinjal is believed to have contained medicinal properties while white brinjal is said to be good for diabetic patients.

Soil

Practically, brinjal can be grown on all types of soils from light sandy 10am to heavy clay. However, light soils are good for early crop while clay 10am are best suited for high yielding hydrids. The soil should be deep fertile and well drained. The soil should be deep fertile and well drained. The soil pH should not be more than 5.5 to 6.0 for its growth and development.

Climate

Brinjal is a warm season crop and susceptible to frost. Low temperature during cool season causes abnormal development of the ovary in flower buds which is splitted bearing deformed fruits. The most favourable temperatures for better growth and yield are between 13^{o}C to 21^{0}C. Brinjal seeds germinates well at 25^{0}C.

Land preparation

Land preparation depends on the type of the soil, cropping pattern etc. The land should be ploughed thoroughly for 4 to 5 timely before transplanting. The seedlings are ready for transplantation in 4 to 6 weeks when they attain a height of 15 cm with 4 leaves. :Plant to plant distance differs depending upon the fertility of the soil, growing season and cultivars. For non spreading types row to row distance is 75 cm and plant to plant distance is maintained at 60-70 cm either in flat or cultivation ridges.

Manuring and Fertilization

Manuring plays an important role in high yield. As such, balanced application of manure and fertilizer is very important for production. Well rotten farm yard manure should be thoroughly incorporated at the time of land preparation. The quantum of fertilizer recommended for 1 hectare is 100 kg N, 60 kg K and 60 kg P. Half of the total N and total P and K should be given as basal dose while the remaining half of the nitrogen in three equal dozes : the first dose is to be given one and half months after transplantation, the second, one

month after the first application and the final dose at three and half months after transplantation.

Irrigation

Irrigation is essential for brinjal cultivaton in the region, where there is little or no rains during the growing season. Brinjal, being a shallow rooted crop, needs irrigation at frequent intervals particularly when there is danger of frost. About 100-110 cm of irrigation are required for a successful crop. In plains of India irrigation is to be given every 4^{th} day during summer season and at an interval of 10 to 15 days during winter.

Weed Control

The most serious weed in brinjal crop is Orobanchae sp. which is a root parasite. DCPA herbicide is recommended for use immediately after transplantation.

Harvesting and Yield

The fruit is harvested before it fully ripens and when it attains a good size and colour. Frequent picking promotes fruit development and hence good yield.

3.2.2 Chilli

Chillies are the green or dried ripe fruit of pungent forms of capsicum annum L. and sometimes capsicum frutescens. It is specially liked for its pungency, spicy taste, besides the appealing colour it adds to the food. Chilli is grown in the entire length and breadth of the country and covers about 8.26 lakh hectares with the annual production to the tune of 5.11 lakh tones of dry chilli.

Soil

Chilli can be grown in a varieties of soils, well drained and rich in organic matter but best suited in light loamy soil rich in lime. Sandy soil needs more frequent irrigation and fertilizer. As a rainfed crop well drained black soils are also suitable, However, acidic and alkaline soils are not suitable for chilli growing. Chilli can be grown in saline soils but germination and early vigor of plants are affected by the salinity of the soil.

Land Preparation

Ploughing 3-4 times to get a fine tilth is necessary and if available, incorporation of farm yard manure in the last plough give good results. Seedlings are transplanted 4-5 weeks after sowing when they are about 15 cm in height. Spacing of 30 x 30 cm is generally recommended as it is believed to increase yield. It is reported that increase in plant density resulted in less lateral branching making the fruits easier to harvest.

Manuring and Fertilization

Judicious management in the application of manures and fertilizers is necessary as chilli has a long growing season. Fertile soil with sufficient humus are best suited for growing chilli. An optimum dose of 100 : 90 : 50 kg/ha N, P, K is recommended for semi-arid zone conditions and relatively higher dose of 150 : 120 : 60 kg/ha N, P and K was recommended for adoption of irrigation green chilli.

Irrigation

A light irrigation is given during the third day of transplanting and thereafter at weekly intervals in arid and semi-arid regions, where water is very scarce and the high consumptive use of water can be reduced by spraying anti-transpirants on the foliage.

Weed Control

Soil incorporation of EPTC 10 days prior to transplanting followed by the application of Nitrofen and Alachlor Provided the best control of weed without any adverse effects on chilli. TOK –E at 2 litres followed by one hand weeding on the 30^{th} day after transplantion give best results compared to hand weeding alone.

Harvesting and Yield

Flowering begin 1-2 months after transplantation and takes another month for the green fruits before picking. Ripe fruits are picked at an interval of 1-2 weeks and harvesting continues over a period of about 3 months. The number of picking varies from 6-10 depending upon the season, cultivar and cultural practices. Chilli crop normally yield 2 to 2.5 tonnes of dry chilli and 7.5 to 10 tonnes green chilli from a hectare.

3.3 Overhead Tank

For operation of the drip irrigation system through gravitational flow of water plastic water storage tanks have been procured and platforms have also been constructed for keeping the plastic tanks overhead. The overhead tanks are filled in using a small water delivery pump.

3.4 Site Preparation

The sites where drip systems have been installed are well prepared by repeated ploughing and tillering till the soil become perfect for growing the crops/plants. Crop beds have been made and pits have been prepared in a regular row to row and column to column spacing recommended for the particular crop by Agriculture/Horticulture Department. Required quantity of Farm Yard Manure have been put to the pits and well mixed with the soil before the crops are planted.

3.5 Design and Installation

3.4.1 System components

The components of drip irrigation system can be grouped into two major heads viz.

i) Control head and

ii) Distribution network.

A. Control head

The control head of drip irrigation includes the following components :

I. **Pump/Overhead Tank**

Pump or an overhead tank is required to provide sufficient pressure in the system. Centrifugal pumps are generally used for low pressure trickle systems. They are easily adjusted to provide constant pressure and have the added safety measure of non-overloading head characteristic. Pumps are generally recommended for larger areas under drip irrigation, undulating topography, closely spaced crops or where water requirement is high comparatively.

Instead of connecting directly to the pump, an overhead tank having a height of about 3 meters can also be used in certain types of drip system. Overhead tank is generally used for small areas of orchard crops with comparatively lesser water requirement.

II. Filters

The hazard of blocking or clogging necessitates the use of filters for efficient and trouble free operation of the drip system. The different types of filters include:

a) **Media filter**

Media filter consists of fine gravel and sand of selected sizes placed in a pressurized tank. It is required to remove organic matter such as algae mass and other vegetative material present in the water. The filters are made up of a circular tank filled with layers of coarse sand and different sizes of gravel with a provision of valves for flushing the filter assembly in case of clogging. The media filters are available in different sizes ranging from 500 to 900 mm diameter with an output of 15to 50 Cum respectively.

b) **Hydro- cyclones or Centrifugal filters or sand separators**

If the irrigation water is having more sand, hydro-cyclone type filters are required to remove the sand; it is also known as vortex sand separator. Hydro-cyclone type filters are produced in various sizes for different discharges and have been found most suitable for removing particles from water before it enters the drip irrigation system. Hydro-cyclones must be followed by a screen filter as a safeguard.

c) **Screen Filter**

The screen filter is fitted in series with the gravel filter in order to further remove the solid impurities like fine sand, dust etc. from the water. In general, the screen filter consists of a single or double perforated cylinders placed in a plastic or metallic container for removing the impurities. Generally 100 to 200 mesh screens are used in this type of filters. It must be cleaned and inspected periodically for satisfactory operation of any drip system.

III **Fertilizer Applicators/Fertigation**

The direct application of fertilizer through drip irrigation has increased the efficient use of fertilizer along with saving in labour and money. Application of fertilizer into pressurized irrigation system is done by either a by-pass pressure tank, or by venture pump or direct injection system. In by-pass system, by closing main system valve, certain quantity-generally 10% of flow quantity is allowed to by-pass through fertilizer tank. Then the by-passed water along with dissolved fertilizer goes into the system. In the venture-pump type fertilizer application, some water is passed through the venture (decreasing the diameter in taper form) where velocity head is created, due to increase in velocity at the place. This will create a suction head and will suck the fertilizer solution in the system. In direct infection type, pumps of piston type or diaphragm type are used. These pumps operated by the system pressure only, give fixed quantity of fertilizer in the water throughout irrigation.

IV. **Pressure Regulators**

Pressure regulators are generally used to decrease the higher system pressure to the lower required system pressure. It controls pressures in one way only i.e. high to low. Pressure regulators are required on a large scale design. Undulating terrain and sloppy land etc. For normal small system, a simple by-pass valve can be used to control pressure in the system.

B. Distribution Network

The distribution network mainly constitutes main line, sub-submain line and laterals with dripper and other accessories.

I. Main and Sub-main Line

Generally Rigid PVC and High density Polyethylene(HDPE) pipes are used as main line. Pipes of 65 mm diameter and above with a pressure rating of 4 to 6 Kg/sq.cm are recommended for main pipes. These pipes laid underground, offer a long life of more than 20 years. For sub-main pipes, Rigid PVC, HDPE or LDPE(Low Density Polyethylene) are recommended. Pipes having an outer diameter ranging from 32 mm to 75 mm with a pressure rating of 2.5 kg/sq.cm are used as sub-mains. These pipes may be laid above the ground or underground.

II. Laterals

The laterals/drip lines are normally manufactured from LDPE (Low Density Polyethylene). These pipes are generally laid above the ground. Recently a better material than the presently used LDPE i.e., Linear Low Density Polyethylene gives more protection against ultra violet rays and longer life of pipe than LDPE. Generally pipes having 10,12,16,20 mm internal diameter with wall thickness varying from 1 to 3 mm are used in drip system.

III Drippers/Emitters

Drippers function as energy dissipaters, reducing the inlet pressure head (0.5 to 1.5 atmosphere) to zero atmosphere at the outlet. These drippers are generally manufactured from poly-propelene material.

Pressure Compensating Drippers

This type of dripper gives fairly uniform discharge at pressure varying from 0.3 to 3.5 atm. Generally the drippers give 2,3,4,8 litres/hr discharge at varying pressure. This type of drippers are provided with a high quality rubber diaphragm to control pressure. The pressure compensating type drippers are most suitable on slopes and difficult topographic terrains.

IV Other Accessories

The other accessories include take out/starter, rubber grommet, end plug, joints, tees, manifolds, etc.

3.6 Monitoring and maintenance

The drip irrigation systems installed are looked after very carefully for its wear and tear more particularly clogging of the drippers and lateral lines. The operation of the system is done by a trained person for a particular site. The overall maintenance and monitoring of the system for analysis of the results are done by the project team headed by the Principal Investigator.

4. PROJECT SITES

During the implementation of the project three sites were identified for growing rabi crops and installation of drip irrigation system.

I Langthabal Kunja

The first site of the project in which the first drip irrigation system was installed is a plot measuring about 0.5 acres at Langthabal Kunja village in Imphal West District about 9 kms. from Imphal Head Quarter. The source of water of the site is stored rain water and a small natural stream (perennial) located at about 100 metres from the plot. The plot is totally flat and the type of soil of the plot is loamy clayed. Drip Irrigation system was operated under gravity from overhead tank (2 x 2000 Ltr capacity) kept at a base about 3m above the ground level. Water was being pumped into the overhead tanks using a 1 HP water pump during the night hours and irrigation was given twice a day one in the morning at 7 – 8 a.m. and the other in the evening at 4 –5 p.m. The main crops grown in the site were brinjal, tomato and chili.

II Maklang

This site is about 20 kms from the Imphal city towards the west. In this project site the source of water was a small river, which is perennial in nature, and water was also very clean free for dirt and sand. The river is at a distance of about 70 m from the plot and the drip system operated under gravitational force from two overhead tanks each of 2000 hrs capacity each connected in series thereby making total capacity of 4000 litres. The water from the river was pumped into the overhead tanks using one 1 H.P. water pump installed near the base of the overhead tanks. The overhead tanks are kept over a base (separately constructed bathroom-cum-toilet.) about 3.5 m above the ground level. The type of soil in the site is sandy clay. The main crops grown in the site were brinjal, tomato, cucumber, cauliflower and chili.

III Lukhambi

The third site was Lukhambi Part-II in Tamenglong District. This site is about 65 km far from Imphal city. The site is a hilly terrain with undulating surfaces and slopes. The project site is a land measuring about 0.5 acres in the hilly terrain where water is available in small streams from the hillocks. The water from the streams are collected in a subsurface water storage tank constructed at the uppermost slope of the plot above 3 m over the ground and drip

irrigation system was operated through gravitational flow. The type of soil available in the site was sandy and rabi crops such as Brinjal, Tomato and Cauliflower were grown in the 1st year and banana trees were grown in the subsequent years.

5. PHYSICAL ACHIEVEMENTS

The following achievements were made during the project period

i) Drip irrigation system has been installed at three different project sites, one in the hilly terrain and the other two in the valley at plots measuring about 0.5 acres each. The drip systems work under gravitational flow using plastic water storage tanks at Lanthabal Kunja and Maklang project sites. However in case of Lukambi project site a subsurface water storage tank has been constructed at the highest elevated portion of the plot to collect spring water from the hillock as well as for harvesting rain water during rainy season. Different rabi crops such as Tomato, Brinjal, chilli, Cucumbe and Cauliflower have been grown at all the three project sites in the first and second years of the project. However, banana trees have been planted and drip irrigated in the third year at Lukhambi Part-II project site.

iii) A 2-day state level awareness-cum training programme on Drip Irrigation System was also organised for the farmers, NGOs and Entrepreneurs of the state during July 3-4, 2007.

5.1 Awareness-cum-Training Programme :

A 2-day state level awareness-cum-training programme on "Drip Irrigation System" was organised as a part of the project in order to introduce drip irrigation system to the general public. The target group of participants were farmers, NGOs and entrepreneurs. Altogether 30 participants from all over the state participated in the said programme. Resource persons from various Departments/Institutions delivered lectures and presented some demonstrations on the working of drip irrigation system. A field visit was also arranged to witness the actual working of drip irrigation system during the 2 days programme. In the feedback session the participants have expressed their willingness to use drip irrigation system in their vegetable gardens, farms, greenhouses and horticultural gardens etc. They also wanted to get technical guidance/support from MASTEC in the installation of drip irrigation system at their farms.

Commissioner Science & Technology, Manipur
Inaugurating the Awareness-cum training programme

A section of participants during the 2-day awareness-cum training programme on "Drip Irrigation System"

Resource person demonstrating parts of Drip Irrigation System during the Awareness Programme

One of the resource persons delivering lecture during the awareness programme

A participant giving feedback during the Awareness programme

Distribution of Participation Certificate on the last day of the Programme


Section of Drip Irrigation System at Langthabal Kunja


Drip Irrigated Rabi crops at Langthabal Kunja

Drip Irrigated chilli and brinjal at Langthabal kunja

Drip Irrigation system through gravitational flow at Maklang

Bed preparation and young brinjal under drip irrigation system at Makalng

Grown up brinjal through drip irrigation system at Maklang

Drip Irrigation system applied to Cucumber at Maklang

Drip Irrigation system applied to Tomato at Maklang

Drip irrigation system applied to cauliflower at Maklang

Water storage tank for drip irrigation system at Lukhumbi

Nursery preparation at Lukhumbi

Brinjal under drip irrigation system in undulating hill slope at Lukhambi

Labours making pits for banana plantation at Lukhambi

Banana trees under drip irrigation during weeding in the 1st year at Lukhamabi

Drip irrigated banana trees in the 2nd year of its plantation at Lukhambi

Fully grown up banana trees under drip irrigation system at Lukhambi

6. OBSERVATIONS AND RESULTS

From the present project it has been observed that brinjal, tomato, cucumber and chilli could be grown under drip irrigation system. However, the performance of brinjal and tomato crops are far better than that of the other crops. The hilly sites where the top soil is sandy but the inner soil is clayey type are much suitable for growing wide spacing horticultural crops like banana, papaya etc. with some of the vegetable crops such as tomato, brinjal as filler crop for inter cropping system with drip irrigation system for maximum utilization of the available land and water. Drip Irrigation system is very much suitable in the sloppy hilly terrain where flooding method of irrigation is not possible without bench terracing. Through the initial cost of fabrication and installation of drip irrigation system is high its maintenance cost is very low (negligible). The growth of weeds in between the crops/plants is very less because of giving water drop by drop directly to the root of the plants. The overall performance of drip irrigation has shown better results as compare to flooding and manual method of giving water to each plant in terms of water saving, higher yield and minimum manpower involvement. Some observations and results of the project are summarised in the following sections.

6.1 Advantage of Drip Irrigation

The following were the advantages of drip irrigation observed during the implementation of the project :

I Water Saving

Due to partial wetting of the soil volume, reduced surface evaporation, decreased run-off and controlled deep percolation losses, the water use efficiency is as high as 90 to 95 percent compared to only 40 to 50 percent in the conventional furrow or flood irrigation.

II Enhanced Plant Growth and Yield

Slow and frequent watering eliminates wide fluctuations in soil moisture content resulting in better growth and yield. It has been reported that drip irrigation increases the yield from 10 to 230 percent depending upon soils and crops over conventional methods of irrigation.

III Saving in Labour and Energy

There is considerable saving in labour as the well designed system needs labour only to start or to stop the system. Because of high irrigation efficiency, much time is not required to supply the desired quantity of water, thus, it also saves energy.

IV. Most Suitable to Poor Soils

Very light soils are difficult to irrigate by conventional methods due to deep percolation of water. Like-wise, very heavy soils with low infiltration rates are difficult to irrigate even by sprinkler method. However Drip irrigation has been found successful in both the types of soils.

V. Control of Weeds

Due to Partial wetting of soil, weed infestation is very less in comparison to other methods of irrigation.

VI. Economy in Cultural Practices and Easy Operations

Besides achieving effective control of weeds, it also increases the efficiency of other operations like spraying, weeding, harvesting etc. thereby reducing the operational costs even upto the extent of 50 percent.

VII. Possibility of Using Saline Water

High soil moisture content due to frequent irrigation and lesser water requirement upto even 60 percent than surface method keeps saline concentration below the determental level.

VIII. Improves Efficiency of Fertilizer

Because of reduced loss of nutrients through leaching and run-off water and also due to localized placement, the fertilizer use efficiency can be improved considerably.

IX. Flexibility in Operation

This system can be worked at any part of the day when power is available.

X. No Soil Erosion

There is no soil erosion due to drip irrigation.

XI. Easy Installation

This system can be installed with considerable ease and is equally beneficial to both small and big farmers.

XII. No Land Preparation

Preparation of leveled bed, bund and channels is not necessary. Only land smoothening will suffice.

XIII. Minimum diseases and Pest Problems

Minimum diseases and Pest Problems are observed because of less atmospheric humidity.

6.2 Disadvantages/Limitations

Despite observed successes, some problems have been encountered in the mechanics of applying water with drip equipment for some soils, water qualities and environmental conditions. Some important limitations are as described below :

i) Persistent Maintenance Requirements :

Emitter clogging is considered the most serious problem in drip irrigation unless preventive measures are taken. It is therefore necessary that water should be filtered properly and this can be expensive. Apart from this salt and chemical deposits can accumulate plugging the discharge openings. Clogging will adversely affect the rate and uniformity of water application, increased maintenance costs (as it becomes necessary to check, replace or reclaim the clogged emitters), and result in crop damage and decreased yield, if not detected early and corrected timely. Other maintenance problems include pipeline leaks and cracking of the tubes. Rodents, coyote, rabbits, dogs, etc. can chew and damaged drip line; and ants and other insects have occasionally enlarged openings in drip tubing. Drip lines can be cut or dug-up accidentally when weeding, replacing plant material or when replacing or repairing other pipelines or utilities in nearby areas. Filters, chemical injectors, pressure regulators, water meters and pumps are also subjected to malfunctioning and are liable to theft.

ii) **Salinity Hazards :**

Although drip system can be used under saline conditions, they must be managed properly. Otherwise reverse pressure gradients in the soil will cause flow of salts towards plant root with the resulting detrimental effects.

Economic-Technical Limitations :

Because, equipment requirements are numerous with drip irrigation, initial investment and annual costs may be high when compared with surface irrigation systems. The actual costs will vary considerably depending on the types of crops, grades of pipe lines, filtration equipments, fertilization equipments etc. Generally, drip irrigation is more suited to widely spaced crops.

6.3 Influence of Method of Irrigation on Yield of Chilli

A total of five pickings of the mature chilli pods were done in the plot at Langthabal Kunja at 10 days interval. The first picking was done on May 17, 2005 and the fifth and final picking was done on June 27, 2005. The yield on subsequent pickings and the total yield obtained under drip and surface irrigation treatments are presented in Table 6.1. The total yield obtained from an identical area of 2100m^2 each for drip and surface irrigation were 2519.6 kg and 2298.1 kg respectively. The yield in ton/acre for the two irrigation treatments were worked out to be 4.4 and 4.8 for surface and drip irrigation treatments respectively. From Table 6.1, it has been observed that the higher yield was obtained for the drip irrigation treated plot as 4.8 ton/acre while for the surface irrigation treated plot the yield was 4.4 ton/acre. The percentage increase in yield of drip irrigation treated chilli over that of surface irrigation treated chilli was 8.8%. It was also observed that there were more mature pods desirable for picking in case of drip than surface irrigation treated chilli showing that drip irrigation advances the date of maturity.

Table 6.1 Effect of different irrigation treatments on yield of chilli.

Irrigation Treatment	Mean Yield of Chilli per plant (Kg)						Yield per plot of 2100 m^2 (Kg)	Yield per acre* (Kg)	% increase over surface irrigation
	1st picking	2nd picking	3rd picking	4th picking	5th picking	Total			
Surface	0.233	0.070	0.046	0.019	0.016	0.384	2298.1	4377.3	-
Drip	0.243	0.074	0.054	0.033	0.017	0.421	2519.6	4799.2	8.8

* 1 acre = 4000 m^2

6.4 Influence of Method of Irrigation on Yield of Brinjal

A total of six pickings of the mature brinjal were done in the plot at Maklang village at 5 days interval. The first picking was done on April 5, 2006 and the fifth and final picking was done on April 29, 2006. The yield on subsequent pickings and the total yield obtained under drip and surface irrigation treatments are presented in Table 6.2. The total yield obtained from an identical area of 2100m^2 each for drip and surface irrigation were 6036.8 kg and 5096 kg respectively. The yield in ton/acre for the two irrigation treatments were worked out to be 9.7 and 11.5 for surface and drip irrigation treatments respectively.

From Table 6.2, it has been observed that the higher yield was obtained for the drip irrigation treated plot as 11.5 ton/acre while for the surface irrigation treated plot the yield was 9.7 ton/acre. The percentage increase in yield of drip irrigation treated brinjal over that of surface irrigation treated brinjal was 15.6%. It was also observed that there were more mature pods desirable for picking in case of drip than surface irrigation treated brinjal showing that drip irrigation advances the date of maturity.

Table 6.2 Effect of different irrigation treatments on yield of brinjal.

Irrigation Treatment	Mean Yield of Brinjal per plant (Kg)							Yield per plot of 2100 m^2(kg)	Yield per acre (Kg)	% increase over surface irrigation
	1st picking	2nd picking	3rd picking	4th picking	5th picking	6th picking	Total			
Surface	0.218	0.128	0.182	0.186	0.135	0.061	0.910	5096	9706.6	-
Drip	0.239	0.151	0.196	0.239	0.160	0.093	1.078	6036.8	11498.6	15.6

6.4 Influence of Method of Irrigation on Yield of Cucumber

A total of six pickings of the mature cucumber were done in the plot at Maklang village at 6 days interval. The first picking was done on May 6, 2007 and the fifth and final picking was done on June 7, 2007. The yield on subsequent pickings and the total yield obtained under drip and surface irrigation treatments are presented in Table 6.3. The total yield obtained from an identical area of 2100m^2 each for drip and surface irrigation were 4738.3 kg and 9025.3 kg respectively. The yield in ton/acre for the two irrigation treatments were worked out to be 7.2 and 9.03 for surface and drip irrigation treatments respectively.

From Table 6.3, it has been observed that the higher yield was obtained for the drip irrigation treated plot as 9.03 ton/acre while for the surface irrigation treated plot the yield was 7.2 ton/acre. The percentage increase in yield of drip irrigation treated cucumber over that of surface irrigation treated cucumber was 20.5%. It was also observed that there were more mature pods desirable for picking in case of drip than surface irrigation treated cucumber showing that drip irrigation advances the date of maturity.

Table 6.3 Effect of different irrigation treatments on yield of cucumber.

Irrigation Treatment	Mean Yield of Cucumber per plant (Kg)							Yield per plot of 2100 m^2(kg)	Yield per acre(Kg)	% increase over surface irrigation
	1st picking	2nd picking	3rd picking	4th picking	5th picking	6th picking	Total			
Surface	1.379	0.515	1.279	0.508	1.133	0.875	7.688	3767	7175.2	-
Drip	1.618	1.133	1.866	0.833	1.566	1.208	9.670	4738.3	9025.3	20.5

7. CONCLUSION

Drip irrigation is generally considered as a new method in the North-eastern region of India although the concept has been practiced from quite some time in the region. In a state like Manipur where there is scarcity of water during rabi season drip irrigation system can effectively be used to commonly grown rabi crops such as cauliflower, cabbage, brinjal, chilli, tomato, cucumber etc. Drip irrigation system would increase the yield of crop and at the same time available water would be utilized at the optimal. Under the same agro climatic condition and soil type drip irrigation system could produce 10-20% higher yield than the ordinary surface irrigation. Drip irrigation system can save water upto 50% than the surface irrigation system depending upon the type of crop. Drip irrigation system can be applied to even undulating sloping hilly sites without land leveling and bench terracing. If drip irrigation system is once introduced to the farmers and its benefit is known to them, then this method of irrigation will surely be adopted. During the project implementation period many farmers from all over the state visited the nearby drip project sites to witness the system and its actual operation. Most of them have suggested for organization of a short term awareness-cum-training programme on drip irrigation system so that they may be able to know the details of the benefits of drip irrigation system. During the third year of the project a 2-day awareness-cum-training programme for the farmers of the state on the use and benefit of drip irrigation system had been organized. Many farmers of the state are motivated on the use of drip irrigation system and they may set up drip-irrigated farms in small scale as well as in large scale in the near future.

8. FUTURE SCOPE OF WORK

In the present project operation of Drip Irrigation System has been demonstrated to the farmers. From the feedback report of the participants it has been learnt that the farmers of the state have the willingness to carry out agricultural as well as horticultural practices with the use of drip irrigation system. However due to high initial cost of installation of drip system they wanted to get the components of the drip system in a subsidized rate so that they may be able to install the system in large scale in terms of hectares of plot to get the return in a shorter duration of time. Though Manipur Science & Technology Council can give the farmers

technical support we cannot give them the components in subsidized rate. At the same time we do not have any manufacturer of drip material in Manipur. Moreover, there are few suppliers/dealers of drip components from whom we can get system components at a very high rate as they have transported the material through road transport. Therefore, the farmers are not in a position to install drip irrigation system as it requires a high initial cost in the procurement of the material/components. If MASTEC could give the drip components to those interested farmers at a subsidized rate and at the same time technical support if needed, the farmers may get self employment through proper scientific farming. Hence MASTEC may take up a project as second phase of the precious project with an objective to give free installation, technical support and supply of drip components at subsidized rate to the interested farmers after a through identification.

Annexure – I

List of Participants for 2-days Awareness- cum-training Programme on "Drip Irrigation System" held at Imphal

Sl. No.	Name	Address
1.	K. Kalachand Singh, Farmer	Patsoi Part I
2.	S. Yaima Singh, NGO	President, The Arts and Cultural Training Cum Production Centre, Mongjam
3.	N. Okendra Singh, Farmer	Salam Village
4.	N. Paogin Haokip, Individual	Chassat Avenue, Imphal
5.	Dhanajit Ngasepam, Farmer	Leikinthabi
6.	Ngasepam Gunajit, Farmer	Leikinthabi
7.	Ng. Sarat Singh, Individual	Wangkhei Thambalkhong
8.	Md. Hayad Ali Shah, Farmer	Keikhu Maning Leikai
9.	Aribam Opendro Sharma, Individual	Sagolband Khamnam Bazar, Imphal
10.	Haokip Ngamsei, Individual	Haokip Veng, Imphal
11.	Moirangthem Ibomcha Singh, Individual	Khurai Chingangbam Leikai, Imphal East
12.	Athokpam Imo, Individual	Khurai Thangjam Leikai, Imphal East
13.	Atu Thomas, Farmer	Nungba, Tamenglong District
14.	Maibam Surjabal Khuman, Farmer	Kongkham Awang Leikai, Nambol
15.	N. Murphy Singh, Individual	Kwakeithel, Imphal West
16.	Nameirakpam Ingocha Singh, Farmer	Nongpok Sanjenbam, Imphal East
17.	Kh. Ibotombi Singh, Farmer	Nongda Thongkhong, Lamlai Imphal East
18.	M. Naba Singh, Farmer	Sabungkhok, Imphal East
19.	Kulla Singh, Farmer	Nongdam, Imphal East
20.	Ningombam Manaobi Meitei, Farmer	Yairipok Angtha
21.	Takhelambam Binoy Singh, Farmer	Yairipok Angtha
22.	Ng. Khai, Farmer	Oinam Hill village Senapati District
23.	L. Rajesh Singh, Farmer	Leimaram Awang Leikai
24.	N. Provin Meitei, Individual	Bashikhong, Imphal East
25.	R. Veichosapou, NGO	Liyai, Kalapahar
26.	Arambam Raghumani Singh, Farmer	Kabowakching Mamang Leikai
27.	M. Biren Singh, Farmer	Wangoo Sanasam Leikai
28.	Ashoka Rajkumar, Engineer	Uchiwa Awang Leikai
29.	M. Binita Devi, NGO	Mantripukhri
30.	Mary, NGO	Thayong Village