Micro Irrigation

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Foreward

I still recollect the day when Mr. Vijay Athawale, the senior consultant appeared in our office and said that I have been told by NABARD to prepare the project proposal for Umbrella Programme for Natural Resource Management (UPNRM). I have suggested the activity of micro irrigation and there were marathon discussions as to whether this product will be accepted by the farmers or not. At this juncture, Dr. Usha Mani and Dr. Divakar Hegde, highly placed officers of NABARD constantly supported the proposal and with their generous support alone, the first project was sanctioned. Incidentally, this micro irrigation system was coupled with the Better Cotton Initiatives (BCI) project and farmers response was encouraging. With the successful implementation and substantial recovery of UPNRM in 3700 hectares, covering 1400 farmers, Dilasa moved ahead to bridge the gap between the bank and the desirous & reliable farmers, who are in grave need of micro irrigation. At this juncture, Mr. Raviraj Satnur of Ratnakar Bank Ltd. (RBL) came forward to give financial assistance to Dilasa of 300 farmers for micro irrigation. Meanwhile, Mr. Ajoy Naquib, the GM of SBH, who is presently deputed in PMO for Janadhan Yojana, supported this concept and came with us at the branch level for the loan of drip irrigation system.

Mr. K.S.Anbalagan, DGM (Agri.) of SBI appreciated the efforts of Dilasa and spontaneously took the initiative to make the MoU for micro irrigation between Dilasa and SBI, the banking giant in India. However, we are very grateful to Dr.Ravindra Chechare, Chief Agriculture Officer of SBI who played very crucial role to bridge the gap between the bank and Dilasa volunteers. Mr. Shubham Malviya, Management Executive, SBI also remained catalyst between the bank and Dilasa. This was a major success in our effort to scale-up the micro irrigation activity. Moreover, Mr.Jayshankar, Assistant Vice President of Agri Finance Product Department of YES Bank at the head office remained guiding force since last two years in agri business who supported the activity and Mr. Sachin Dahale, Vice President in Government Banking at Aurangabad played supportive role for Dilasa all the times. Mr. Nilesh Tandulwadikar, Assistant Vice President, Axis Bank of Aurangabad is also encouraging the agri related activities as a banker. Mr. Swapnil Mudhale, Chief Manager, ICICI Bank, Ahmednagar is also taking initiatives and putting his hands forward for Dilasa in this venture. However, NETAFIM played the major role of big brother from the very initial stage and remained as constant partner in this activity. The companies like Finolex, EPC Mahindra and EMTELLE remained our promising business partners in this life changing activity of farmers for their sustainable livelihood.

Within a short span of five years, Dilasa Janvikas Pratishthan has carved its name as the major player in the micro irrigation. I recollect the above names with a sense of gratitude while writing foreward for this book which is a mirror image of our work apart from the total information about the micro irrigation system. Complements to Ms.Anjali Ritu Tiwari, Marketing & Business Development Manager & Ms. Rucha Chitnis having the field experience of five years in micro irrigation company for contributing a lot for this book. I am sure this book will be a source of information as well as motivation to the persons working in banking, financial institutions and micro irrigation companies and NGOs.

Mr. Sanjeev Unhale

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Acronyms

FAO	UN Food and Agriculture Organization
TMC	Thousand Million Cubic Feet
Mcum	Million Cubic Meters
BCM	Billion Cubic Meters
GPS	Global Positioning System
PVC	Poly Vinyl Chloride
PE	Polyethylene
HDPE	High Density Polyethylene
LLDPE	Linear Low Density Poly Ethylene
Ha	Hectare
Ac	Acre
RBL	Ratnakar Bank Limited
UPNRM	Umbrella Project for Natural Resource Management
NABARD	National Bank for Agriculture and Rural Development
NAFA	Netafim Agriculture Financing Agency
SBI	State Bank of India
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
AIBP	Accelerated Irrigation Benefit Programme
ICT	Information Communication Technology

Role of Dilasa in the Micro-Irrigation Process

Role of Dilasa

Irrigation is the method in which water is supplied to plants at regular intervals for agriculture. It is used to assist the growth of agricultural crops, maintenance of landscapes, and re-vegetation of disturbed soils in dry areas and during periods of inadequate rainfall.

Dilasa Janvikas Pratishthan head office at Aurangabad Maharashtra is an organisation which work for the upliftment of people who are connected to soil directly , which in other term we call it as farmers. Since last 20 years (Two decades) we are working in development of watershed and covered an area of around 4 lacs hectare in this way a new record is being created. The development of water shed has been done by us with collaboration of many funding agencies and while doing that we have the objective of changing the farmers mind on their cropping pattern, this is the field where they lack. The development of watershed in the villages has made the farmers shelf sufficient with water if it rains for one whole day. It majorly helps in the increase in productivity per unit area of land.

It was also observed by us that when the farmers become self sufficient in terms of water they started utilising it indiscriminately that is not the reason for our development then there comes into the picture micro irrigation system that we made farmers well averse with.

With this we started training farmers on the subject of drip and sprinkler irrigation and its benefits. Encouraged them to adopt this technique of low water usage so that the extra water can be used to benefit the needy ones. This is not actually grant oriented scheme for Dilasa but then also we are working because finally we want prosperous farmers at the end.

Bridging the gap between farmers and the banking institutions is our prime motto. Till now our achievement in drip irrigation coverage is five thousand hectares of land (5000 Ha of land) and with the great enthusiasm and positive energy we have target as same as watershed. However to fulfil this target we need support of banking agencies as well so that rapid work can be done at less span of time. In this context if bank will be interested in taking its responsibility as a Business Correspondent then we will be more than happy. We know that it takes a lot of time for the procedure to be on paper basically we want it to create a bond of faith between us and the bank.

So, let us start our relation on the firm basis of foundation that is trust. We will assure you that no account will become NPA (Non performing Assets),we will help in all recovery from the farmer side and subsidy application.

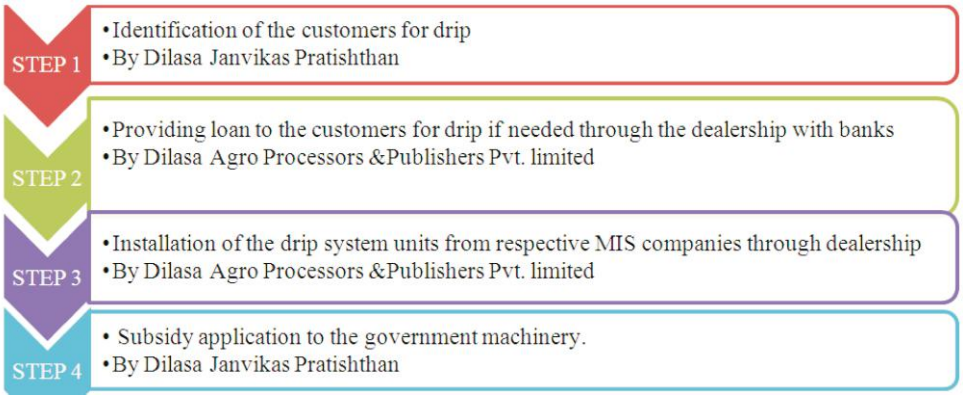
Hope for your goodearance this year!!!!!

In this way we define our role in Micro Irrigation as Dilasa Janvikas Pratishthan.

The role of Dilasa in the entire process can be shortened to as the "service provider". Dilasa attempts to bring the Micro Irrigation companies, banking institutions and the farmer under one floor for both the profit making and the extension service. As the extension service Dilasa attempts to bring more and more farmers under the drip irrigation system to make their agriculture more profitable in water scarce condition and increase the awareness for the drip and other micro irrigation system.

Dilasa Janvikas Pratishthan ,as a part of its profound interest in 'Natural Resources Management' has successfully implemented the project under UPNRM(Umbrella Programme for Natural Resource Management) in Aurangabad district with financial assistance and full support of NABARD and GIZ. NABARD is the first agency which has given its firm hand to us for the project initiation and we Dilasa has proved our success by covering around 1600 farmers and land area of 3700 hectares without fail and within the given time span. The projects aimed at creating awareness among the farmers regarding the judicious use of natural resources present nearby and sustain them for long for future betterment and with the help of NABARD we were able to provide them hassle free credit for installation of micro irrigation system. The project was started in 2011 with a credit assistance of Rs.350 lakhs ,there were 30 villages which were covered under this and all the assistance is provided to them at their door step as a result of this more and more farmers get enthusiasm to take micro irrigation for the increase in yield per unit area as well as farm income.

As a profit making activity Dilasa Agro Processors and Publishers receive commissions from both Micro Irrigation companies and the banking institution on each customer provide to these institutions as the loan customers to the banking institutions and the drip unit customers to the Micro Irrigation companies. The entire work process of drip can be divided into four major activities as:

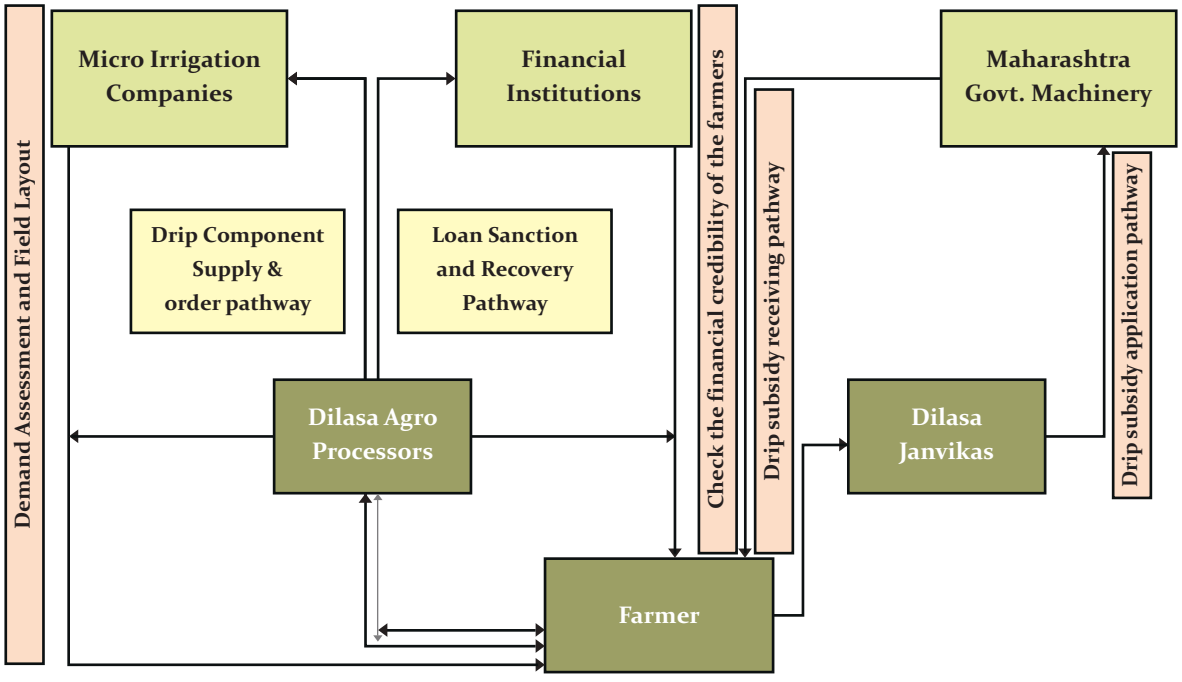


Role of Dilasa in the drip outreach program

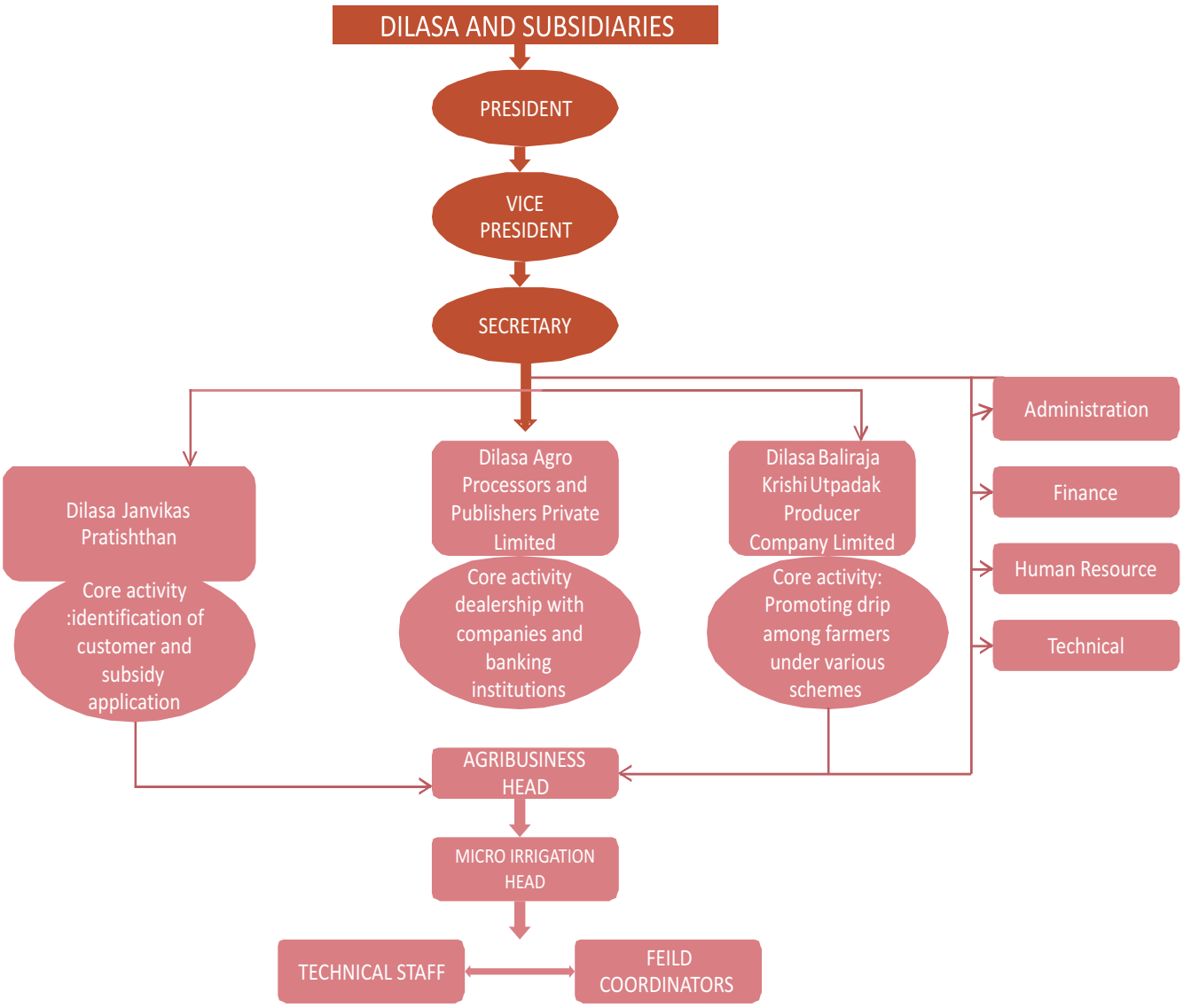
Out of these activities subsidy application is a non profit making activity, which is done to frame a good will among the framers as a good service provider and also to facilitate the subsidy application for the farmers. The processing fees charged for the subsidy application is minimal, however it eases out the process for the farmers. The goodwill created provides the strong base of the customer pool. The major profit making activity is through the commissions received from the MIS companies and the banking institution on customers.

Institutional Linkage Framework

The entire process is the integration of the Dilasa Janvikas Pratishthan, Dilasa Agro Processors and Publishers Private Limited, MIS companies, Banking institution and the Government machinery. The integration of the institutions along with their activity for integration is shown below:



Institutional Linkage Framework



The structure of organization is well defined but it is more inclined towards the divisional type of structure at the strategic level however with hybrid structure at the operational level. The divisional activities are more based finance, administration, human resource and technical work. A second type of divisional activity is based upon the programmes and the projects running like IWMP, BCI, micro irrigation projects and others. The activities between the divisions are but highly integrated and are difficult to differentiate clearly under different divisions head. The hybrid structure is more visible at the operational structure as the technical staff and the field coordinators are common for all these divisions and projects. The organogram framed is only for the micro irrigation project and shows the organizations involve in the drip project.

Benefits of the organizational structure

1. Employees are aware of different projects running in the organization under different subsidiaries. Employees are exposed to vast level of work and have greater flexibility.
2. Certain degree of specialization exists in the organization for which divisional work is carried out like for the IWMP and the Micro irrigation projects.
3. Switching of employees between the projects is economical in terms of time. Since employees are aware about the projects the lapse time between the responsibility handling and the project switching is quite less.
4. Over lapping of the projects proves beneficial in creating the customer pool for the different project. The field coordinators use their experience from the previous project to the new projects.

Dealership and Time Assessment

Pathways of drip irrigation unit instalment

The mode of pathway that farmer chooses for the drip irrigation unit instalment depends upon the financial strength of the farmer or the cash availability with the farmer. Farmers choose cash payment mode if they can bear the immediate installation cost and loan mode if they can't bear the immediate installation cost.

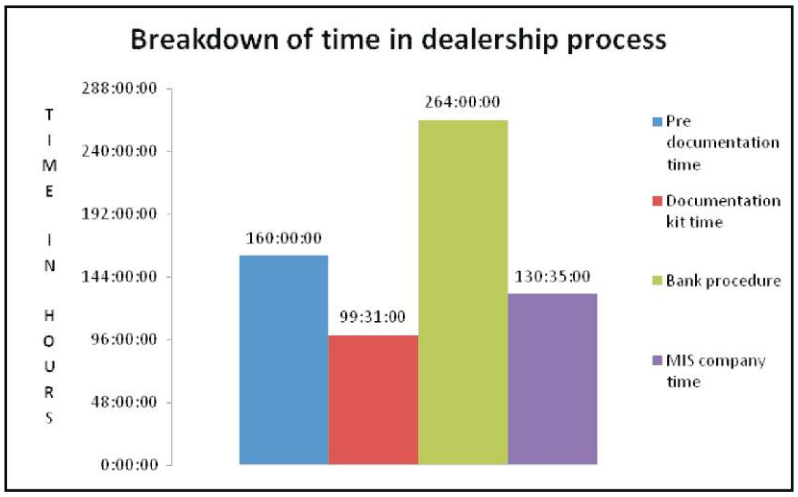
Thus there are two modes:

1. Cash payment
2. Loan mode

Cash Payment

Time stamping: In the cash payment method the process is comparatively short and farmer receives the drip unit within 10 days of demand. The entire process contains only 1 decision making step. This decision making step is performed by the field coordinator that the farmer has water availability and there has been continuous cultivation of crop on the field and the crops cultivated by the farmers are suited to the drip irrigation unit. This decision making step is necessary to be performed in the cash payment mode also as failure to do so can lead to rejection of the subsidy file of the farmer by the government machinery.

The average breakdown of the activities in the days is given below:



The total time taken to complete the entire process is 654:00:00 hour that is equivalent to 27.25 days.

Subsidy Process

Government machinery

The drip irrigation unit installation cost on an average per acre varies between Rs. 40000 to Rs. 45000. The drip irrigation system thus is a high one time investment cost for the small and medium farmers. But the need of drip irrigation is also very well understood by the farmers of Marathwada region, a region suffering from hydrological drought, meteorological and agriculture drought since last 4 years consequently. The efficient farming will become near to impossible in case there is no water efficient irrigation system. To lessen the burden of farmers and promote the installation of drip irrigation unit on all scale, Maharashtra State Government provides the subsidy on the installation cost. Maharashtra government provides subsidy to the small and marginal farmers for the installation of the micro irrigation system i.e. drip and sprinkler. The subsidy to the farmers is being provided under three schemes namely:

- National Mission on Micro Irrigation (NMMI)
- Vidarbha Intensive Irrigation Development Programme (VIIDP)
- On Farm Water Management (OFWM)

National Mission on Micro Irrigation (NMMI)

The scheme on micro irrigation which was launched in 1986 has been upgraded to be implemented as "National Mission on Micro Irrigation" during the 11th plan period. The subsidy assistance for the small and the marginal farmers is 60% while for other framers is 50% of the cost of micro irrigation for application in both the horticultural and non-horticultural crops. Assistance is limited to 5 ha for the beneficiary. In this centrally sponsored scheme the 40% cost of the micro irrigation system is borne by the Central government, 10% by the State Government and remaining 50% by the beneficiary.

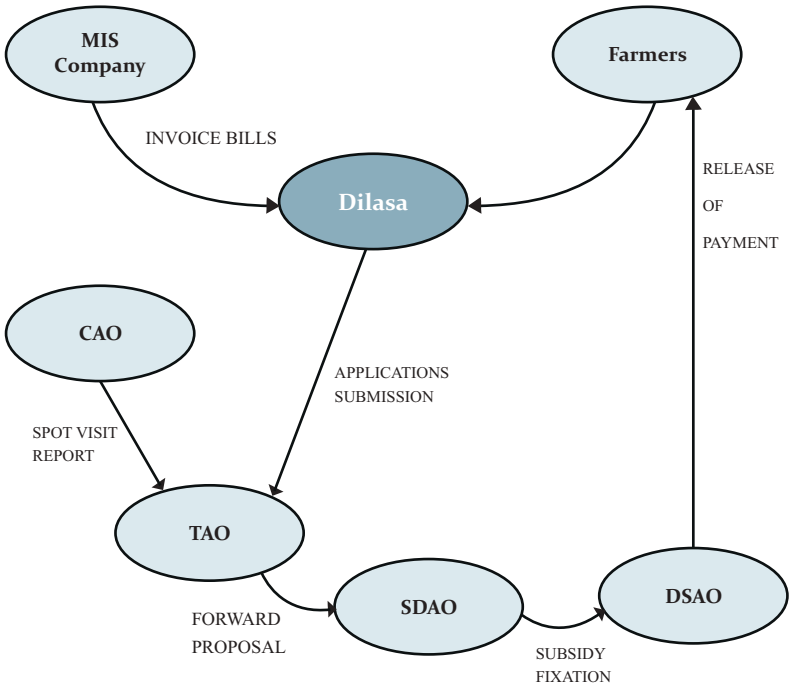
Vidarbha Intensive Irrigation Development Programme (VIIDP)

The scheme is a special programme for the Vidarbha region of Maharashtra and it covers up to 2 ha of land area per beneficiary in 8 districts of Vidarbha. The scheme provides enhanced assistance of 75% to small and marginal farmers while 50% assistance to other farmers.

E Thibak

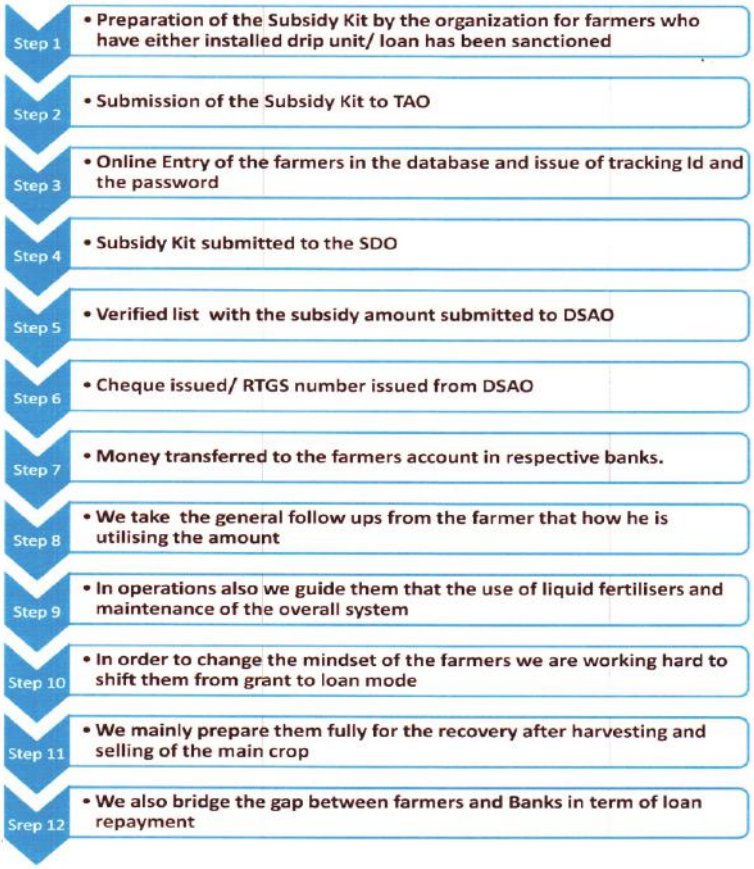
The government machinery system has launched e Thibak, an online administration system,

- To provide web based centric workflow to perform all administrative roles.
- To provide transparency and visibility
- Automation in subsidy calculation for subsidy fixation process
- Checking of eligibility of beneficiary as per norms
- Timely distribution of grant to large number of beneficiaries.



Process under Dilasa

The process of subsidy includes these major steps:



The main service offered by Dilasa in the process is preparation of subsidy kit. The subsidy kit preparation requires compilation of documents from farmers, Micro Irrigation companies and financial institutions.

Documents required for the subsidy application

The documentation procedure for the subsidy application is long and assures that the farmer has installed the drip irrigation at field. The list of documents needed for the subsidy kit is:

Document	Captures	Issued By/ In name of
Application of cultivar		Farmer
Consent Certificate		Farmer
7/12	Crop cultivated and the source of water	Taluka office in name of owner
8A	History of land including propertiership passage and crops	Taluka office in name of owner
ChaturSima	4 sides description of land	Taluka office in name of owner
Mandalm Krishi Adhikari Crop Cultivation and Well Availability Certificate (Annexure 13)	Taluka officers certification of the availability of water source and crop cultivation	CAO
Graph of Drip installation	Farmers land and drip unit layout	MIS Company/ Engineer
Mandal Krishi Adhikari&Taluka Officer Inspection Report	Drip irrigation components and parts are verified with their ISO numbers and certified	CAO
Subsidy Finalization Report	Based on the components the eligible subsidy amount is certained	SDAO
Description of payment of drip irrigation unit by farmers		MIS company and dealer
Water Availability Certificate	Source of water and mode of drawing motor. Specification of horsepower of the motor.	Taluka agriculture office
Agreement		In name of farmer
Panchnama		In name of Farmer
Installation certificate	The micro irrigation company certifies that the farmer has done for the mentioned drip components parts.	MIS company
Unit Delivery Certificate	Drip irrigation components were delivered and received by the farmer at the mentioned village, block and district.	Farmer and dealer
Soil and Water testing report	Soil type and various content of soil and water are mentioned.	Taluka agriculture office

The organization has an important role to play in the fastening of the documentation of the process. Of the list mentioned above the farmer provides the document 7/ 12, 8A, ChaturSima ,Mandal Krishi Adhikari Crop Cultivation and Well Availability Certificate and MandalKrishiAdhikari&Taluka Officer Inspection Report. While, other documents are prepared by the NGO in collaboration with the Micro irrigation company.

The transaction cost for the framer for the subsidy application is reduced. The excel sheet in the hyperlink shows the step by step in the subsidy application.

The prior activity to each step shows the essential activity that needs to be completed before the initiation of that activity.

Time stamping for subsidy

Total time taken from the loan sanction to the subsidy issue on an average takes about 4 to 5 months. Sometimes it is issued within days and sometimes it extends to years. The reason of this uneven time period is due to the dependency of the arrival of the grants from the government machinery for the year. The subsidy disbursement gets delayed even on the submission of the documents and the verification if the grants are not issued to the agriculture department.

The total time taken for the subsidy receiving can be controlled by Dilasa only to small extent that is through controlling the total time taken in the subsidy kit preparation. On an average estimation the time taken for the feeding and taking the prints is nearly 50 minutes for a farmer kit.

Success Stories

Name of farmer	**: Sanjay Nath Rao Mishra**
Village	**: Manjri**
Block	**: Gangapur**
Crop	**: Cotton**
Variety	**: Ajit 151**

"Farmer has installed the drip irrigation unit of Parixit since 2012. Farmer has reported that before 2012 the yield of cotton was 7 quintal per acre and after drip irrigation installation the yield reported by him is 10 quintal per acre."

Name of farmer	**: Rameshwar Babusaheb Dore**
Village	**: Chinchkheda**
Block	**: Gangapur**
Crop	**: Cotton**
Variety	**: Ajit 151**

"Farmer installed drip in year 2013 of FINOLEX and reported yield increase from 5 quintal per care to 9 quintal per acre at his field. He rated Dilasa as very good in terms of providing services for credit facility and speed of service. He said, "I was able to install drip unit system at my field within 20 days and it was only twice I had to incur the transportation cost"."

Name of farmer	**: Raktilal**
Village	**: Maliwadgaon**
Block	**: Gangapur**
Crop	**: Cotton**
Variety	**: Ajit 151**

"Farmer rated Dilasa as "good" and banks as "poor" in terms of credit receiving facility. He said, "I was able to receive loan within 20 days while BOI took 4 months to sanction the loan amount. He reported increase in yield of cotton from 7 quintal to 12 quintal per acre. He said, "I was able to reduce the water and fertilizer consumption by 60% and 50% respectively in my drip irrigated crops. I was able to reduce mu pump operating time from 10 hours to 3 hours."

Name of farmer : **Nanasaheb Laxman Rao** Village : **Manjri** Block : **Gangapur** Crop : **Sugarcane** Variety : **Ajit 151**	

"I am able to save 20% water with drip irrigation unit and there has been considerable increase in the yield of the crop. The yield of sugarcane was 35t per ha which has increased to 80t per ha due to combined effect of drip irrigation and the fertigation."

Name of farmer : Vijay Kisan Rao **Village : Sawangi** **Block : Jalna** **Crop : Soybean**	

"I was able to increase the yield of soyabean from 7 quintal per acre to 14 quintal per acre "

Name of farmer : **Dhananjya Bhaskar Thakrey** Village : **Karanjkheda** Block : **Kannad** Crop : **Cotton & Ginger** Variety : **Ajit 151**	

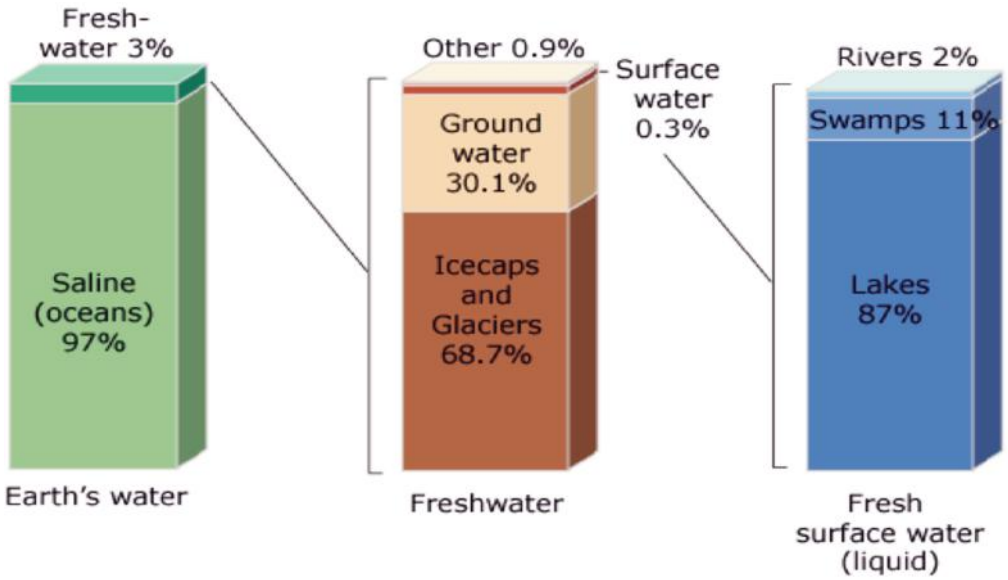
"use drip irrigation in cotton and ginger and I have been able to increase the yield in ginger from 8 quintal per acre to 15 quintal per acre. Dilasa service providing is very fast and easy. Banks services are not only time taking but also mentally torturing. We face no problem in Dilasa and work is carried out smoothly."

1 Introduction

1.1 Water

Water (chemical formula: H2O) which is also known as the universal solvent, is a transparent fluid which forms the world's streams, lakes, oceans and rain, and is the major constituent of the fluids of organisms. Human body consists 60% of water. Water covers about 71% of the Earth's surface. For survival of all living things on the earth, water is very vital. For instance, humans can't survive more than a week without fresh water. It serves several purposes like growing plants, processing food, making a variety of products, cleaning, extinguishing fire, recreation etc.

1.2 Earth's Water Distribution



Source: Google Image

Figure-1 : Distribution of Earth's Water

Out of the total water available on the Earth, 97% of the water is saline and is from the oceans and 3% of water is fresh water from rivers, lakes etc. Out of total fresh water 68.7% is in icecaps and glaciers, 30.1% is ground water, 0.3% is surface water and 0.9% is in other forms. The UN report has predicted that as many as 3.4 billion people will be living in "water-scarce" countries by 2025.

1.3 Usage of available fresh water

There is an ever increasing demand for water by various sectors which is made available from many river basins. Amongst all sectors like agriculture, Industry etc. that use water as one of the major inputs, water consumed by industries is a fraction of that consumed by the agriculture sector. Agriculture (Irrigation) consumes a major part of available fresh water on the earth which amounts to about 70% of the available fresh water.

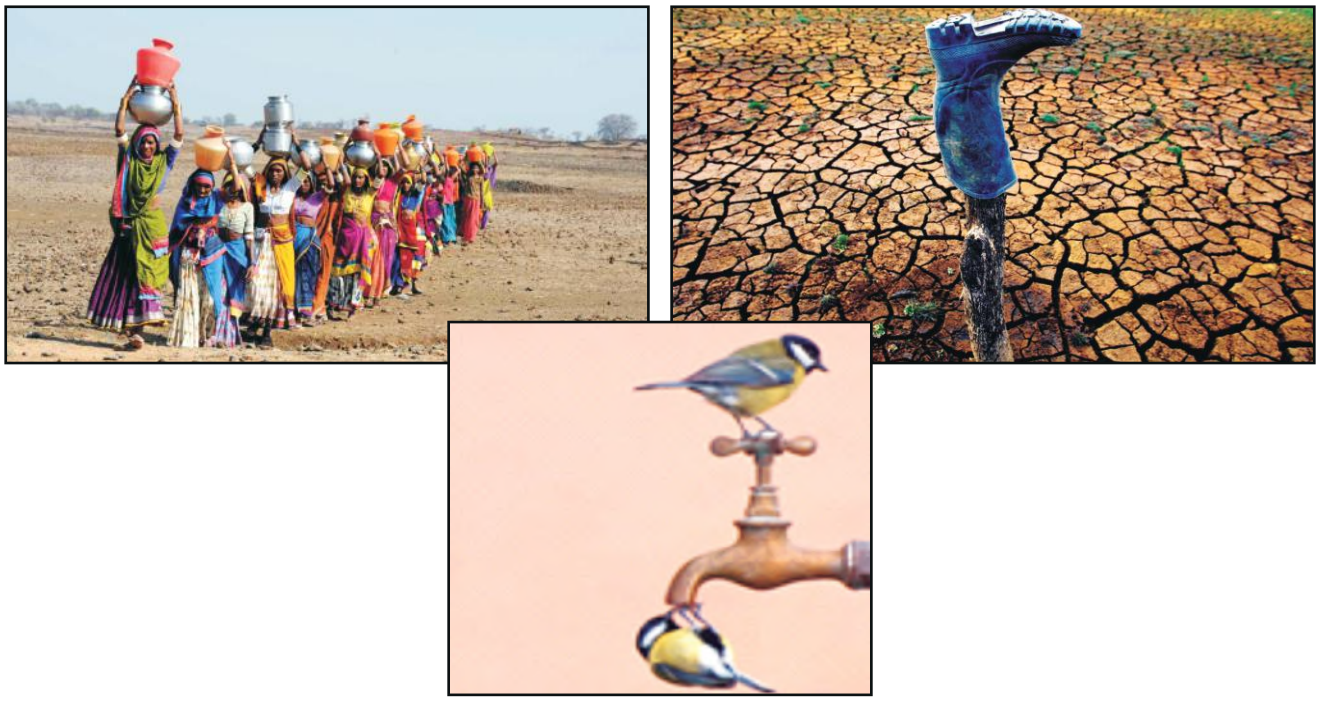


Figure-2: Result of water Wastage on Living World

As per a report by the UN Food and Agriculture Organization (FAO), about 60% water is wasted out of the total water used for irrigation - either via runoff into waterways or by evapo-transpiration. This wastage of water results in water scarcity, which in turn, adversely affects the human health (as per the UN report "1/5th of the world's population lacks safe drinking water'), other living things, industrial development and also agriculture.

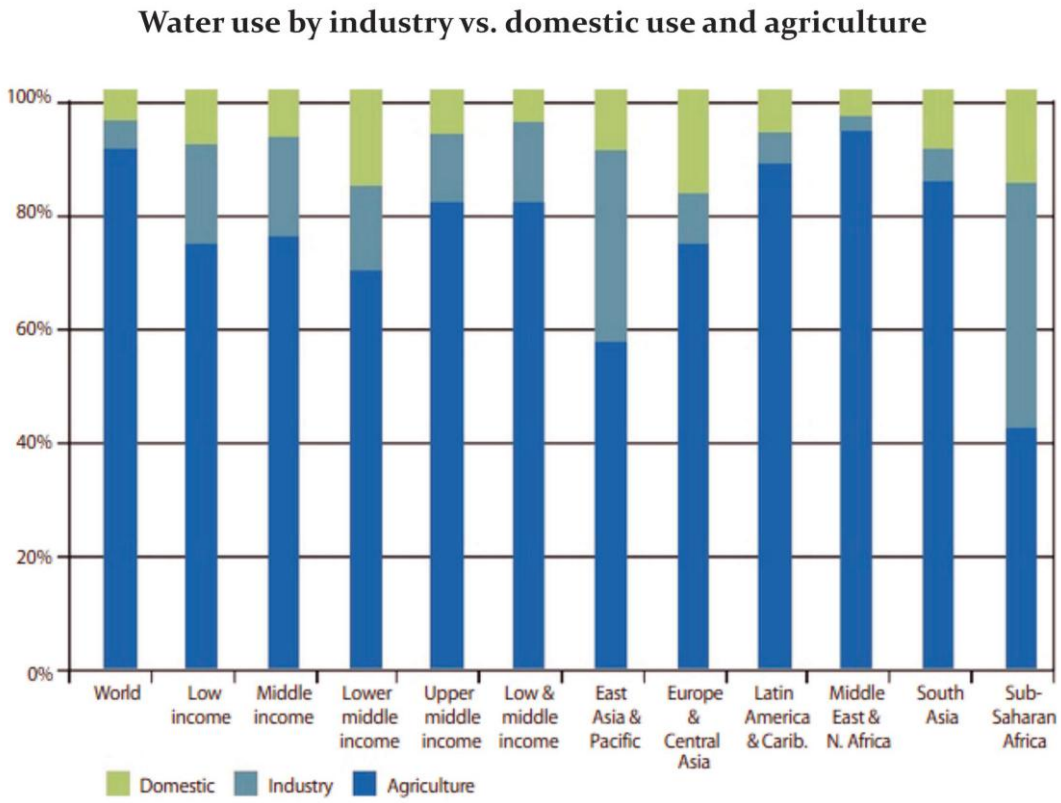
Sectorial water requirements in India (in billion cubic metres)

Water Requirements for Different Uses in India (BCM) (1997-1998, 2010, 2025 and 2050)										
Uses	**Year 1997-98**	**Year - 2010**			**Year - 2025**			**Year - 2050**		
		Low	**High**	**%**	**Low**	**High**	**%**	**Low**	**High**	**%**
Surface Water :										
Irrigation	318	330	339	48	325	366	43	375	463	39
Domestic	17	23	24	3	30	36	5	48	65	6
Industries	21	26	26	4	47	47	6	57	57	5
Power	7	14	15	2	25	26	3	50	56	5
Inland Navigation		7	7	1	10	10	1	15	15	1
Flood Control		-	-	0	-	-	0	-	-	0
Environment (1)Afforestation		-	-	0	-	-	0	-	-	0
Environment (2)Ecology		5	5	1	10	10	1	20	20	2
Evaporation Losses	36	42	42	6	50	50	6	76	76	6
Total :	**399**	**447**	**458**	**65**	**497**	**545**	**65**	**641**	**752**	**64**
Ground Water :										
Irrigation	206	213	218	31	236	245	29	253	344	29
Domestic & Municipal	13	19	19	2	25	26	3	42	46	4
Industries	9	11	11	1	20	20	2	24	24	2
Power	2	4	4	1	6	7	1	13	14	1
Total :	**230**	**247**	**252**	**35**	**287**	**298**	**35**	**332**	**428**	**36**
Total Water Use :										
Irrigation	524	543	557	78	561	611	72	628	817	68
Domestic	30	42	43	6	55	62	7	90	111	9
Industries	30	37	37	5	67	67	8	81	81	7
Power	9	18	19	3	31	33	4	63	70	6
Inland Navigation	0	7	7	1	10	10	1	15	15	1
Flood Control	0	0	0	0	0	0	0	0	0	0
Environment (1)Afforestation	0	0	0	0	0	0	0	0	0	0
Environment (2)Ecology	0	5	5	1	10	10	1	20	20	2
Evaporation Losses	36	42	42	6	50	50	6	76	76	7
Total :	**629**	**694**	**710**	**100**	**784**	**843**	**100**	**973**	**1180**	**100**

(Source: Central Water Commission)

Table-1: Sectorial Water requirement in India

From the data one can infer that the Agriculture sector for Irrigation consumes a huge quantity of water among all major water consuming sectors. The consumption of water for Irrigation will increase exponentially and by 2050 it will reach an insurmountable level.



Source: World Bank (2002)

Figure-3: Water usage by Different Sectors

1.4 Current Water Situation in Maharashtra

GOVERNMENT OF MAHARASHTRA

WATER RESOURCES DEPARTMENT

WATER STORAGE POSITION IN MAJOR, MEDIUM & MINOR IRRIGATION PROJECTS- 06.05.2016

SR. NO.	REGION	NO. OF PROJECTS	LIVE STORAGE (Mcum)				2015		2014	
			PROJECTED	TODAY's	%	STORAGE IN LAST WEEK SAME DAY (Mcum)	WATER STORAGE ON SAME DAY (Mcum)	%	WATER STORAGE ON SAME DAY (Mcum)	%
1	2	3	4	5	6	7	8	9	10	11
A.	MAJOR PROJECTS									
1	Konkan Region	5	1870	754	40	792	796	43	710	38
2	Marathwada	11	5142	102	2	116	615	12	1526	30
3	Nagpur	17	3257	872	27	886	929	29	1619	50
4	Amarawati	9	1399	247	18	261	432	31	582	42
5	Nasik	19	3512	448	13	469	1011	29	1090	31
6	Pune	29	11163	1507	13	1730	3226	29	2421	22
	Total	**90**	**26343**	**3930**	**15**	**4254**	**7009**	**27**	**7948**	**30**
B.	MEDIUM PROJECTS									
1	Konkan Region	5	389	165	42	170	145	37	104	27
2	Marathwada	75	935	32	3	36	84	9	247	26
3	Nagpur	40	551	63	11	70	62	11	154	28
4	Amarawati	23	659	114	17	125	217	33	283	43
5	Nasik	38	904	190	21	199	330	37	324	36
6	Pune	44	1405	293	21	322	439	31	392	28
	Total	**225**	**4843**	**857**	**18**	**922**	**1277**	**26**	**1504**	**31**
C.	MINOR PROJECTS									
1	Konkan Region	150	547	200	37	212	202	37	170	31
2	Marathwada	728	1582	32	2	34	75	5	270	17
3	Nagpur	307	479	44	9	49	61	13	126	26
4	Amarawati	428	937	77	8	84	174	19	277	30
5	Nasik	294	669	52	8	60	103	15	116	17
6	Pune	326	760	94	12	101	177	23	152	20
	Total	**2233**	**4974**	**499**	**10**	**540**	**792**	**16**	**1111**	**22**
D.	TOTAL OF ALL PROJECTS (Major, Minor & Medium)									
1	Konkan Region	160	2806	1119	40	1174	1143	41	984	35
2	Marathwada	814	7659	166	2	186	774	10	2043	27
3	Nagpur	364	4287	979	23	1005	1052	25	1899	44
4	Amarawati	460	2995	438	15	470	823	27	1142	38
5	Nasik	351	5085	690	14	728	1444	28	1530	30
6	Pune	399	13328	1894	14	2153	3842	29	2965	22
	Total	**2548**	**36160**	**5286**	**15**	**5716**	**9078**	**25**	**10563**	**29**
E.	**OTHER DAM'S**	**11**	**1781**	**347**	**19**	**386**	**471**	**26**	**555**	**31**
	TOTAL MAHARASHTRA	**2559**	**37941**	**5633**	**15**	**6102**	**9549**	**25**	**11118**	**29**

Source: Govt. of Maharashtra (Water Resource Department)

Table-2: Water Storage Position in Maharashtra as on May

Marathwada Region

Sr. No.	Project	District	Live Storage (Mcum)				Today's Rainfall (mm)	Total Rainfall from 1st June (mm)	Last Year (Same Day) position (2015)			Last 5 Years Average of Water Storage	Same Day Water Storage Position (Mcum)			
			Projected	Today's	%	Water Storage in last week			Total Rainfall from 1st June (mm)	Water Storage (Mcum)	%		2011	2012	2013	2014
1	Jayakwadi	A'Bad	2171	0	0	0	0	0	463	197	9	410	675	226	689	262
2	Purna Yeldari	Parbhani	809	0	0	0	0	0	489	89	11	216	378	49	135	428
3	Purna Sddheshwar	Parbhani	81	0	0	0	0	0	508	22	27	46	46	0	141	21
9	Majalgaon	Beed	312	0	0	0	0	0	581	0	0	62	125	41	79	68
5	Manjra	Beed	177	0	0	0	0	0	625	0	0	19	68	14	0	580
6	Upper Penganga	Nanded	964	69	7	77	0	0	783	224	23	456	561	373	544	580
7	Lower Terna	Osmanabad	91	0	0	0	0	0	532	0	0	10	52	0	0	0
8	Manar	Nanded	138	0	0	0	0	0	685	8	6	22	43	17	0	45
9	Vishnupuri	Nanded	81	2	2	3	0	0	716	10	12	17	29	19	0	25
10	Lower Dudhna	Parbhani	242	31	13	36	0	0	566	65	27	43	0	0	55	97
11	Sina Kolegaon	Osmanabad	76	0	0	0	0	0	227	0	0	0	0	0	0	0
	Total		5142	102	22	116	0	0	6175	615	115	1301	1977	739	1643	2106

Source: Govt. of Maharashtra (Water Resource Department)

Table-3: Water Storage Position in Marathwada

1.5 Current Water Situation in the Marathwada Region

Severe drought in the last 2 successive years and poor rainfall across the state since 2014 has resulted in the sharp decline in the water levels in dams across the state. The water crisis in the drought-struck region of Marathwada is pathetic long before the summer sets in. Marathwada region has 11 major dams constructed for water storage. The capacity of the 11 dams is 5142 TMC as per the planned storage level. Currently, as on May 2016 those 11 dams have only 102 TMC (2%) water in it. Water levels in the region's dams are reducing with each passing day causing a very serious problem for all sectors in the Marathwada region. 6 of the 11 major dams are at dead storage level. The biggest dam in the region, Jayakwadi, has only 2% water left. Last year, at this time, water levels in the Marathwada dams were much higher, at 18%. The worst affected areas are Beed, Latur and Osmanabad where the water level in the dams is 1% or less.

Successive and severe drought and fall in the water level in Marathwada region has affected both human and animals life as well as on agriculture greatly. We need to take urgent steps for efficient use of available water by implementing methods of Irrigation inorder to avoid such a situation in the future.

Water could be saved by only its efficient use in the field of 'Agriculture'

Irrigation is the only and effective option for efficient use of water in Agriculture

2 Irrigation

2.1 Irrigation

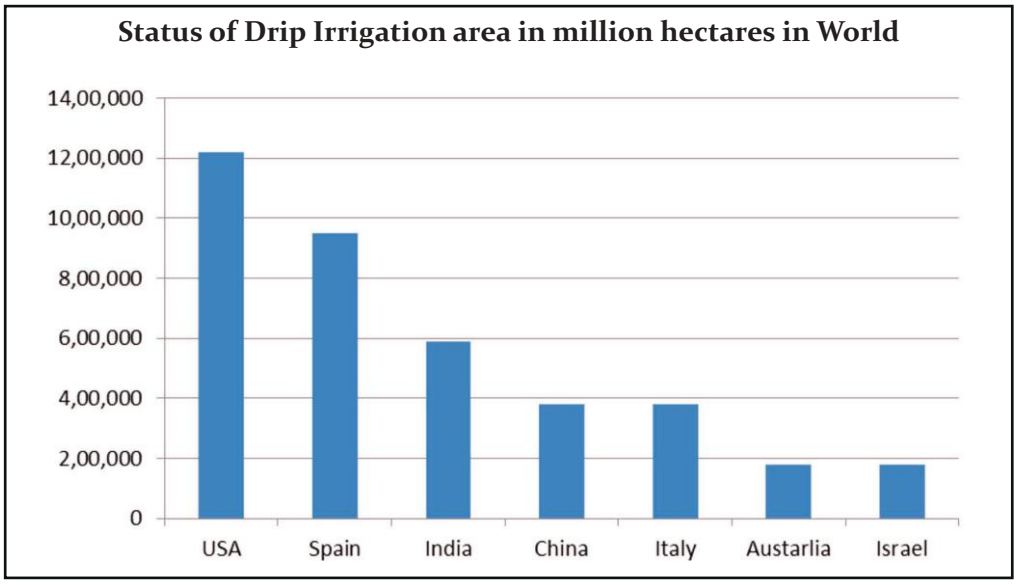
Irrigation is the method in which water is supplied to plants at regular intervals for agriculture. It is used to assist the growth of agricultural crops, maintenance of landscapes, and re-vegetation of disturbed soils in dry areas and during periods of inadequate rainfall.

Application of water through different methods of Irrigation results in;

- Improving water use efficiency / Reducing the water wastage
- Increasing the seasons for cultivation and quality of produce
- Reducing the weed growth
- Preventing deterioration of soil condition / Reducing the soil Erosion

2.2 Global Status of Irrigation

About 68% of the total irrigated area is located in Asia, 17% in America, 9% in Europe, 6% in Africa. The most popular method of irrigation is surface irrigation. Around 94% of the area covered under irrigation is irrigated through the surface irrigation, only remaining 6% of the area is under drip and sprinkler combined. Traditional methods of irrigation consumes large amount of water all over the world.
The modern drip irrigation system was invented in Israel. During initial years of its development its usage was limited to Israel and Australia. But now it's the most efficient form of irrigation in most of the countries. The largest area covered under drip in world is USA followed by Spain and India respectively. Within the last two decades, the area irrigated using drip and other micro irrigation methods has increased 6.4 fold from 1.6 million hectares to over 10.3 million hectares.



Source: World Bank

Figure-4: Status of Drip Irrigation in the World

2.3 Status of Irrigation in India

In India, the agricultural sector currently consumes over 80% of the water available for irrigation in India, and agriculture continues to be the major water-consuming sector due to the impetus given to agriculture (see, Saleth, 1996; MOWR, 1999, Iyer, 2003)

In India, the supply of water by drip (2.13%) and sprinkler (3.30%) irrigation methods, is negligible when compared with its total potential, which is estimated to be 21.01 million hectares by drip and 50.22 million hectares by sprinkler irrigation method.

In India outreach of drip system is not up to the mark due to the following issues,

- High initial capital required for procurement and implementation of the system
- Poor awareness amongst farmers about importance and usefulness of Drip system
- Farmers are complacent with free electricity and low cost of canal water for irrigation
- Poor extension and training facilities to create awareness in farmers
- Absence of Promotional schemes in many states.

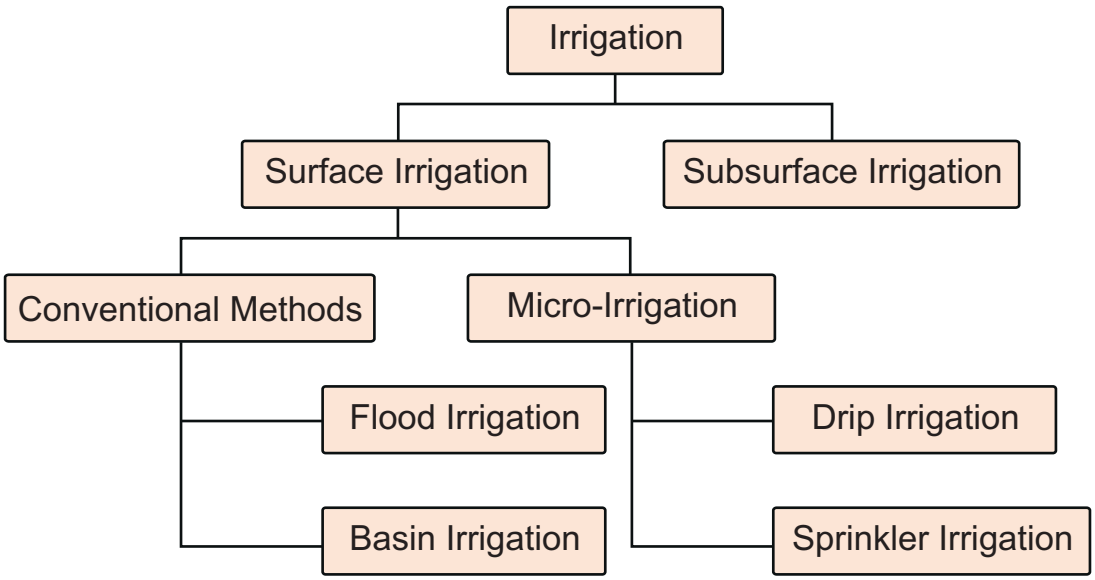
2.4 Status of Irrigation in Maharashtra

Maharashtra government has been providing subsidy since 1986-87 onwards through State schemes. Maharashtra State alone accounts for nearly 50% of the India's total drip irrigated area followed by Karnataka, Tamil Nadu and Andhra Pradesh.

In Maharashtra due to state govt. schemes and extension facility, outreach of drip Irrigation is highest in India. The other reasons of improving Drip Outreach are,

- Area under irrigation from both surface and groundwater is quite low and hence, many farmers have adopted drip irrigation to avoid water scarcity largely in divisions like Nashik, Pune, etc
- Owing to continuous depletion of groundwater, farmers are not able to cultivate wide spaced and more lucrative crops like grapes, banana, pomegranate, orange, mango, etc. by using only surface irrigation methods in many regions.

2.5 Types of Irrigation



Depends on mode of water application, methods are divided into different parts as,

2.5.1 Surface Irrigation

Surface irrigation is defined as an irrigation method wherein water is supplied to the target crop area by using the slope of the surface for flow of water by gravity. It is, by far, the most common method of irrigation throughout the world and has been practiced in many places, virtually unchanged for thousands of years.

Surface Irrigation is mainly divided into two types viz., *Conventional irrigation (Traditional Methods) and Micro-Irrigation.*

Conventional methods are used by farmers for the past several years but those methods are found to be inefficient for water usage when compared with the modern methods of Micro-Irrigation.

Figure-5: Surface Irrigation

A. Flood Irrigation

Flood irrigation is an ancient method of irrigating crops. It is most likely that this is the first and foremost method of irrigation used by humans as they began cultivating crops and is still one of the most commonly used methods of irrigation. Very simply, water is delivered to the field by ditch, pipe, or some other means and water flows over the ground through the crops by gravity. The efficiency of water usage by this method is only 50%.

Figure-6: Flood Irrigation

B. Basic Irrigation

This type of irrigation is mainly used for orchards (fruit crops). A circular ditch is created around each crop in the farm and water is supplied to the ditch through different means (e.g. through pipes or canals etc.) This method is effective to supply water with less wastage as there is considerable distance in between the fruit crops. The efficiency of this method is only 50%.

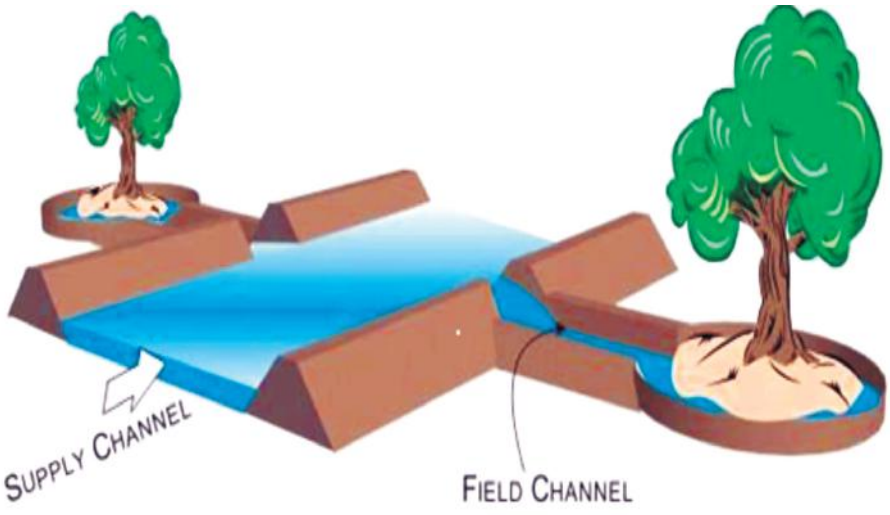


Figure-7: Basin Irrigation

2.5.2 Micro-Irrigation

Micro-Irrigation is a modern technique of supplying water to the root zone of the crops. This method ensures highest efficiency of water usage when compared with all other available methods of irrigation. This method is mainly divided into 2 major types such as,

A. Drip-Irrigation

Drip Irrigation is the artificial supply of water to root zone of crops at regular interval of time and with optimum quantity of water. Drip Irrigation is also known as the trickle irrigation system because the crops are irrigated by the dripping water or trickling water from the emitters. The water from this system directly goes to the root zone of the crops thus there is less wastage of water. It minimizes the losses of conventional methods, like deep percolation, seepage, conveyance loss, run off and soil water evaporation.

It is used to assist in the growing of agricultural crops, maintenance of landscapes, and re-vegetation of disturbed soils in dry areas, especially during the periods of inadequate rainfall.

Supply of water through these non-conventional methods of Irrigation results in;

- Improving efficiency of water usage by reducing the water wastage
- Increasing the number of crop seasons for cultivation and quality of produce
- Reducing the weed growth
- maintaining the soil condition / Reducing the soil Erosion

B. Sprinkler Irrigation

Sprinkler irrigation is a method of supplying irrigation water similar to natural rainfall i.e. water is not supplied continuously but in drops by sprinkling. In sprinkler system, water is distributed through a system of pipes usually by pumping the water at a reasonable pressure. It is then sprayed into the air through sprinklers so that it breaks up into small water drops which spread and fall to the ground by gravity.

2.5.3 Sub-Surface Irrigation

In sub surface drip irrigation the irrigation pipes are laid below the top layer of soil. This type of system is more suited when the crop is of perennial nature and there is no need of land preparation in the field or no need to remove the irrigation pipes. This system has maximum water use efficiency than any other irrigation method, because there are very less evaporation losses in the system. Irrigation laterals are directly placed at such as depth where the actual root zone of crops lies.

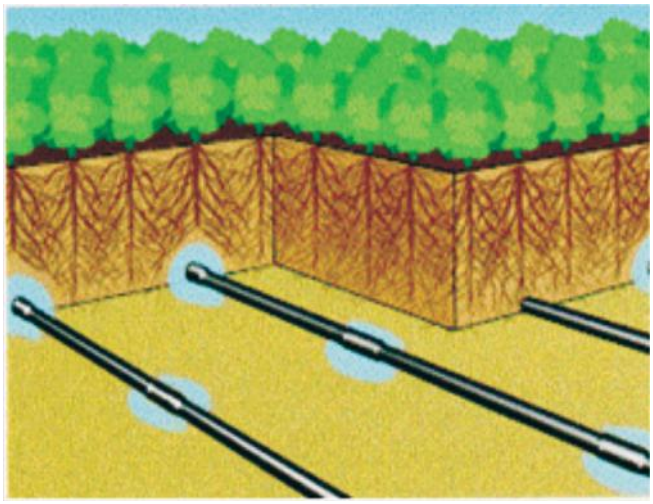
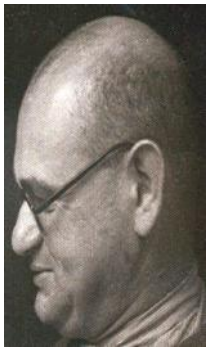


Figure-8: Subsurface Irrigation

3 Drip Irrigation

3.1 Discovery of Drip-Irrigation



Simcha Blass was an eminent Israeli engineer and inventor of Drip System. He was the key person in the water development, introducer and developer of new drip irrigation systems in Israel.

During early 1930s, a farmer drew his attention to a big tree, growing in his backyard "without water". After digging below the apparently dry surface, Simcha Blass discovered why water from a leaking coupling was causing a small wet area on the surface, while an expanding onion shaped area of underground water was reaching the roots of this particular tree and not the others. This sight of tiny drops penetrating through the soil causing the growth of a giant tree provided a catalyst for Blass's invention. Thus the concept of drip irrigation was born and experiments that followed led Blass to create an irrigation system that used friction and water pressure loss to leak drops of water at regular intervals. Recognizing the high potential of his discovery, he began to look for ways to turn his idea into a useful product.

3.2 Why Drip-Irrigation

It is extremely effective,

1. For sustaining Agriculture in water scarce areas.
2. To fight against erratic monsoon in the country.
3. To survive crops in drought prone areas, due to uneven and scanty rainfall.
4. To save the water and to improve efficiency and effectiveness of water usage
5. For improving quality of produce with optimum use of fertilizers.
6. To save on maintenance and labour costs.
7. To install easily with flexible and coupled with better adaptability.

3.3 Benefits of Drip Irrigation

1. Drip irrigation saves water (up to 40 – 50 %) due to higher efficiency of water usage.

2. Suitable for all types of soils and doesn't need intense land preparation or levelling for the installation
3. Uniform Irrigation to entire field irrespective of the land topography.
4. Easy installation, doesn't required any expert technician for it, farmers also can install the system
5. Effective use of water soluble fertilizers (Fertigation) and chemicals (Chemigation) through drip systems is possible.
6. It minimises weed growth in the field there by conserving water and costly fertilizers.
7. It saves on labour and maintenance costs (upto 40%)
8. It helps to reduce soil erosion that occurs due to runoff
9. It improves productivity as well as quality of produce (by 40 – 45%)
10. It operates at relatively low pressure. Hence reduces cost of electricity (about 30 – 35%).

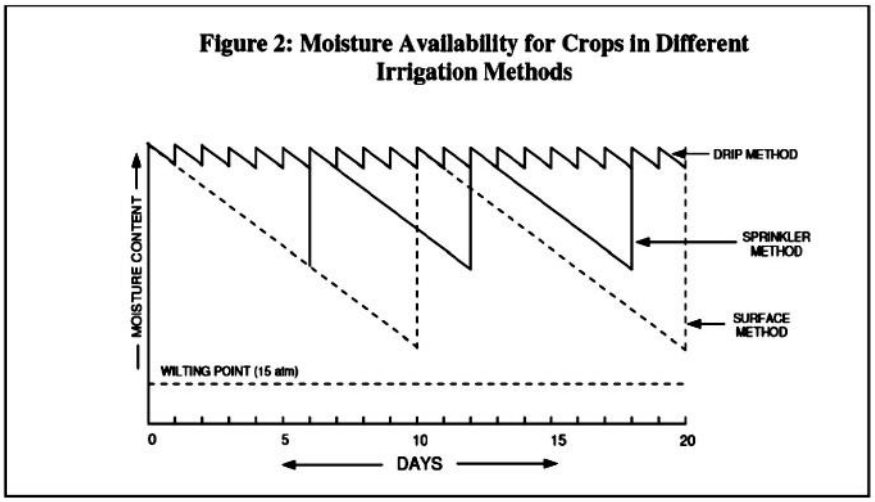


Figure-9: Moisture Availability in different irrigation methods

3.4 Limitations of Drip Irrigation

1. High Initial Cost

The cost per hectare of land of drip irrigation system depends on the type of crop to be irrigated and the plant spacing. Initial investment required for installation of drip system is comparatively higher than any other irrigation method. Hence cost may be a limiting factor for adopting this method, especially for small and marginal farmers.

2. Clogging of emitters/dripper:

Chances of emitter/ dripper clogging are very high as the source of water may contain physical and biological elements in it. Further, dissolved salts and minerals from the water will increase the chances of emitter clogging. Techniques to filtration of 100% water from these contaminants are not yet developed which results in the clogging of emitters, which is the major drawback of Drip Irrigation.

3. Damage chances

Damage to the lateral flush valve and drippers may be caused by certain rodents, birds, other animals and also due to careless field operations that are carried out normally on the field. These may cause problems for smooth and uninterrupted operation of the system.

4. Need of specialized skills:

For designing drip system, persons with suitable technical skills are needed as it is not easy to design the system without thorough working knowledge of the system. Hence, a system without proper technical support during design may fail after the installation.

5. Maintenance:

Drip components require regular maintenance (e.g. Filter back flushing, chemical treatments, flushing of mains and sub-mains). Without proper maintenance, the system may not work efficiently. Also this exercise is time consuming and calls for extra labour to carry out the maintenance tasks.

3.5 Irrigation efficiencies of different methods

Irrigation Efficiencies (In %)	Methods of Irrigation		
	Surface	Sprinkler	Drip
Conveyance efficiency	40-50 (canal) 60-70 (well)	100	100
Application efficiency	60-70	70-80	90
Surface water moisture evaporation	30-40	30-40	20-25
Overall efficiency	30-35	50-60	80-90

Source: Sivanappan, R. K. (1998) Status, scope and future prospects of microirrigation in India. Proc. Workshop on microirrigation and sprinkler irrigation system. CBIP New Delhi, April 28-30, 1998: 1-7

Table-4: Irrigation Efficiencies in Different Methos

3.6 Basic Information required for implementation of drip system

1 Land survey:

Land survey is important to decide the suitability of the system for that location. Depending upon the type of land, either plain or undulating, method of surveying is decided. For plain land, normal measuring tape survey is done as exact details of land are required for design purpose. And for the details of undulating land, contour surveying is done by using either total station or GPS unit, which is helpful in designing of the system. As the slope of the land plays an important role, this should be kept in mind while surveying the land.

2. Crop Details:

Crop details are also necessary for designing a suitable system, such as – Row to Row spacing, Plant to Plant spacing, Peak Water Requirement of crop during the crop season, etc.

3. Soil type:

The texture and structure of soil, infiltration rate, water holding capacity and bulk density of soil must be known before installation of the system. The texture affects the horizontal and vertical water movement in the soil and directly affects the spacing of the drippers. This is required to determine the spacing between emitters and also scheduling the irrigation.

4. Climatic Records:

Information regarding the parameters that influence the system design like, the rate of evapo-transpiration, seasonal details of the area, wind direction and speed is necessary to design an effective and efficient system. These details can be obtained from the local metrological department as they possess historical data for several years.

5. Water Details:

Source of water, quality of water, water contaminants should be obtained for the purpose of designing the system. Also a water test report is required with necessary data that can help while designing a suitable filtration system and water treatment plant, if required.

3.7 Components of Drip System

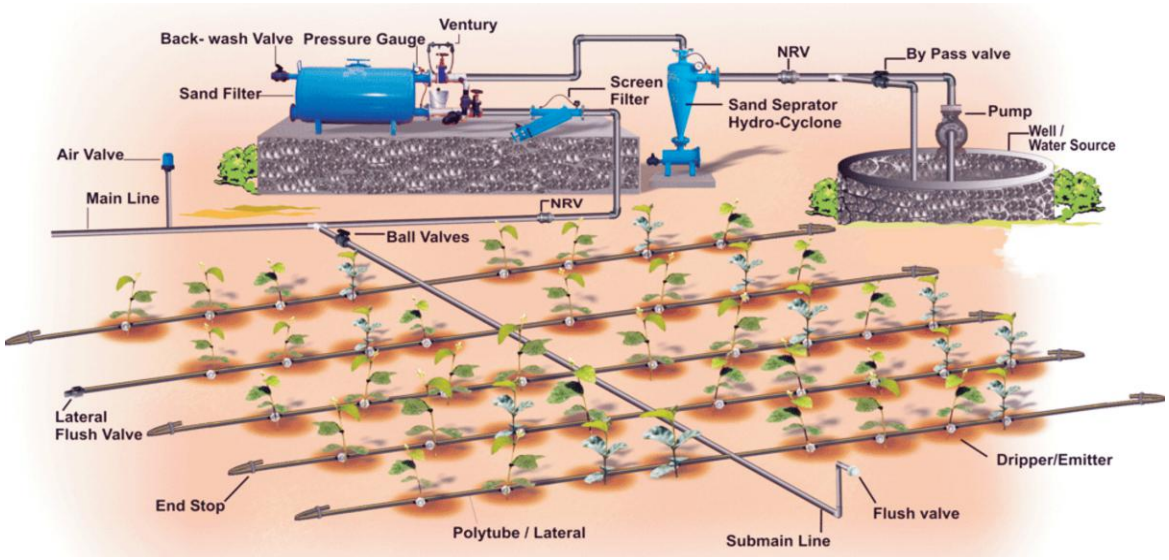


Figure-10: Components of Drip Irrigation

1) Head Control Unit

a. Pump
b. Primary Filtration
c. Secondary Filtration
d. Fertigation Unit

2) Piping and Distribution

a. Mainline
b. Sub-main
c. Lateral
d. Emitters/ Drippers
e. Valves

3) Fittings and Accessories

a. PVC Fittings
b. PE Fittings

4) Automation System

1) Head Control Unit

Head control unit is the main part of the system that controls the entire system for pressure, water quality and also overall system operation. This unit comprises of the following components,

a. Pump

It provides sufficient pressure and flow in the system. For Drip Irrigation, Centrifugal pumps are generally used. Appropriate capacity of pump (HP) is required to maintain the pressure in the system pipeline.

Figure-11: Pump Set

Overhead tanks can be used for small areas or orchard crops with comparatively lesser water requirement and land having considerable slope, where water can flow by gravity

b. Primary Filtration:

Drip system requires clean water for its easy and trouble free operation. Water is filtrated by using suitable filtration units. Depending on the quality of the water used for the drip purpose, the capacity and other specifications of the filtration system are decided. Primary filtration is done to separate bigger size biological and sand particles from the water. There are two primary filters used viz.,

i. Gravel / Media Filter (Sand Filter)

This is used when the source of water is from either reservoirs, open channels, rivers or other sources that contain suspended particles in water. For this purpose, specially treated sand is used as filter in these filtration units by which bigger size particles get trapped in the sand filters resulting in clean water

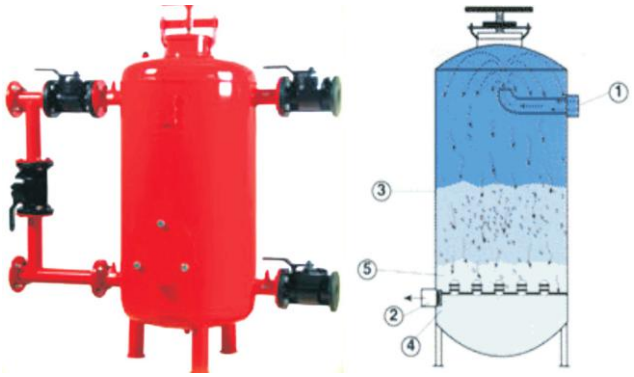


Figure-12: Gravel/Sand Filter

In this process, typically water enters through the top of the filter body and percolates through the filtering bed. Filtration occurs as the water moves through the filtering medium and enters into the mushroom and eventually the filtered water enters into the system.

ii. Hydrocyclone Filter:

It is used when the supply water contains sand in it. The operation of hydro cyclone filter is based on the principle of centrifuge, in which water enters through the inlet of the cyclone. Heavy sand particles are thrown out to the periphery due to centrifugal force while the water is rotates at high speeds. Due to the gravity, the sand particles that hit the edge move down and settle in the sedimentation tank. The filtered water goes out through the outlet. The sand that gets collected at the sedimentation tank is removed through drain valve.

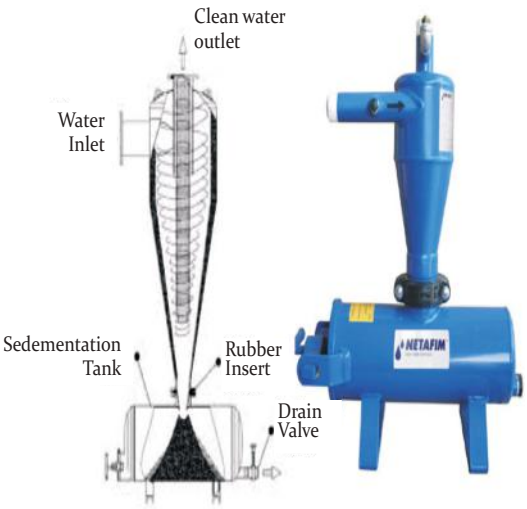


Figure-13: Hydro-cyclone Filter

c. Secondary Filtration:

It is used after primary filtration for further cleaning of water. For worst water quality both primary and secondary filters are used in the system.

Normally for regular water quality, any one of the two filters is used in the system.

i. Screen Filter:

This filter is used when the source of water is from farm pond, river , lake , bore well or a tube well etc. In this system, water comes through inlet and enters into the filter through screen. The dirt particles get accumulated outside the screen. The filtered water thus circulates through out through the outlet.

Figure-14: Screen Filter

ii. Disc Filter:

In this, water enters through the inlet into the housing outside the discs. Then the water enters into the piled grooved discs. The dirt gets accumulated in the grooves of the discs. Filtered water then passes out through the outlet.

Figure-15: Disc Filter

Choosing a filter according to dirt type:

Dirt Type	Filter Type	Filter Principle
Various solids and sand	Screen Filter	Surface Filtration
Clay, silt and some sand	Disc Filter	Depth Filtration
Clay, silt and organic matter	Gravel Filter	Depth Filtration
Sand	Hydro cyclone filter	Centrifugal separation

Table-5: Filter Choice according to DirtTtype

d. Fertigation Unit:

Fertigation is the process of application of water soluble solid or liquid fertilizers through drip irrigation system.

Advantages

1) Efficiency of the Fertilizer use can be improved up to 35-40% than the traditional methods.
2) Fertilizer delivery is precise and is exactly at the root zone of the plant and can be uniformly applied through drip irrigation system.
3) All types of nutrients can be given simultaneously.
4) Lower doses of fertilizer could be applied daily or weekly (i.e. large number of split application) to avoid leaching and fixation in soil.
5) Optimum production in light soil is possible.
6) Liquid fertilizers can reach the plants root zone immediately.
7) Reduction in labour and energy cost.
8) The quality and quantity of crop production can be improved.

Limitations

1) *Toxicity and contamination:* Care must be taken whenever fertilizer solution is introduced into a water supply system.
2) *Fertilizer suitability:* Slowly water-soluble fertilizer such as super phosphate or calcium ammonium phosphate is not suitable. This method is suitable for liquid fertilizers or those that are readily soluble in water.
3) *Corrosion:* The metallic parts of the equipment are highly prone to corrosion. Sensitive parts of the equipment must be made out of corrosion resistant materials like stainless steel etc. Also extra care should be taken in filling up the tanks.
4) *Chemical reaction in the network:* Certain fertilizers e.g. phosphates may precipitation within the pipeline depending on the pH of the water that results in the clogging of the pipe line.

i. Venturi

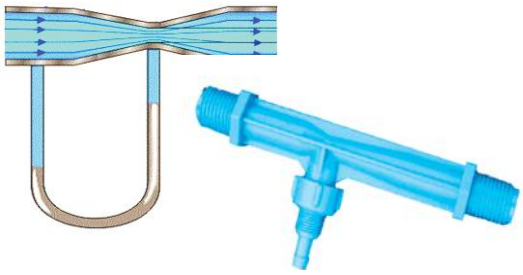


Figure-16: Venturi

Working principle - As per **Bernoulli's theorem** - suction is created due to vacuum formation by an advanced Venturi.

A venturi fixed in the main line, creates pressure difference due to its structure. Hence, vacuum is created as the water flows through a converging passage that gradually widens. Due to the creation of the vacuum, the solution in the tank is sucked upward through the pipe and is delivered to the system along with the water.

ii. Fertilizer Tank:

It is also used for application of fertilizers through the drip irrigation system. These tanks are used for smaller quantity fertilizer application. This tank is connected to mainline after primary filtration and fertilizer solution get mixed with drip water.

Figure-17: Fertilizer Tank

iii. Fertikit

It is an advanced technology used for Fertigation process. Venturi's are kept in series and Fertigation is done. This is normally used with automation systems. The entire process is controlled by an automatic control unit containing electro-mechanical systems.

Figure-18 : Fertikit

2. Piping and Distributi:

For the drip irrigation, PVC or HDPE (High Density Poly-ethylene) pipe networks are used from Head Control to actual field for supply of water to avoid corrosion as in the case of metallic piping. Pipes of different specifications are used according to the system design to supply water.

a. Mainline:

These are either PVC or HDPE pipes supplying water from Head Control to the Sub-mains in the field. Size and pressure class of the pipe is decided upon flow required and field conditions for pressure requirement.

b. Sub-Mainlines:

Sub-mains are connected to the mainline that supply water to the laterals that are installed in the field. The number of sub-mains needed to be connected to each mainline depends on the field situation. Sub-mains are normally of PVC material. Size and pressure class depends on the flow of shift block and pressure of shift.

c. Laterals:

These are LLDPE (Linear Low Density Poly Ethylene) black colour small pipes placed in the field through which water is supplied to the root zone of the plants by emitters. These laterals are kept black intentionally as they are directly exposed to the sun, where there are chances of algae formation resulting in clogging of emitters. Because of the black colour of the pipes, chance of algae formation is reduced and thereby the system works trouble free.

Figure-19 : Laterals

d. Emitters / Drippers:

Emitters or the drippers are the outlets of the system near the root zone of the plants. They work as pressure reducers down to atmospheric pressure at the point of delivery of water i.e. at the root zone. Due to low pressure these emitters trickle water drop by drop. The actual delivery of water and fertilizers to the plants is done by these emitters.

There are different types of emitters as,

i. Pressure compensating Online Drippers:
Online drippers are placed on the laterals; they look like buttons on the laterals. A pressure compensating drippers supplies water uniformly in long rows and on uneven slopes even with variations in operating pressure. These are most suitable on undulating lands and difficult topographic conditions.

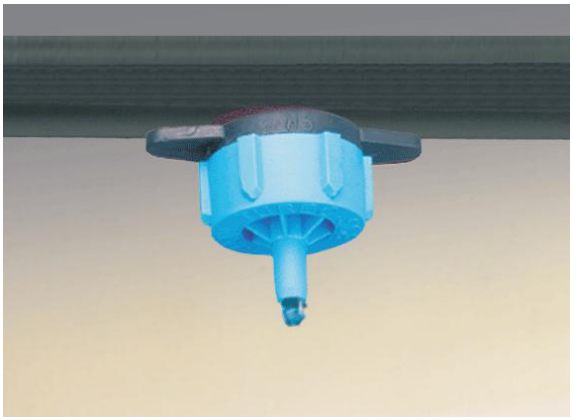


Figure-20 : Online dripper

ii. Non-Pressure compensating Online Drippers:
In Non-Pressure compensated online dipper system, pressure and flow varies with the change in working pressure at any particular point in the lateral. This causes an uneven water distribution in the field. Hence these drippers are suitable for land without or minimum undulations.

iii. Pressure Compensated Inline Drippers:
Drippers are placed inside the drip line/ lateral and there is only small outlet on drip line. These are most effective to use because there are no any chances of misplacing any dripper. Dripper spacing is already fixed at factory installation itself. Silicon chip is kept in the dripper for self-cleaning and pressure compensation. Because pressure compensating features these drippers deliver equal water irrespective of pressure and land topography

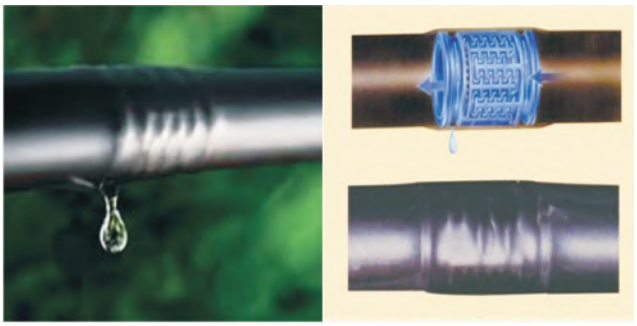


Figure-21 : Inline dripper

iv. Non-Pressure compensating Inline Drippers:
Inline drippers placed inside the lateral without any pressure compensating technology.

e. Valves:
Valves play an important role in satisfactory working of the system. In the entire drip system there are a number of valves required for controlling the operations at each stage.

❖ **Foot Valve**
This is placed at the inlet of the suction pipe of the pump. This works as a filter and also as a non-return valve at pump inlet to retain water for priming.

Figure-22 : Foot Valve

❖ **Non-Return Valve**
This valve is placed on the delivery side of the pump, before the inlet to the filtration unit. This will restrict the reverse flow of water ensuring only unidirectional flow so that there is no reverse flow of water when the pump is off

Figure-23 : Non Return Valve

❖ Pressure release Valve

This valve is fitted on the delivery side of the pump before any other valve. This will work as a safety valve. In case of a very high pressure developed by the pump due to inadvertent closure of the valves or clogging in the pipe line resulting in the blockage of the pipe, pump develops a high water pressure which will be bypassed to the tank i.e. the inlet side of the pump thereby avoiding the bursting of the pipes or damaging the pump itself. This will help to maintain constant system pressure and reduce chances of bursting of pipes.

❖ Air Valve

These valves are kept at the head control and at the highest elevation points on mainline and sub-mains. This will help to remove air blocks by venting the air into the atmosphere. Air blocks are created in the system due to discontinuous flow or due to cavitation and this may create a high pressure in the pipe line which may bust the system. Hence air vents are provided at elevated points so that water will not drain out of the system.

Figure-24 : Air Valve

❖ Pressure reducing Valve / Ball Valve

These valves are placed in the field for controlling irrigation of any particular block. Depending on the shifts and flow, operation of these valves is decided. These are either ball valves or automatic valves. They help to regulate the flow of the water or close the water supply when the water is not needed.

Figure-25 : Ball Valve

❖ Flush Valve

These valves are placed at the end of sub-main for cleaning purpose. These will help to remove accumulated dirt in the pipe and cleaning of mains and sub-mains

3. Fittings and Accessories:

Pipe Fittings are required for inter connecting of pipes and valves. Fittings are necessary to connect various parts of the water pipe line to achieve required water flow at targeted points in the system without unnecessary interruption. They are made of different types of materials viz,

a. PVC Fittings

These are used for connecting PVC pipes and valve in the system.

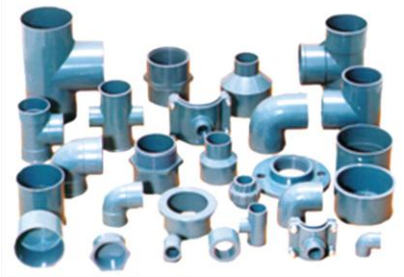


Figure-26 : PVC fittings

b. PE Fittings

These are used in lateral and dripper connections in the system.

Figure-27 : PE fittings

4. Automation System

Drip Automation is a modern technique used in drip system. Drip automation has proved its performance in improving product quality and saving in time and money. Automation system is easy to handle.

Benefits of Drip Automation:

❖ **Saves Time:** Automation system will do all the watering operations by it auto feed dat. Whole system will run automatically which saves a time.

❖ **Saves Water:** An automatic system uses less water than watering by hand.\

❖ **Saves Money:** System will start at exact time and it will stop as per the data feed into it. It will save electricity, labour charges. And exact amount at required time irrigation will improve plants health.

Automation System Components:

i. Automation Valves:

Automation valves works on hydraulics principle and work automatically with the help of solenoid attached to it.

Figure-28 : Valve

ii. Controllers:

Automation controllers are the small computers placed at the head control of the system and due to its instructions whole system is operating easily. Those controllers are electronic cards in it on which we can set the operation program of the system.

Figure-29 : Controller

iii. Fertikit:

Fertikits are the automated Fertigation units on the venturies are placed in series. Controllers are attached to those fertikits for its automatic operations.

3.8 Testing of Drip System

After installation of the drip system, inspection and checking of the system is necessary before starting the system. Testing is important for trouble free operation, which could be done in the following steps,

Step 1	• Backwash the filter till clean water comes out through its flush valve.
Step 2	• See that all the gate valves and flush valves are opened before testing.
Step 3	• Close the flush valve after the sub main is completely flushed
Step 4	• When the laterals are completely flushed, close with the help of end caps
Step 5	• Chek all the pipes and fittings for leakage
Step 6	• Check the pressure on the gauges installed at inlet and outlet of the filter.
Step 7	• Obtain the desired pressure at the filter, if excess pressure is observed open the bypass valve slowly till the desired pressure is obtained
Step 8	• Check the working of air release valve at the submains.
Step 9	• At this pressure, measure the discharge at a minimum of three places(first, middle and last dripper of lateral) by volumetric method.

Table-6 : Steps for testing drip system

3.9 Common problems in drip system operation and their solutions

Sl. No.	Problems	Causes	Remedies
1.	Water not flowing up to lateral end	Holes in laterals. Cuts in laterals. Bents in laterals. Leakage in fittings	Close the holes and cuts. Remove the bends. Remove the leakage
2.	Accumulation of salt on removing the end plug	More salinity in water. Un cleaned lateral	Remove the end cap. Clean the laterals fortnightly.
3.	Under flow or over flow from laterals	Clogging of drippers. Unclosed end plug	Clean the sand and screen filters. Close the end cap
4.	Oily gum material comes out on opening the lateral end	More algae or ferrous material in water	Clean the laterals with water or give chemical treatment
5.	More pressure drop in filters	Accumulation of dirt in filters	Clean filters every week. Back wash the filters for every 5 minutes daily.
6.	Pressure gauge not working	Rain water entry inside. Corrosion in gauge pointer damage	Provide plastic cover and fix pointer properly.
7.	Drop in pressure	Leakage in main opened outlet. Low water level in well.	Arrest the leakage and close outlet. Lower the pump with reference to well water level
8.	More pressure at the entry of sand filter	No bypass in the pipeline/ bypass not opened. Displacement of filter element. Less quantity of sand in filters	Provide bypass before filter and regulate pressure. Place filter element properly. Fill required quantity of sand
9.	Accumulation of sand and debris in screen filter	Displacement of filter element. Less quantity of sand in filters	Place filter element properly. Fill required quantity of sand
10.	Venturi not working during chemical treatment and fertigation	Excess pressure on filters Improper fitting of venturi assembly	Bypass extra water to reduce pressure Repair the venturi assembly.
11.	Leakage of water from air release valve.	Damaged air release valve ring.	Replace the damaged ring.

Table-7 : Common problems and their solutions

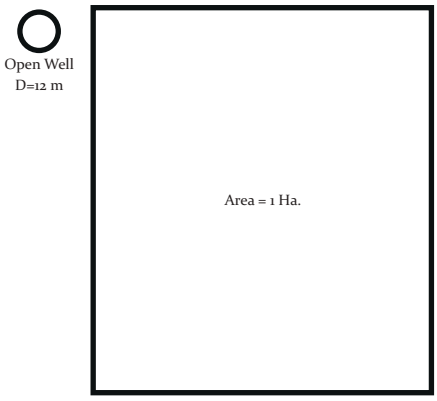
3.10 Sample Design of Drip System *(Source - Standard design by Netafim Irrigation)*

FARM SURVEY QUESTIONNAIRE (FSQ)

- Area-1.00 Ha
- Crop-Cotton
- Row Direction-N-S
- Product-NPC 16 mm 0.4 mx 2.0 lph
- Row Spacing-1.22 m
- Lateral Spacing-1.22 m
- WS- Open Well
- WS Depth-12m
- Electricity Available-8hrs.

PLOT LAYOUT

- Draw outline from :
- Manual survey
- GPS Survey
- Google Earth



AREA CALCULATION

- Manual Calculation.
- Calculation in AutoCAD

Design Calculations-

Basic Data:
- Area- 1.00 Ha
- Lat/Row Spacing-1.22 m
- Water Requirement- 5 mm/day
- Product- NPC 16 mmx 0.4m x 2.0 Lph

1. **Application Rate -** 2.0 Lph/ 0.4m x 1.22m = **4.10 (mm/hr)**

2. **Duration of one operation -** 5mm/day / 4.10(mm/hr)
   (Hrs/day) - 1.22

3. **Daily water Requirement in Peak Period**
   (m3/day) - 1.00 x 5mm/day x 10
   - **50**

(Daily WR (m3/day)= Area (Ha) 10 x W.R (mm/day)

IRRIGATION DATA	
CROP	Cotton
Net Area, Ha	1.00
Emitter type	Aries 16008
Irrigation System	Drip
Distance between Rows, m	1.22
Distance between Plants, m	0.30
Emitter spacing m	0.40
No. of laterals per Row	1
Lateral spacing m	1.22
Emitter Discharge l/h	2.0
Emitter Operating Press., m	10
Application rate mm/h	4.10
Evaporation Equivalent mm/day	5.0
Evaporation Equivalent Lit/P/day	1.8
No. of Operations per day	2
Duration of one operation hr	1.22
Total operational time hr per Day	2.44
Available time for irrigation	8.00
Max.Disch. Variation %	10.0
Water Source	Open Well
Permissible length for 7.5% Flow Var., m	76
Permissible length for 10% Flow Var., m	84
Total Area, Ha	1.00
Total Q - (Cum / hr)	41.0
Flow per Shift (Cum / hr)	20.5
Area per Shift (Ha)	0.50
Daily water Requirement in Peak Period, m3/day	50
Ave. Shift flow for available time, m3/h	6.25

Area-1.00 Ha

Row Spacing- 1.22 m
Emitting Pipe Spacing -1.22m

Application rate
=4.10 mm/hr

Possible Shift-2 .
Available Time -8.0Hrs

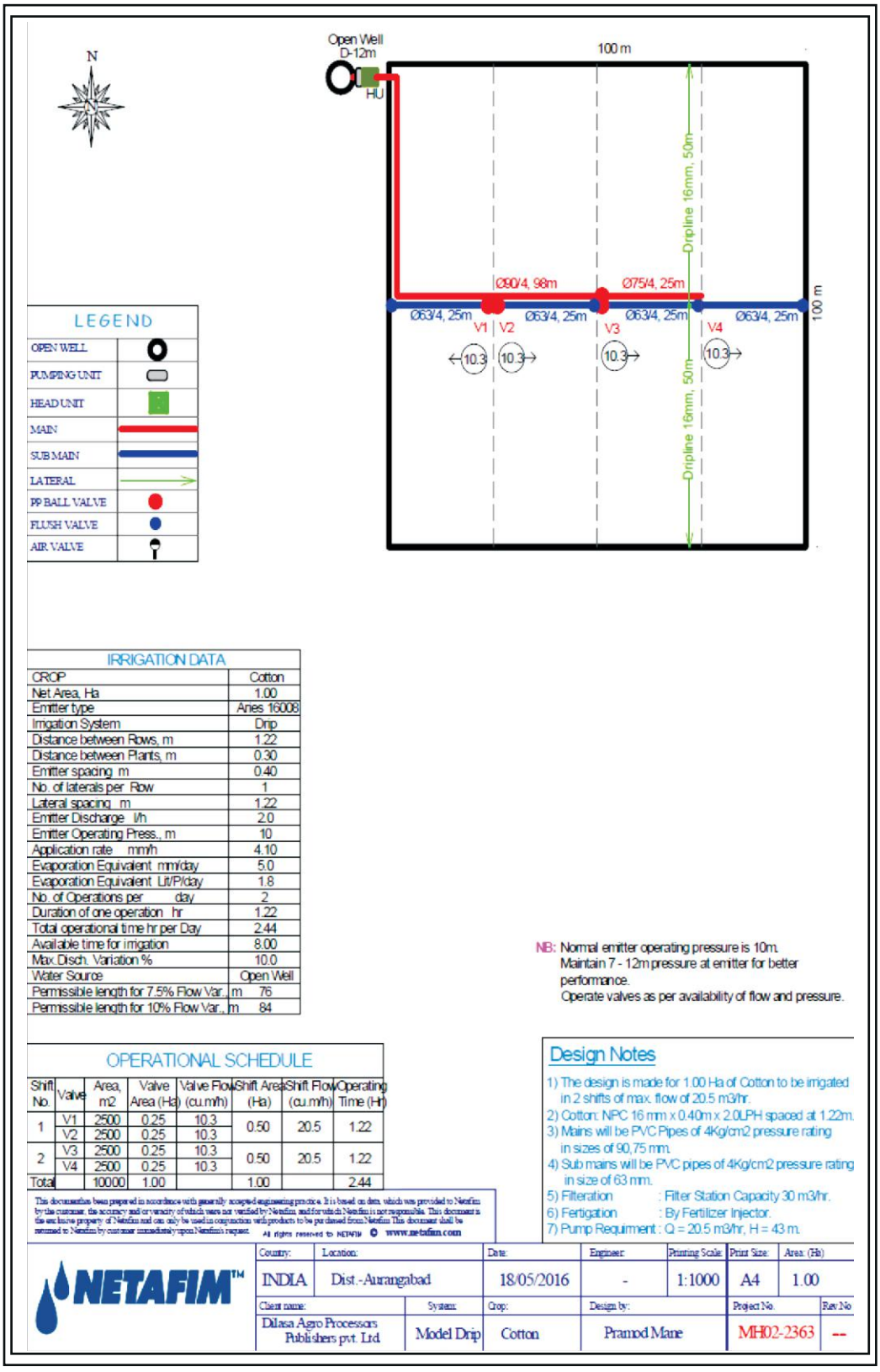
Permissible Length

Shift Calculations

PUMP DUTY CALCULATIONS

Pump Duty Calculations for Drip		
	Shift No.	1
	Valve	V1
1	Emitter Min. Operating Pressure (m)	10
2	Lateral Dripline Headloss (m)	2
3	Submain Headloss (m)	0.5
4	Elevation (m)	
5	Pressure Required at Submain Inlet (m)	12.5
6	Valve Headloss (m)	2
7	Field Fitting Headloss (m)	1
8	Mainline Headloss (m)	2
9	Elevation (m)	0
10	Pressure at the OUTLET of HU (m)	17.5
11	Secondary Filtration Headloss (m)	3
12	Fertigation Headloss (m)	4
13	Primary Filtration Headloss (m)	3
14	Pressure at the INLET of HU (m)	27.5
15	Water Source Depth (m)	12
16	Vertical Pipe Headloss (m)	2
17	Safty Factor (m)	1
18	Total Head Required (m)	42.5
19	Valve Flowrate, m3/h	
20	Shift Flow Rate CM/H	20.5
	Pump Requirement For Drip:	
	Shift No	1
	Q cu.m/h	20.5
	Q lps	5.7
	H mt	43
	HP (by Formula) with 65% efficiency	5.0

B : Please check the Water Source depth & plot elevations and adjust accordingly.



IRRIGATION DATA	
CROP	Cotton
Net Area, Ha	1.00
Emitter type	Aries 16008
Irrigation System	Drip
Distance between Rows, m	1.22
Distance between Plants, m	0.30
Emitter spacing m	0.40
No. of laterals per Row	1
Lateral spacing m	1.22
Emitter Discharge l/h	2.0
Emitter Operating Press., m	10
Application rate mm/h	4.10
Evaporation Equivalent mm/day	5.0
Evaporation Equivalent Lit/P/day	1.8
No. of Operations per day	2
Duration of one operation hr	1.22
Total operational time hr per Day	2.44
Available time for irrigation	8.00
Max.Disch. Variation %	10.0
Water Source	Open Well
Permissible length for 7.5% Flow Var., m	76
Permissible length for 10% Flow Var., m	84

NB: Normal emitter operating pressure is 10m.
Maintain 7 - 12m pressure at emitter for better performance.
Operate valves as per availability of flow and pressure.

OPERATIONAL SCHEDULE

Shift No.	Valve	Area, m2	Valve Area (Ha)	Valve Flow (cu.m/h)	Shift Area (Ha)	Shift Flow (cu.m/h)	Operating Time (Hr)
1	V1	2500	0.25	10.3	0.50	20.5	1.22
	V2	2500	0.25	10.3			
2	V3	2500	0.25	10.3	0.50	20.5	1.22
	V4	2500	0.25	10.3			
Total		10000	1.00		1.00		2.44

Design Notes

1) The design is made for 1.00 Ha of Cotton to be irrigated in 2 shifts of max. flow of 20.5 m3/hr.
2) Cotton: NPC 16 mm x 0.40m x 2.0LPH spaced at 1.22m.
3) Mains will be PVC Pipes of 4Kg/cm2 pressure rating in sizes of 90,75 mm.
4) Sub mains will be PVC pipes of 4Kg/cm2 pressure rating in size of 63 mm.
5) Filteration : Filter Station Capacity 30 m3/hr.
6) Fertigation : By Fertilizer Injector.
7) Pump Requirment : Q = 20.5 m3/hr, H = 43 m.

NETAFIM™

Country:	Location:	Date:	Engineer:	Printing Scale:	Print Size:	Area: (Ha)
INDIA	Dist.-Aurangabad	18/05/2016	-	1:1000	A4	1.00

Client name:	System:	Crop:	Design by:	Project No.	Rev No
Dilasa Agro Processors Publishers pvt. Ltd.	Model Drip	Cotton	Pramod Mane	MH02-2363	--

3.11 Major companies working in drip irrigation in India.

NETAFIM™
GROW MORE WITH LESS

Netafim India has the lineage of global leader in smart drip and micro-irrigation solutions for a sustainable agriculture. Since introducing the world's first drip irrigation solutions in 1965, it has led the way by developing products that help their customers optimize results.

Netafim India is a wholly owned subsidiary of Netafim, the global leader in micro-irrigation solutions for sustainable productivity. Established in 1997, Netafim India offers a wide range of micro-irrigation, greenhouse and field automation solutions. With three manufacturing plants, over 1000 employees, and more than 1500 dealers, Netafim India's operations span throughout the subcontinent. At present Netafim Irrigation Systems are running successfully on more than 15 lakh acres of land across diverse agro-climate in the country, suitable for a wide range of crops., Netafim India offers extensive agronomic, design, after-sales support, and agri-extension services to ensure sustainable prosperity to over 5 lakh farming families and this journey is still on. Netafim India is an active partner in several government projects like GGRC, APMIP and TANHODA.

Finolex
PLASSON
Industries Pvt. Ltd.

FINOLEX PLASSON INDUSTRIES PVT. LTD. (FPIPL) is a Joint Venture between Finolex Group – and Plasson Ltd. – Israel. Established in 1992 and based near Pune, FPIPL, an ISO 9001:2008 company, is today a leader in the field of Micro Irrigation in India.

FPIPL offers a wide range of products and solutions in the field of precise Irrigation and Intensive agriculture cultivation.

Their solutions include complete tailored Drip and Sprinkler Irrigation Systems and Turn- Key projects for all Agriculture sectors such as Row Crops, Horticulture, Green Houses, Plantations, Orchards, Nurseries and more.

Along with its advanced systems, FPIPL also provides comprehensive Agronomic Guidance and Knowledge Transfer Programs on Irrigation, Fertigation and all parts of cultivation. Our goal is to maximize the user's benefit from FPIPL's systems. FPIPL has successfully executed Irrigation system over 7, 50,000 acres area on various crops.

Samriddhi
epc A Mahindra Group Company

EPC is a Mahindra group company, popularly known as EPC Irrigation. And is a pioneer of micro-irrigation in India.

Mahindra and Mahindra Ltd. (M&M) has acquired majority stake in EPC Industries' Ltd through preferential issuance of equity shares. This transaction has enabled M&M to enter Micro-Irrigation Sector.

Started in 1986 with the initial French Technology support, EPC had developed the capability to design and develop the irrigation products of international standard, satisfying every need of Indian Farmers.

EPC provides complete solution for agriculture with a focus on Micro-Irrigation, Pumps & inter-related requirements of fertigation & agronomic support. EPC is also planning to enter another allied business activities in future.

The company is registered in all major states under subsidy program in India.

Emtelle India limited was established as Parixit India limited in 1989 to manufacture and distribute drip and sprinkler sets as a step up to help farmers with better irrigation practices. The company slowly and steadily grew as a small enterprise to large manufacturing unit. In the year 2010 Parixit industries entered into strategic tie up with Emtelle group as a part of ambitious expansion and diversification plan. In 2015 Parixit Industries became Emtelle India Limited.

Emtelle India limited is a leading manufacturer of MI Systems, water management systems and execution of water related projects. The company has state of art manufacturing infrastructure with advance technology.

The company has 14 regional and branch offices, over 400 dealers and strength of over 300 employees.

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4 Sprinkler Irrigation

Sprinkler irrigation is a method of supplying irrigation water similar to natural rainfall i.e. water is not supplied continuously but in drops by sprinkling. In sprinkler system, water is distributed through a system of pipes usually by pumping the water at a reasonable pressure. It is then sprayed into the air through sprinklers so that it breaks up into small water drops which spread and fall to the ground by gravity.

Sprinklers provide irrigation to vegetation or for recreation, as a cooling system, or for the control of airborne dust. The sprinkler system irrigates the field and thus it is widely used in sandy areas as it checks the wastage of water through seepage and evaporation. The pumping system and the sprinkler system including the piping should be designed in such a way to ensure a uniform delivery of water.

Figure-30 : Sprinkler System

4.1 Advantages of Sprinkler

1. Land Levelling is not required for installation of sprinkler system. Cost of land levelling and land preparation is reduced.
2. Higher water use efficiency up to 80%
3. Sprinklers are also used for cooling of temperature at plant environment.
4. Uniform water distribution all over the field results in uniform plant growth.
5. We can easily use fertilizers and pesticides through irrigation system with its higher use efficiency.
6. No any special trained personnel are required to operate the system.
7. Increase in production and quality of produce due to exact application of water and fertilizers.
8. Frequent and light irrigation possible giving better response from the crops.
9. Soil moisture is maintained at optimum level by sprinkler irrigation

4.2 Dis-Advantages of Sprinkler

1. Higher initial cost is required for installation of Sprinkler system
2. High and continuous energy requirement for operation
3. Under high wind condition and high temperature distribution and application efficiency is poor
4. Loss of water due to evaporation from the area during irrigation

4.3 Types of Sprinkler System

1. Industrial Sprinklers:

Rain-guns are impact sprinklers operates at higher pressure and having higher discharge with nozzles diameter range from 0.5 to 1.9 inches. These types of sprinklers are used in mining industries for the purpose of dust suppression.

Impact sprinklers are used in industry for cooling purpose also.

2. Residential Sprinklers:

Home lawn sprinklers vary widely in their size, cost, and complexity. They include impact sprinklers, oscillating sprinklers, drip sprinklers and underground pop up sprinkler systems. These are often attached to an outdoor water faucet and are placed only temporarily. Other systems may be professionally installed permanently in the ground and are attached permanently to a home's plumbing system. Permanently installed systems may often operate on timers or other automated processes. These often are programmed to operate at certain times of day or on some other schedule.

3. Underground Sprinklers:

Underground sprinklers i.e. pop ups are used majorly for landscaping. These are installed in gardens, industrial lawns, in golf course and in race course etc. The whole system of these pop ups is installed underground.

4. Agricultural Sprinklers:

In agriculture, sprinklers are mainly used for irrigation purpose. Water is distributed evenly all over the field as a natural rain. Sprinkler irrigation is high pressure system than drip irrigation because for operation of sprinklers higher pressure is required.

4.4 Layout of Sprinkler System

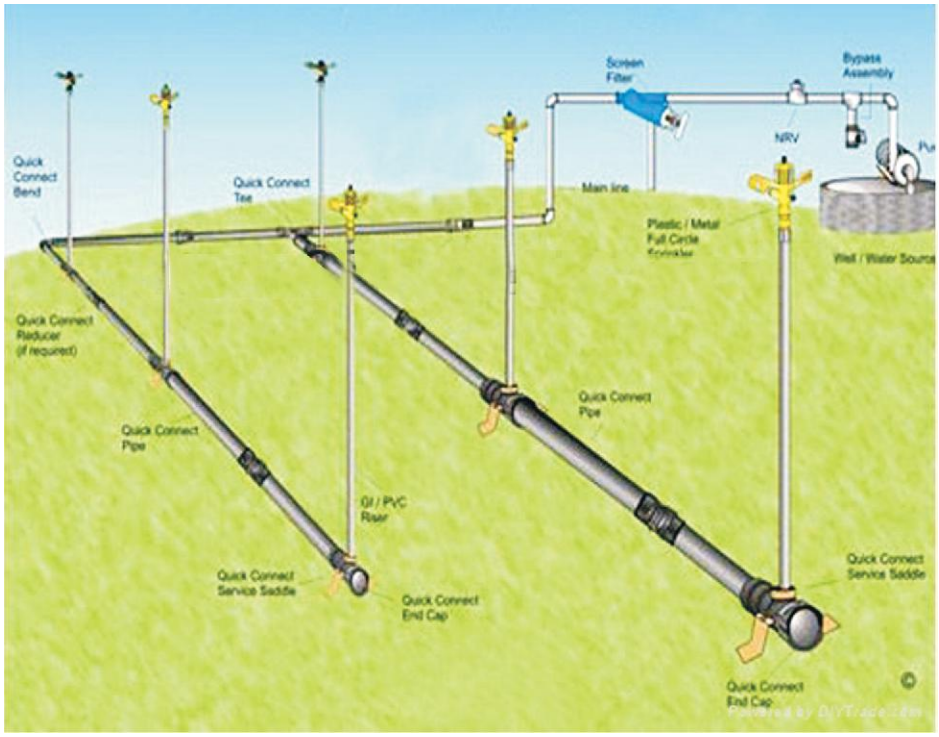


Figure-31 : Typical Layout of Sprinkler System

A typical sprinkler irrigation system consists of the following components:

1. Pump unit

The pump unit is usually a centrifugal pump which takes water from the source and provides adequate pressure for delivery into the pipe system.

Pumping system is similar to drip system. Size/ Capacity (HP) of pump are depending on flow and pressure required for operation of sprinklers.

2. Mainline and sometimes sub-mainlines

The mainline and sub-mainlines are pipes which deliver water from the pump to the laterals. In some cases these pipelines are permanent and are laid on the soil surface or buried below ground. In other cases they are temporary, and can be moved from field to field.

PVC, HDPE or Poly-net pipes are used as a mainline or sub-mains in sprinkler irrigation system.

Most of the times sprinklers are directly attached on the mainline through laterals, there is no sub-mainline exists. For the bigger size plots main and sub-mains both are designed.

3. Laterals

These are the bigger size PE pipes with about 25mm, 32mm & 40mm dia. etc. depends of size of riser and sprinkler.

When using micro-sprinklers small size pipes also can be used as a lateral.

4. Sprinklers

Sprinklers are the outlets of the system supplying water to the field.

Sprinklers are connected to system through sprinkler assembly which consist of swing joint and rising rod. This assembly is placed on laterals either directly to sub-mains or mainlines.

Micro-Sprinklers are mainly used for vegetable cultivation and for orchards. These sprinklers have small flow rate and operates at lower pressure

Figure-32 : Micro Sprinkler

Impact Sprinklers are used for crops like sugarcane, jowar, wheat, rice etc. These sprinklers are placed according to height of the crop. Operating pressure of these sprinklers is higher than which is required of micro-sprinklers.

Figure-33 : Impact Sprinkler

Rain-guns are used for crops like sugarcane, pasture cultivation, for playing ground lawns etc. Rain-guns are portable and can be moved from one place to other depends on requirement.

Figure-34 : Rain Gun

Pop-up sprinklers are used for landscaping purpose.

Figure-35 : Pop-ups

4.5 Design of Sprinkler System

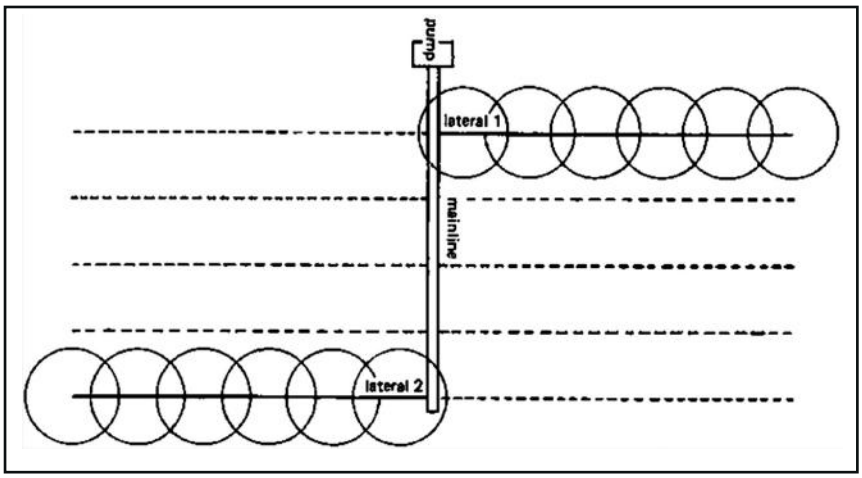
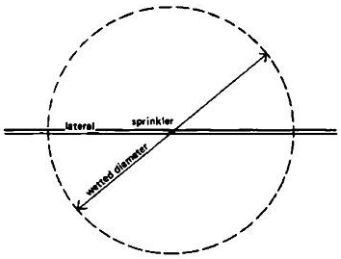


Figure-36 : Schematic Layout of Sprinkler System

Design of sprinkler system is mainly depends on

a. Wetting patterns

The wetting pattern is the area covered by sprinkler while operation, this is mainly depend on flow, pressure and nozzle size of sprinkler. Normally the area wetted is circular. The heaviest wetting is close to the sprinkler. For good uniformity the sprinkler wetting pattern should be overlapped. This determines the spacing between sprinklers. Sprinkler placement is depend on its wetting pattern and overlapping percentage.



b. Application rate

This is the average rate at which water is sprayed onto the crops and is measured in mm/hour. The application rate depends on the size of sprinkler nozzles, the operating pressure and the distance between sprinklers. When selecting a sprinkler system it is important to make sure that the average application rate is less than the basic infiltration rate of the soil. In this way all the water applied will be readily absorbed by the soil and there should be no runoff.

a. Sprinkler drop sizes

As water sprays from a sprinkler it breaks up into small drops between 0.5 and 4.0 mm in size. The small drops fall close to the sprinkler whereas the larger ones fall close to the edge of the wetted circle. Large drops can damage delicate crops and soils and so in such conditions it is best to use the smaller sprinklers.

Drop size is also controlled by pressure and nozzle size. When the pressure is low, drops tend to be much larger as the water jet does not break up easily. So to avoid crop and soil damage use small diameter nozzles operating at or above the normal recommended operating pressure.

5 Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)

(Source: PMKSY Policy Document)

Government is committed to giving high priority to water security. It will complete the long pendin g irrigation projects on priority and launch the 'Pradhan Mantri Krishi Sinchayee Yojana' with the motto of 'Har Khet Ko Paani'. There is a need for seriously considering all options including linking of rivers, where feasible; for ensuring optimal use of our water resources to prevent the recurrence of floods and drought. By harnessing rain water through 'Jal Sanchay' and 'Jal Sinchan', we will nurture water conservation and ground water recharge. Micro irrigation will be popularised to ensure 'Per drop - More crop'

Out of about 141 mHa of net area sown in the country, about 65 million hectare (or 45%) is presently covered under irrigation. Substantial dependency on rainfall makes cultivation in un-irrigated areas a high risk, less productive profession. Empirical evidences suggest that assured or protective irrigation encourages farmers to invest more in farming technology and inputs leading to productivity enhancement and increased farm income.

The overreaching vision of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) will be to ensure access to some means of protective irrigation to all agricultural farms in the country, to produce 'per drop more crop', thus bringing much desired rural prosperity.

5.1 Objectives

The broad objectives of PMKSY will be:-

a. Achieve convergence of investments in irrigation at the field level (preparation of district level and, if required, sub district level water use plans).

b. Enhance the physical access of water on the farm and expand cultivable area under assured irrigation (Har Khet ko pani).

c. Integration of water source, distribution and its efficient use, to make best use of water through appropriate technologies and practices.

d. Improve on-farm water use efficiency to reduce wastage and increase availability both in duration and extent.

e. Enhance the adoption of precision-irrigation and other water saving technologies (More crop per drop).

f. Enhance recharge of aquifers and introduce sustainable water conservation practices.

g. Ensure the integrated development of rain-fed areas using the watershed approach towards soil and water conservation, regeneration of ground water, arresting runoff, providing livelihood options and other NRM activities.

h. Promote extension activities relating to water harvesting, water management and crop alignment for farmers and grass root level field functionaries.

i. Explore the feasibility of reusing treated municipal waste water for peri-urban agriculture.

j. Attract greater private investments in irrigation.

5.2 Program Components

5.2.1 Accelerated Irrigation Benefit Program (AIBP)

To focus on faster completion of on-going Major and Medium Irrigation including National Projects.

5.2.2 PMKSY (Har Khet ko Pani)

a. Creation of new water sources through Minor Irrigation (both surface and ground water)

b. Repair, restoration and renovation of water bodies; strengthening carrying capacity of traditional water sources, construction rain water harvesting structures (Jal Sanchay)

c. Command area development, strengthening and creation of distribution network from source to the farm

d. Ground water development in the areas where it is abundant, so that sink is created to store runoff/ flood water during peak rainy season

e. Improvement in water management and distribution system for water bodies to take advantage of the available source which is not tapped to its fullest capacity (deriving benefits from low hanging fruits). At least 10% of the command area to be covered under micro / precision irrigation.

f. Creating and rejuvenating traditional water storage systems like Jal Mandir (Gujarat); Khatri, Kuhl (H.P.); Zabo (Nagaland); Eri, Ooranis (T.N.); Dongs (Assam); Katas, Bandhas (Odisha and M.P.) etc. at feasible locations.

5.2.3 PMKSY (Per Drop More Crop)

a. Programme management, preparation of State/ District Irrigation Plan, approval of annual action plan, Monitoring etc.

b. Topping up of input cost particularly under civil construction beyond permissible limit (40%), under MGNREGS for activities like lining inlet, outlet, silt traps distribution system etc.

c. Construction of micro irrigation structures to supplement source creation activities including tube wells and dug wells (in areas where ground water is available and not under semi critical /critical /over exploited category of development) which are not supported under AIBP, PMKSY (Har Khet ko Pani), PMKSY (Watershed) and MGNREGS as per block / district irrigation plan.

d. Secondary storage structures at tail end of canal system to store water when available in abundance (rainy season) or from perennial sources like streams for use during dry periods through effective on-farm water management

e. Water lifting devices like diesel/ electric/ solar pump sets including water carriage pipes, underground piping system.

f. Extension activities for promotion of scientific moisture conservation and agronomic measures including cropping alignment to maximise use of available water including rainfall and minimise irrigation requirement (Jal sarankchan)

g. Capacity building, training and awareness campaign including low cost publications, use of Pico projectors and low cost films for encouraging potential use water source through technological, agronomic and management practices including community irrigation.

h. The extension workers will be empowered to disseminate relevant technologies under PMKSY only after requisite training is provided to them especially in the area of promotion of scientific moisture conservation and agronomic measures, improved/ innovative distribution system like pipe and box outlet system, etc. Appropriate Domain Experts will act as Master Trainers.

i. Information Communication Technology (ICT) interventions through NeGP-A to be made use in the field of water use efficiency, precision irrigation technologies, on farm water management, crop alignment etc. and also to do intensive monitoring of the Scheme.

5.2.4 PMKSY (Watershed Development)

a. Effective management of runoff water and improved soil & moisture conservation activities such as ridge area treatment, drainage line treatment, rain water harvesting, in-situ moisture conservation and other allied activities on watershed basis.

b. Converging with MGNREGS for creation of water source to full potential in identified backward rain-fed blocks including renovation of traditional water bodies

Out of these all scheme PMKSY (per drop more crop) scheme is for Micro-Irrigation

5.3 PMKSY in Maharashtra

Micro-Irrigation programme under PMKSY (per drop more crop).

Objectives:

1. Increasing land under Micro-Irrigation by using modern techniques like Drip, Sprinkler
2. Increasing the water use efficiency
3. Improving productivity ultimately improvement in the Farmers situation

4. Employment generation for skilled and semi-skilled labour.
5. Implementation of scheme by co-operation of central and state govt.

Scheme will be implemented in 22 districts of Maharashtra except 11 of Vidarbha.

It is applicable for cash crops like Cotton, Sugarcane, Horticulture crops, pulses, cereals, vegetables, spices, floriculture and all crops.

5.4 Fund Distribution

1. Out of total allocated fund under PMKSY, 50% fund must be disbursed for small and marginal land holding farmers. There should be 30% fund allocation to women famers in the scheme (15% from SC/ST and 15% other). For SC/ST respectively 16% and 8% fund should be allocated out of total fund
2. 25% of fund must be used for crop sector out of total allocated fund.

5.5 Fund Allocation by Govt. under PMKSY

Total allotment of funds under different programmes in PMKSY scheme.

INTER MINISTERIAL FUND ALLOCATION (B.E.) 2015-2016

Sl.	Ministry/Department	Component	Allocation
1	MoWR	AIBP	1000
		PMKSY(Har khet ko pani)	1000
Sub Total MoWR :			2000
2	DoLR	PMKSY(Watershed)	1500
Sub Total DoLR :			1500
3	DAC&FW	PMKSY(Per drop more crop)	
		➢ Micro Irrigation	1000
		➢ Drought proofing & GW recharge and water application	410
		➢ Topping up with MGNREGA	175
		➢ Extension Activities	185
		➢ DIP/SIP Preparation	30
Sub Total DACFW :			1800
Grand Total :			5300

Source: PMKSY website (http://pmksy.gov.in/Documents.aspx)

Table-8 : Inter Ministerial Fund Allocation for PMKSY

5.6 Fund Allotment for Maharashtra under PMKSY

FUNDS RELEASED UNDER PMKSY AS ON 13.01.2016 for 2015-2016												
Sl. No.	Name of the state	Amount released (Rs. Lakh)										
		MoWR, RD & GR				Department of Land Resources	Department of Agriculture, Cooperation and Farmers Welfare					
		CADWM	AIBP-MMI	MINOR IRRIGATION	RRR	IWMP	Micro Irrigation	Other interventions-Supplementing material cost of MGNREGS	Other interventions-water conservation and water harvesting work (watershed approach)	Extension Activities (ATMA Scheme)	Preparation of DIPs	Total
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
1	Andhra Pradesh	0	10000	0	0	8673	12714	1460	1014	142.26	60	34063.26
2	Arunachal Pradesh	0	0	1472.25	0	1800	0	0	0	79.5	70	3421.75
3	Assam	0	4985	13940.952	0	4500	0	0	0	183.27	130	23739.222
4	Bihar	284.814	2106.185	0	0	500	1000	0	1033	446.86	180	5550.859
5	Chhattisgarh	0	0	0	0	2000	375	840	10	122.18	130	3477.18
6	Goa	0	0	0	0	0	0	0	0	10.04	10	20.04
7	Gujarat	0	0	0	0	10000	14675	30	330	205.02	150	25390.02
8	Haryana	4268.6	0	0	0	0	1694	220	1273	99.58	100	7655.18
9	HP	0	0	0	0	2000	0	0	500	65.27	60	2625.27
10	J&K	14	0	0	0	0	0	0	0	266.95	100	380.95
11	Jharkhand	0	15686.047	0	0	2000	0	0	1040	216.74	110	19052.787
12	Karnataka	5201.29	0	0	0	12500	5588	7240	2460	147.28	140	33276.57
13	Kerala	48.492	0	0	0	2000	86	0	500	127.2	70	2831.692
14	Madhya Pradesh	1166.8891	1201.85	0	0	15000	7654	530	1360	261.93	200	27374.669
15	Maharashtra	478.13	7626.485	0	0	25000	8837	0	1252	296.24	160	43649.855
16	Manipur	929.8	0	4000	0	900	0	0	0	50.21	40	5920.01
17	Meghalaya	0	0	0	0	1800	0	0	0	32.64	40	1872.64

Source: PMKSY website (http://pmksy.gov.in/Documents.aspx)

Table-9 : Fund Allotment for Maharashtra under PMKSY

5.7 Subsidy Details

For subsidy of Micro-Irrigation there is contribution of central and state govt. according to area and land holding of farmers. Subsidy is disbursed with criteria as;

For Draught-prone Area:

1. *For small and marginal land holding farmers – 60% (30% by Central govt. and 30% by State govt.)*
2. *Normal land holding farmers – 45% (22.5% by Central govt. and 22.5% by State govt.)*

For other than Draught-prone area:

1. *For small and marginal land holding farmers – 45% (22.5% by Central govt. and 22.5% by State govt.)*
2. *Normal land holding farmers – 35% (17.5% by Central govt. and 17.5% by State govt.)*

Category	2015	
	Percentage	Per Ha. Amount
VIIDP (<2 Ha.)	75	57000
VIIDP (>2 Ha.)	50	42700
PMKSY (<2 Ha.) DPAP	60	51240
PMKSY (>2 Ha.) DPAP	45	38430
PMKSY (<2 Ha.) Non DPAP	45	38430
PMKSY (>2 Ha.) Non DPAP	35	29890

Table-10 : General subsidy amount for 1 Ha. under different criteria

DPAP - Drought Prone Areas Programme

VIIDP - Vidarbha Intensive Irrigation Development Programme

6 Mulching

Mulching is process of covering soil around plants root area with a view to insulate the plant and its roots from extreme temperature fluctuations.

Mulch is simply a protective layer of a material that is spread on top of the soil

Mulches are applied at various times of the year depending on the purpose. Towards the beginning of the growing season mulches serve initially to warm the soil, by helping soil to retain heat which is lost during the night. This allows early seeding and transplanting of certain crops, and encourages faster growth. As the season progresses, mulch stabilizes the soil temperature and moisture, and prevents the growing of weeds from seeds. In temperate climates, the effect of mulch is dependent upon the time of year they are applied and when applied in fall and winter, are used to delay the growth of perennial plants in the spring or prevent growth in winter during warm spells, which limits freeze thaw damage.

6.1 Benefits of Mulching

1. Mulching conserves soil moisture
2. Moderates soil temperature by insulating the soil surface
3. Control weed growth under mulch film
4. Reduces soil compaction caused by equipment's and humans
5. Reduces soil erosion y wind or water
6. Preventing leaching of fertilizers
7. Improves productivity
8. Improves seed germination
9. Early maturity
10. Provides favourable environment for plant growth

Materials used as mulches vary and depend on a number of factors. Use takes into consideration availability, cost, appearance, the effect it has on the soil—including chemical reactions and pH, durability, combustibility, rate of decomposition, how clean it is—some can contain weed seeds or plant pathogens

6.2 Types of Mulching

Basically there are two types of mulches depending upon material used for mulching. They are as below,

A. Organic Mulches:

The organic materials such as crop residues and by products, farm yard manure & by products of timber industry, when used for mulching are known as organic mulches. Organic mulches create no post utilization issue.

Commonly used Organic mulches are,

a. Leaves

Leaves from deciduous trees, which drop their foliage in the autumn/fall. They tend to be dry and blow around in the wind, so are often chopped or shredded before application. As they decompose they adhere to each other but also allow water and moisture to seep down to the soil surface. Thick layers of entire leaves, especially of maples and oaks, can form a soggy mat in winter and spring which can impede the new growth lawn grass and other plants. Dry leaves are used as winter mulches to protect plants from freezing and thawing in areas with cold winters; they are normally removed during spring.

Figure-37 : Leaves Mulching

b. Grass Clippings / straws:

Grass clippings / straws of wheat or rice are sometimes collected and used elsewhere as mulch. Grass clippings are dense and tend to mat down, so are mixed with tree leaves or rough compost to provide aeration and to facilitate their decomposition without smelly putrefaction. Straws takes time to decompose, they effectively work as mulching layer. Grass clippings are often dried thoroughly before application, which mediates against rapid decomposition and excessive heat generation.

Figure-38 : Straw Mulching

c. Composted animal manure:

Well composted animal manure can be used as a mulch or soil amendment. Composted animal manure is an excellent choice for new planting beds as it improves soil quality and adds nutrients. Fresh manure should not be used in garden beds because it can burn plant roots.

d. Newspaper:

Layers of black and white newspaper can be used to suppress weeds. Apply two to three layers at a time and cover with an organic material such as leaf mulch or grass clippings to hold it in place. Newsprint will eventually decompose and can be incorporated into the soil.

Figure-39 : Newspaper Mulching

Other mulches as woodchip, peat moss, sphagnum moss, bark chips, card sheets etc. are also can be used as a mulching material.

e. Ground Cover (Living Mulch):

Groundcovers are plants which grow close to the ground, under the main crop, to slow the development of weeds and provide other benefits of mulch. They are usually fast-growing plants that continue growing with the main crops. However, live mulches also may need to be mechanically or chemically killed eventually to prevent competition with the main crop.

Some groundcovers can perform additional roles in the garden such as nitrogen fixation in the case of clovers, dynamic accumulation of nutrients from the subsoil in the case of creeping comfrey (Symphytum ibericum), and even food production in the case of Rubus tricolor.

B. In-Organic Mulches:

When in-organic material like plastics, stones are used as a mulching material are in-organic mulches. While organic mulches some restrictions about their availability that time plastic mulches are used with required size and thickness for better results.

a. Crushed stone / Rock mulch

Landscape rocks are available in many sizes, shapes and colours. Rocks don't do anything for the soil nutritionally, but a one or two inch layer will help to suppress weeds. Rocks are hard to get rid of once you have them, so they are best used for permanent plantings. Rocks reflect solar radiation and can create a hot landscape during the summer months.

Figure-40 : Stone Mulching

b. Rubber mulch:

Rubber mulch generally consists of either waste tire buffing's or nuggets of rubber from tires that are ground up whole, after having their steel bands removed. Almost any tire can be used to make rubber mulch, including passenger vehicle tires and large truck and trailer tires. Buffing's are produced from recycled truck tire tread when the remainder of the worn-down tread is removed from the tire prior tore treading. Buffing's are generally thin slivers of rubber. Nuggets range in size from 10 mm to 32 mm, or 3/8 inch to 1¼ inch.

Figure-41 : Rubber Mulch

c. Plastic mulch:

Crops grow through slits or holes in thin plastic sheeting. This method is predominant in large-scale vegetable growing, with millions of acres cultivated under plastic mulch worldwide each year (disposal of plastic mulch is cited as an environmental problem). Black plastic is very effective in preventing weed growth. Because it also holds water in the soil, it is not recommended for poorly drained areas. Black plastic does a good job of warming soil up in the spring, so you can get an early start on planting vegetables that like warm soil.

Figure-42 : Plastic Mulching

d. Landscape Fabric

Materials woven of fabric, plastic or paper are available at garden centers and often types of mulch used by professional landscapers. These materials are treated to resist decomposition, but unlike black plastic, the fabrics allow water and air to move through them.

Landscape fabric needs to be fastened down with pins so it will not be pushed up by perennial weeds. You will want to cover the fabric with a few inches of another mulching material such as wood chips, both to hide the fabric and because it is possible for weeds to sprout up on top of the fabric. Landscape fabric is best used for more permanent plantings because it is more difficult to transplant plants that are growing in fabric.

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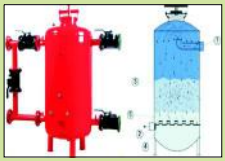

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