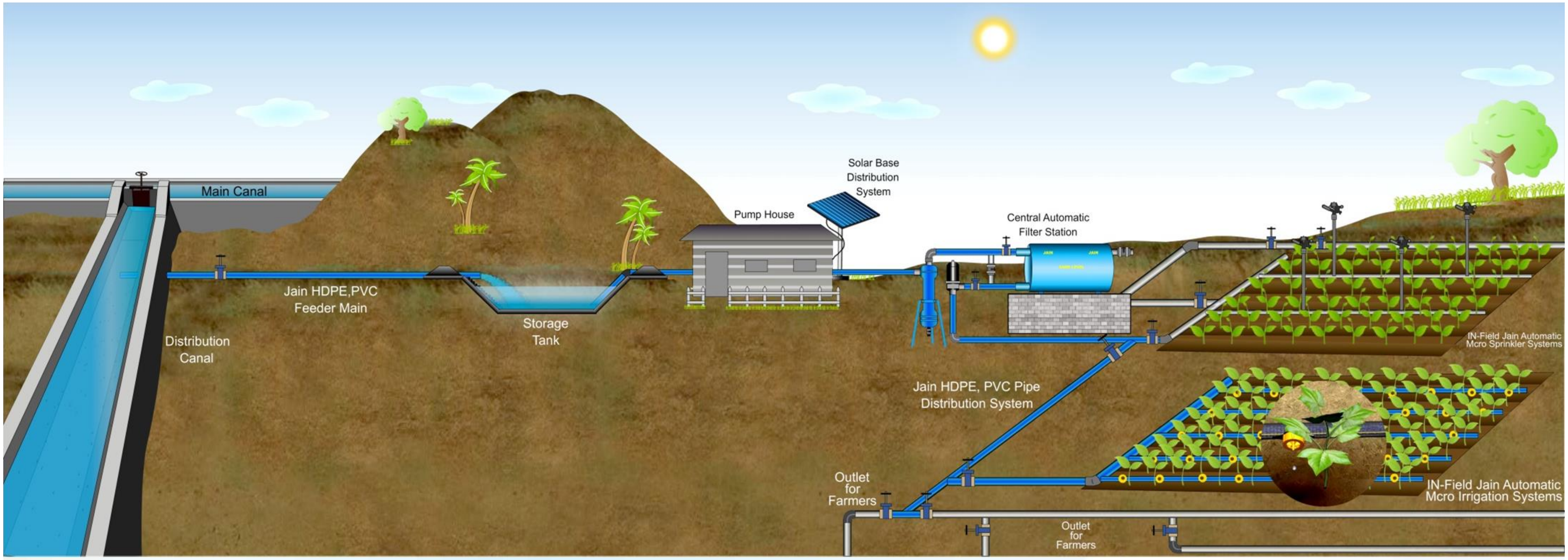

Welcome

Command Area Development Through Micro Irrigation

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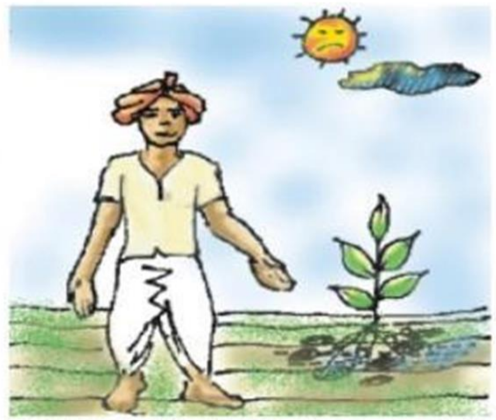
Ahemadabad -28.05.2019

DrawBacks of Conventional Irrigation

First Three Days After Irrigation

During first three days of irrigation soil pores are saturated with water. In this condition, total air in the soil is replaced by water & field capacity level is not maintained in the soil. Though sufficient nutrients are avaiable in the soil, the excess water condition suffocates the roots of the plant & water absorption by roots is totally ceased. As the plant is under suffocation the growth is hampered.

Middle Three Days



During next three days, due to evaoration & percolation losses, the excess soil moisture is reduced & soil comes to field capacity level wherein air, moisture & nutrients are available at optimum level.

Plant growth takes place only during this phase.

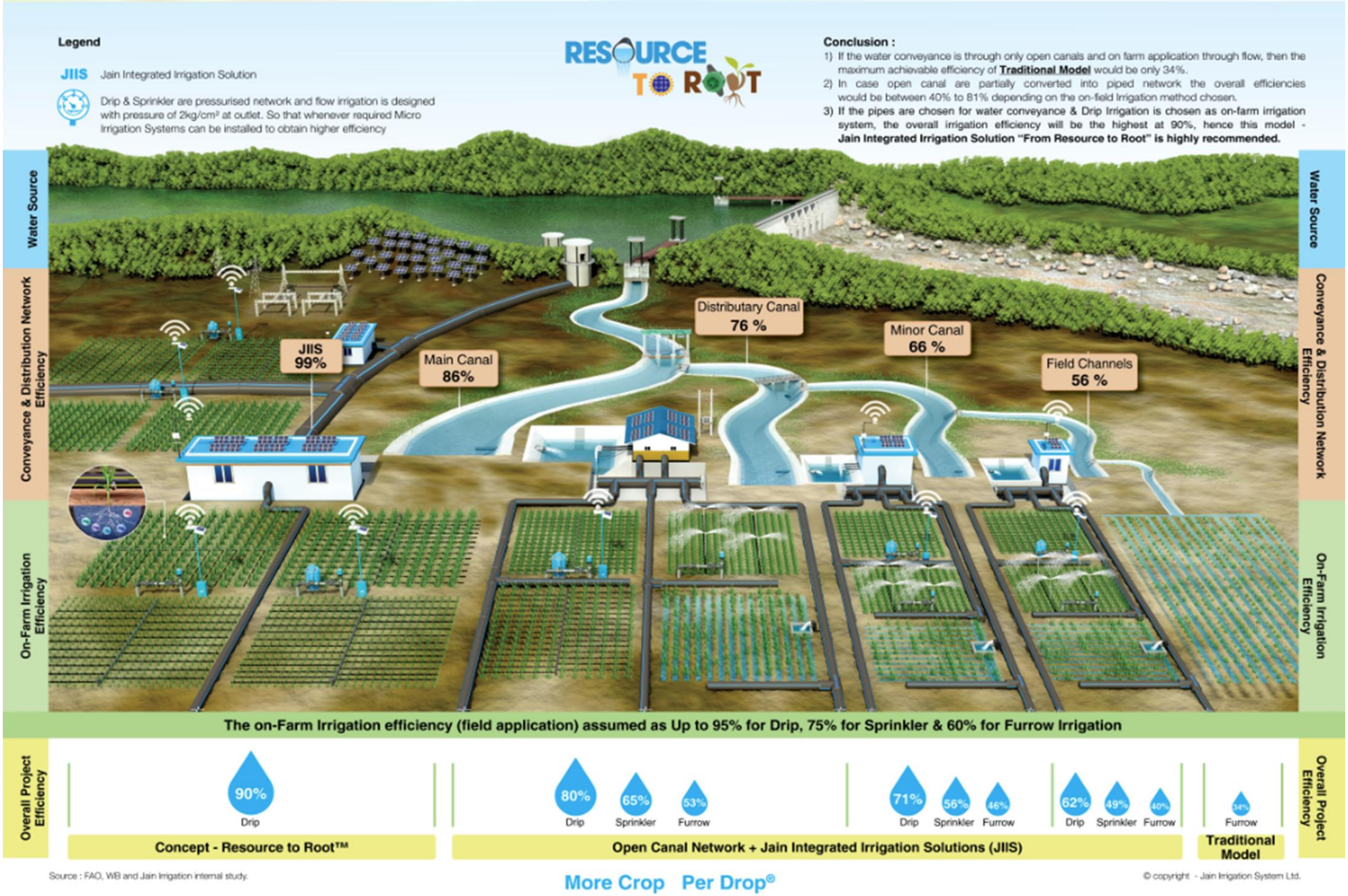
Last Two Days

In last two days, the moisture level in the soil goes below the root zone hence, plant is under stress condition in this period.

Even though air and nutrients are sufficiently available in the root zone they can not be taken easily by plant as the plant is under stress and hence growth restricted.

Conclusion: It is very clear from the above phenomonon that for the plant growth, optimum moisture level available is only for about three days out of 8 days' cycle. Rest of the time plant is either under stress or suffocation condition, hence gorwth is restricted thereby yield is reduced.

Technology for Efficiency Improvement



Integrated Drip Irrigation is the Most Efficient Solution. (Hypothetical Example from Cane Growing area in MS)

Sr .	Parameter	Model 1 - Traditional(20 ha)	Model 2- Piped Up to 4 ha level	Model 3 – JIIS
1	Conveyance By	Canal	Piped (Pressure)	Piped
2	Field Application By	Flow	Flow	Drip
3	Designed Area, Ha	10000	10000	10000
4	Overall Irrigation Efficiency, %	34	59	89
5	Water Use, Mm	228.48	131.67	87.28
6	Water Saving over Model 1, Mm^3	0.00	96.81	141.19
7	Capital Cost, Rs Crore	150	214.37	313.16
8	Energy Cost, Rs Crore (@ Rs 5/unit)	0	7.16	7.16
9	Total Yield, MT	495075	495075	933844
10	Gross Income, Rs crore	128	128	230
11	Cost of Cultivation, Rs Crore	85	85	85
12	Water Use Efficiency, Kg/m^3	2.17	3.76	10.70
13	Water Productivity, Rs/m^3	5.6	9.7	26.3
14	BC Ratio	1.27	1.15	1.92
15	IRR, %	21%	10%	49%
16	Payback Period, Years	6-8	10-12	4-5

Note: In Model 2, monitory value of water saving is not considered

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Concept - Resource to Root™ -
Ensures Higher Water Productivity & Efficiency

1) **Water Productivity :** This concept is related to the biomass production and is the ratio between biomass produced in kg to the water consumed by the plants in m3, both under rainfed conditions and irrigated conditions. This can be achieved either by 1) increasing the marketable yield of crops for each unit of water transpired, 2) reducing outflows/losses or 3) increasing the effective use of rainfall. All the three ways lead to Good Agricultural Practices (GAP) which includes reduced water consumption, better yields, better fertilizer efficiencies, better soil health, better crop growth and ultimately better Water Use Efficiency and Water Productivity. It is measured in terms of yield of crops in kg per m3 of water consumed. In the cash crops like Sugarcane, Cotton etc., the Water productivity should be doubled as compared to flow irrigation because the water consumption is only 50% and there is an yield increase of at least 50% in these crops.
2) **Energy Productivity :** This can be defined as the ratio of biomass produced in kg to the power consumption in terms of units of electricity. Unit of Energy Productivity is kg/unit of power consumed.
3) **Value Creation Efficiency:** This can be defined as the value created in terms of monetary gains divided by water/power consumed. Unit of Value Creation Efficiency is Rs/m^3/unit of power consumed.
4) **Life Cycle Analysis:** Normally the projects are designed based on minimum capital costs. In order to make the projects efficient and successful in long term and also keep recurring/operational costs to minimum, the life cycle analysis of the major components of the project should be done and the components having minimum life cycle costs should be adopted/ selected. e.g. instead of conventional metal pipes, plastic pipes should be selected.

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Progress in Irrigation Water Management

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Efficiencies of Different Irrigation Methods

Sl. No.	Description	Existing Practice (Canal with flow method)	Proposed Project (Piped Conveyance with drip)
1	Conveyance Efficiency	56%	99
2	Field Application Efficiency	60%	> 90
	Overall Project Efficiency of Models	34%	90%

Case Study 1 : SSP Issues

- Large Area, about 18.45 Lac Ha to be converted in to irrigated land within the short stipulated time.
- High value lands due to urbanization and industrialization, hence Farmers are reluctant to give up the lands
- Water Logging
- Large Saline Patches
- Flat Terrain, difficult for gravity designs.

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Technical feasibility- Sardar Sarovar Project

- Live Storage Capacity of the SSP as stated in the official web site is 5860 Mm3.
- The general and major crop being grown in the command area of SSP is Cotton.
- Water Requirement of Cotton under flow irrigation is 856 mm for one season and under drip irrigation is 302 mm (Ref : Dr. A. Narayanmoorthy's Paper "Potential for drip and sprinkler irrigation systems in India")
- That means with 5860 Mm3 of live storage if the entire available water is used for agriculture, state will be able to irrigate only up to 6.84 Lakh Ha under flow irrigation or approx. 19.00 Lakh Ha under drip irrigation.
- Technically, with flow irrigation, it may not be feasible to irrigate entire targeted command area of 18.45 Lakh Ha. Hence adoption of water saving technologies such as drip irrigation is a MUST.

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Water Balance Calculations of SSP for Cotton Crop

System Type	PWR, mm	Water Available, Mm^3	Area Possible, Lakh/Ha
Flow	856	5860	6.85
Drip	302	5860	19.40

Possibilities

- With out Drip irrigation, it is impossible to bring entire targeted area of 18.45 Lakh ha under irrigation.
- Three Ways :

a) To increase irrigation water availability by introducing intermediate storages (MITs, small/medium dams, village ponds, sumps etc). During rainy season, fill up these structures and use them for irrigation, drinking water, livestock etc.

b) To introduce low water consuming crops

c) To reduce command area

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UGPL- A Partial Solution

- Presently SSNNL has started development of command area with UGPL (Underground Pipeline Systems) below minor level. One VSA (Village Service Area) of 200-500 Ha area consists of approx. 10 Chaks of 40 Ha each. Each chak consists of 8 sub chaks of 5 Ha each.
- It is proposed to bring the water from minor to each sub chak of 5 Ha either by gravity or by pumping. The cost of providing this piping infrastructure is around Rs 45000 to Rs 48000 per Ha (Average say, Rs 46500 per Ha).
- SSNNL is providing this system in place of sub-minors and water courses. Therefore otherwise also they would have spent this money.
- However, UGPL with flow irrigation (OR without drip irrigation) will have only up to 50% Water Use Efficiency and may cover approx. 15-20% more area (i.e. 6.84 *1.2= 8.20 Lakh Ha). In other words, even if the entire area is done with only UGPL, with available water, one will not be able to irrigate the targeted command area of 18.45 Lakh Ha. Hence this setting up of UGPL would be partial solution.
- Introduction of drip irrigation system with UGPL will ensure irrigation to approx. 18.45 lakh Ha.

Issues Involved in Present Partial Solution

- From Kundi to the individual farmer's fields, the water has to reach by channels. This may result in to water logging and /or percolation, seepage and evaporation losses. This may also create the issue of ROW in some cases.
- What is the guarantee that the farmers would follow the irrigation schedule ? Because there is no automation/any mechanism to control the water, farmers would have full freedom and flexibility to operate the valves and get water anytime. Such situation would lead to un- uniform distribution of water and will create disputes among the farmers.
- Since it is a partially open system and partially closed system, in case if the farmers do not draw the water as per the schedule given, where such unutilized water will be accommodated. In such a case, the Kundies, canals and other structures will get overflow and there will be complaints from the farmers. This situation would lead to a total mess and collapse of the entire hydraulics of the scheme.
- It is necessary to desilt the Kundies regularly from time to time. If the desilting is not done as per the schedule/requirement, the Kundies will block / tend to overflow. Disposal of silt will be an issue after some period.
- Where ever there is a provision of diesel pumps, those farmers will get the water as per requirement. However the farmers receiving water by gravity may suffer for the want of adequate volume. This will not only create the disputes, but will also result in to social injustice.
- Operating cost of diesel pumps being very high, those farmers will incur higher recurring expenses. Thus for these farmers, the water will be very expensive and must be used judiciously.

Modifications Required for Adoption of MIS

- 40 Ha chak should be considered as a unit for adoption of micro irrigation. This can be centrally energized with the help of 20 HP VFD pump to be installed on Minor. Thus the total estimated power requirement would be 20*1845000/40=922500 HP (or approx. 700 MW)
- Presently proposed "Kundi/outlets" etc will have to be removed and 40 Ha is to be pressurized from minor. Equipment such as suitable filters will have to be provided near the pump to arrest the silt in the canal.
- The chak of 40 Ha would be divided in to 8 sub chaks of 5 Ha each having 3 sections in each sub chak. Total sections in each chak would be 24 nos. It is assumed that total number of farmers in each chak would be 24 and each section would belong to one farmer.
- Each section would be operating for 1 hr per day. Thus total operating hours would be 24 per day (since the canal would be flowing for 24 hours, we have to fully utilize the time. This would also help reduce the cost of the system).
- Systems would be provided with suitable automation equipment.

Costs

The average estimated costs for installation of complete automated Drip Irrigation systems for closely spaced crops like Cotton with the proposed model would be as follows:

No	Item	Estimated Cost for 40 Ha , Rs	Estimated Cost, Rs/Ha
1	Pump House	400000	10000
2	Piping Infrastructure cost	1840000	46000
3	Drip Irrigation System	4160000	104000
4	Pumping System	300000	7500
5	Filtration System	200000	5000
6	Automation	1400000	35000
	Total	8300000	207500

- *Above does not include cost of electricity infrastructure*
- *We have also assumed that canal network upto minor level is available*
- *For 24 hours water and electricity will be made available.*

Thus if entire area is to be brought under drip irrigation (which is the ultimate solution also), government (State + Central) would be required to provide subsidy assistance of Rs.9230 Crore (@ Rs.50,000 per Ha), grant of Rs. 19, 095 Crore (@ Rs.1,03,500 per Ha) and farmers will have to invest Rs.9,963 Crore (@ Rs.54,000 per Ha).

Anticipated Benefits

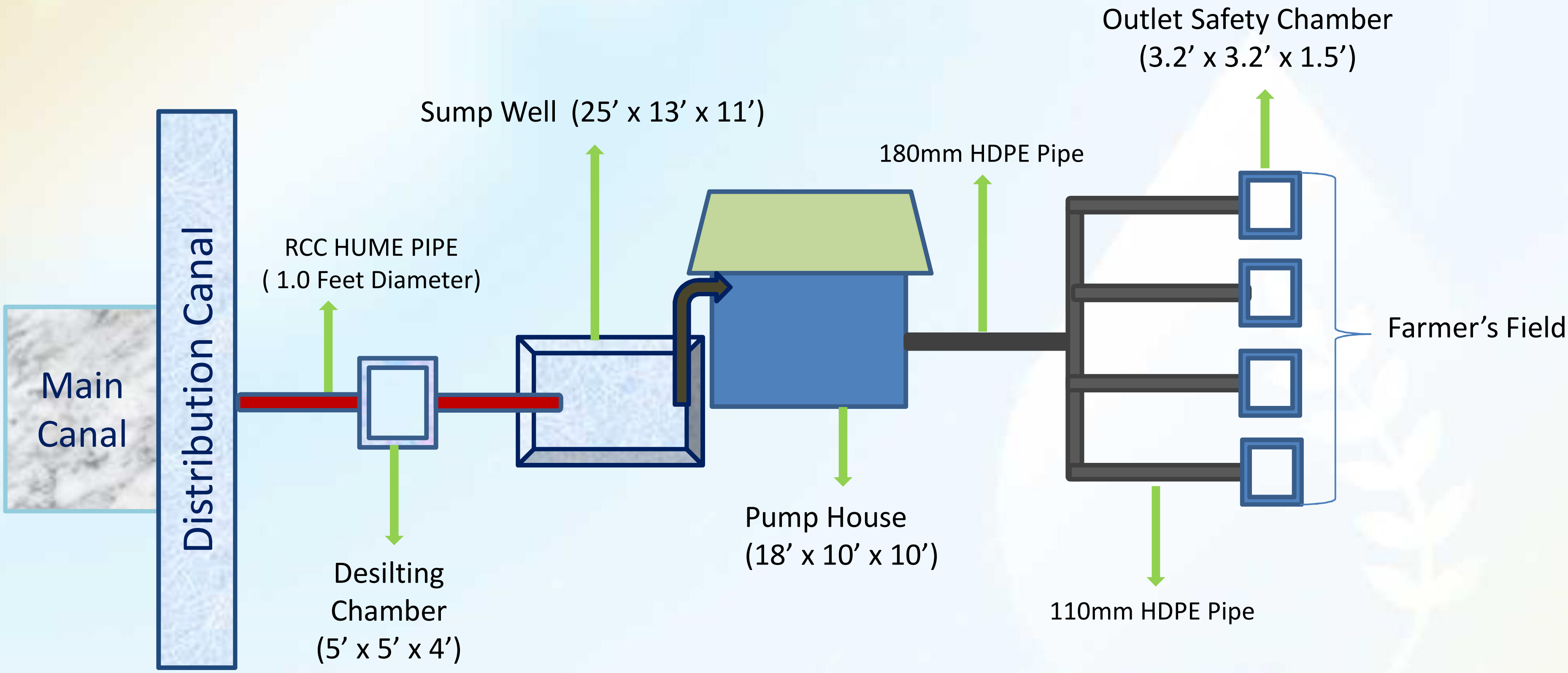
- The approx. command area of 18.45 Lakh Ha can be brought under irrigation in phased manner.
- The time required to do this would be far less than the time required to construct sub-minors and water courses. This means less gestation period for the project.
- Huge water savings. Less conveyance, percolation, evaporation and seepage losses would result in to high Water Use Efficiency upto 75-85%.
- The yield would increase up to 50% which will add to GDP growth of the state and the nation. Overall social well-being and prosperity.
- No water logging and land degradation issues. Drip irrigation would help to maintain the on-farm soil health.
- Undulating land can also be brought under cultivation. This would generate additional income for the farmers.
- No wastage of land due to construction of sub-minors and water courses.
- No land acquisition/rehabilitation is required for sub-minors and water courses. So huge cost and time saving.
- The above comments are based on available information and certain assumptions. After collecting all necessary details, detailed proposal/presentation can be prepared based on these lines. Estimated costs and anticipated benefits are tentative and may change after detailed survey, design and analysis of the scheme/proposal.

Available Technology

- On-field Drip and Sprinkler Irrigation for water saving
- Sub surface Drip Irrigation for water saving
- Solar Pumping Systems for reliable power
- PE Pipes (Up to 2000 mm dia) for conveyance of higher flows
- Automation (with wires OR wireless) for precision application
- Fertigation for yield enhancement
- HDD for crossing roads/railways etc for time saving
- De-silting/filtration for allowing clean water to enter the system to prevent blockages

Case Study 2 : Pilot Project Of Infrastructure for Micro-irrigation on Lanjhi Distributory at Karechh village and on Durgawati Right Main Canal at Badalgarh, Pachaura, Dafarpur and JAMHAT village respectively under Rohtas District, Bihar

Key Plan of Project



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Command Area Details

Concept : Water Distribution Network From Canal/Minor to Sump, Sump to farmer's field by HDPE Pipe network through Pumping

The total CCA	:	200 Ha
Water source (Outlet)	:	at Lanjhi Disty. & DRMC
Duty	:	1.0 cusec. for 100 Acre
Water availability	:	3 months in a year
Total no. of beneficiaries	:	300 no.
Average land holding	:	0.5 to 1.0 Ha
Ground water level	:	150 feet BGL
Cropping Pattern	**:**	Kharif - Paddy , Tomato
	:	Rabi - Wheat , Gram, Arhar
Annual Rainfall	:	1000 mm

Note - The major bottleneck of this command is need of irrigation water throughout the year so that farmers can cultivate different crops in a year and can enhance their economic condition. It is recommended to go for conjunctive use of surface as well as ground water for availability of water throughout the year.

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Objective of Project

- To ensure pollution free environment.
- To bridge the gap between the irrigation potential created and utilized.
- To reduce wastage of water and to increase the irrigation efficiency.
- To improve the water use efficiency.
- Uniformity of water application.
- Assured Irrigation to the agricultural fields.
- To adopt best possible cropping pattern.
- Crop diversification & Crop rotation.

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General Planning

- In this Pilot Project, it is proposed to take water from the existing Canal / Disty. to Sump by Gravity and water is pumped from Sump to Farmer's field.
- The water will be carried in the entire area through HDPE pipes after proper filtration.
- It is proposed to install Hydrocyclone filter, Sand filter and Disc filter inside the Pump House.
- The entire HDPE pipe networks are buried under ground at least 3 feet deep. Thus, land acquisition is not required.
- 7.63 lps Discharge & 20 m head are maintained at each field Outlet while designing of Pipe Network.
- 1.0 Ha – 1.5 Ha area is irrigated under each outlet.
- At a time three outlets are run in this system.

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Components of the Project

Components :

- Sump Well
- Desilting Chamber
- Pump & Filtration unit
- HDPE pipe network
- Outlet/Hydrant assembly

Present work status

Name of site	Civil work	Pipe laying / Trenching work
Karechh	100%	100%
Dafarpur	95%	100%
Badalgarh	95%	50%
Pachora	100%	Nil
Jamhat	100%	Nil

Note – Pipe laying / Trenching is slowed down because of hindrance created by farmers. They have no assurance to availability of water throughout the year.

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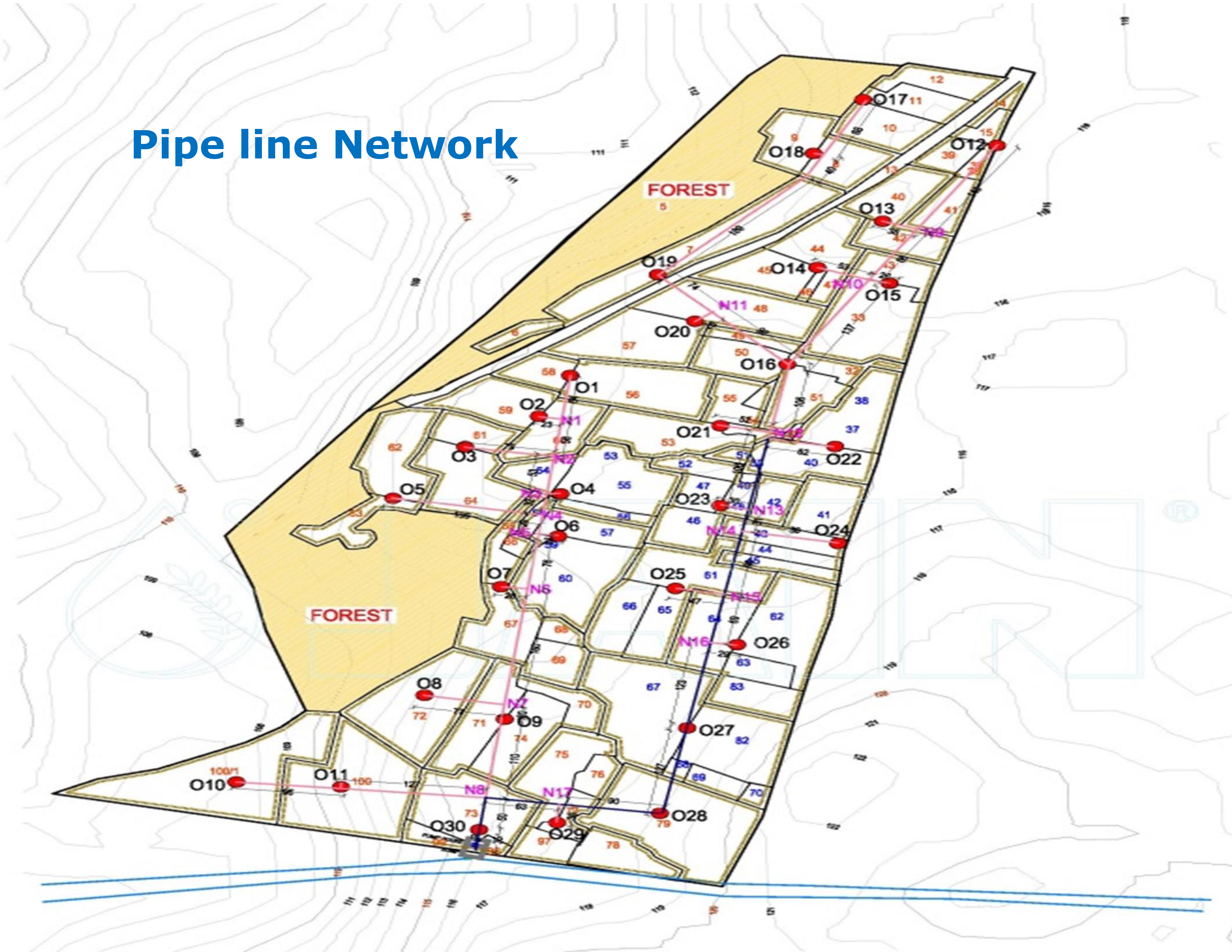
Pipe line Network

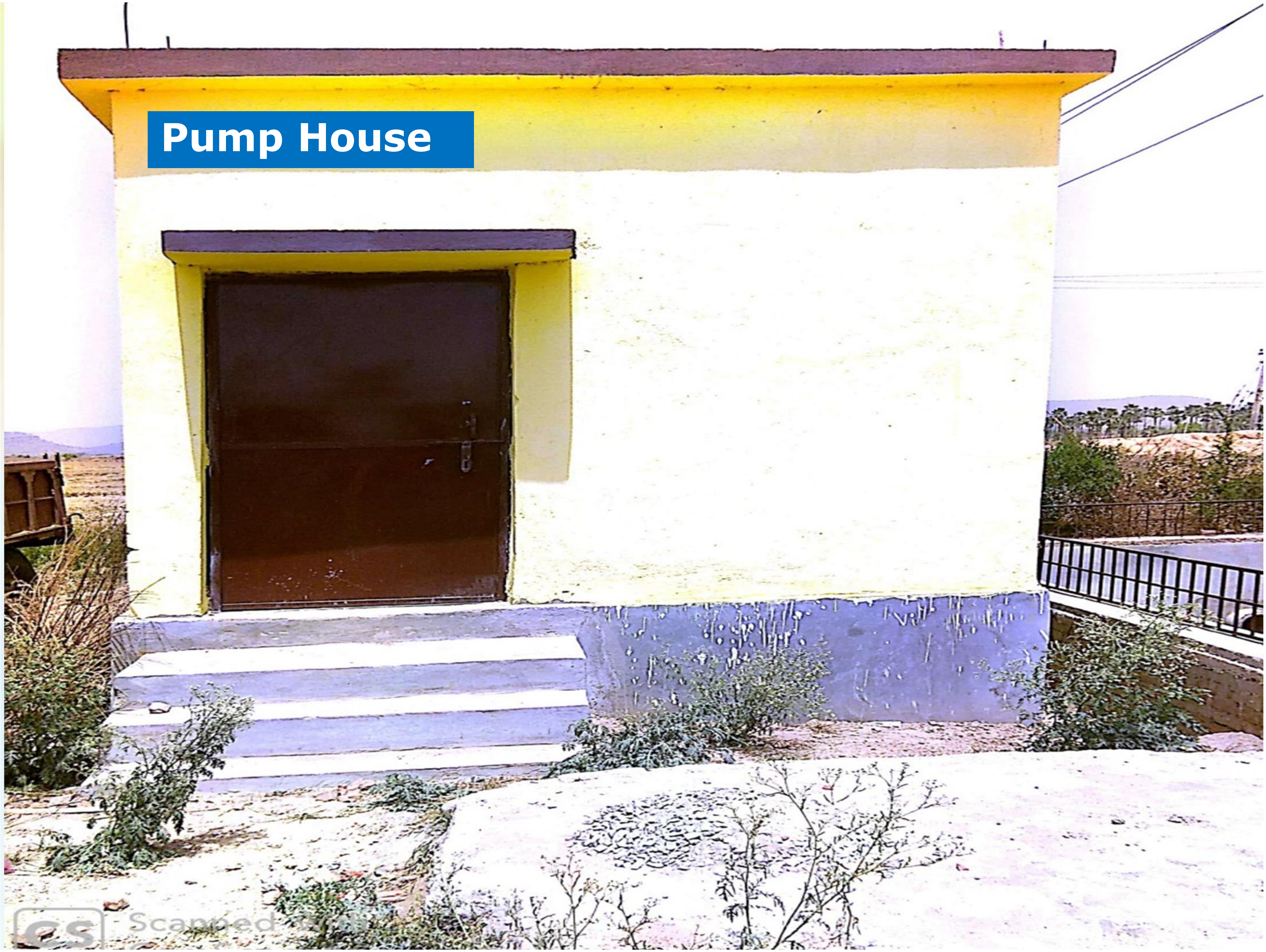


Canal outlet to desilting chamber

Scanned with CamScanner


Sump with pipe inlet


Sump with Protection Bar


Pump House

HDPE Delivery Pipe

Scanned with

Trench for Pipe Laying


HDPE Pipe Jointing


HDPE Pipe Laying


Outlet Safety Chamber

Technical Factors (Designing & Planning)

- Cropping Pattern.
- Water Requirements.
- Head/Pressure Requirement.
- De-silting, Filtration and silt disposal
- Power Availability.
- Hardware and Software Availability.
- Training Needs of Farmers.

Technical Factors

- Irrigation project - not merely water distribution system . Approach should be **"From Resource to Root".**
- Adoption of On – farm drip/sprinkler irrigation is a MUST . Flow irrigation should never be allowed.
- Canal systems -Supply based rotational systems Vs Micro irrigation systems - demand based . Change in planning/design/mindset of all stake holders is a must.
- In some of the cases, the intermediate storages are MUST to convert these schemes in to integrated micro irrigation projects.
- De-silting or Filtration
- Automation becomes necessary to deliver precise amount of water to each plant and nutrients
- Focus – End use i.e. Cropping Pattern
- The projects for Kharif (only four months), irrigation should be designed as Integrated Sprinkler Irrigation Projects.
- Projects for Eight months or twelve months should be designed as integrated Drip/Sprinkler Irrigation projects.
- It is recommended to take minimum three crops with drip irrigation in order to ensure reduction in payback period of the project/investment.

Way Forward ....

1. The **objectives and performance parameters** should be made clear at project planning stage itself. To bring **sustainability** to the project following parameters should be considered at the time of biding.
   a) Irrigation Efficiency
   b) Crop Productivity
   c) Water Use Efficiency
   d) Energy Productivity
   e) Value Creation
2. Irrigation project should not be merely seen as water distribution system or creation of water distribution network. It should be planned as integrated agricultural irrigation project having last mile connectivity. In short approach should be **"From Resource to Root"**
3. Considering the unmatched sustainable benefits, ONLY Integrated Micro Irrigation Projects (i.e Model 1 in the picture with Drip Irrigation having 90% Overall efficiency) should be undertaken.
4. Adoption of On – farm drip/sprinkler irrigation is a MUST and should be integral part of the project. **Flood irrigation should never be allowed.**

References

- FAO Manual
- Guidelines for improving Water Use Efficiency in Irrigation, Domestic and Industrial sector, by CWC, New Delhi
- Ministry of Water Resources, Government of India
- Narayanmurthy's research papers
- Das, Anup., Mudra, G, C., Patel, D, P., 2009. Technological Options for Improving Nutrient and Water Use Efficiency
- Strategies to Improve Water Use Efficiency, 2016. http://extension.psu.edu/plants/crops/news/2016/07/strategies-to-improve-water-use-efficiency , accessed on 5th Oct, 2016.

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Thank You

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