सत्यमेव जयते
Government of India

झारखण्ड सरकार
GOVERNMENT OF JHARKHAND

JSLPS
Jharkhand State Livelihood Promotion Society

IRRIGATION MANUAL

Community Managed Micro Irrigation Scheme (CMMIS)

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सचिव
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झारखण्ड सरकार

MESSAGE

It is of paramount importance to provide a thoughtful, sustainable and lasting solution to the everlasting challenges faced by the indigent farmers of Jharkhand requires innovation coupled with creativity. Boost Irrigation project sponsored by the Rural Development Department, is one such endeavor wherein the right combination of experience, technical proficiency and local planning have produced desired results for the farming community.

Jharkhand Micro Lift Irrigation manual is a comprehensive document that has adopted systematic approach, delving into technical intricacies, preparation of DPRs and field level challenges, in a lucid way. Concerted efforts of Jharkhand State Livelihood Promotion Society (JSLPS) and its technical partner, Transforming Rural India Foundation (TRIF) in bringing out the Irrigation Manual based on the knowledge gained through execution of the pilot project which was being implemented in six pilot blocks of the state viz., Angara (Ranchi), Gola (Ramgarh), Khunti (Khunti), Bengabad (Giridih), Jama (Dumka) and Satbarwa (Palamu). The manual is poised to assist the rural community, extension workers, staff and other agencies in grounding and establishing similar initiatives in the state and beyond.

I acknowledge and appreciate the contribution of the community, our field level representatives, and experts at **'State Irrigation Execution Cell (SIEC)'** anchored by **'Transforming Rural India Foundation (TRIF)'** for the successful implementation of the project and developing aninsightful document that has the potential to boost the implementation of large-scale micro lift irrigation systems.

I wish this manual to be used as a guidebook for the stakeholders in the present time and for reference in posterity through the corridors of time.

(Manish Ranjan)

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झारखण्ड सरकार की एक नई पहल
द्वारा प्रवन्धित लिफ्ट सिंचाई योजना

Nancy Sahay, I.A.S.
Chief Executive Officer

FOREWORD

The collaborative effort of **'JSLPS with Transforming Rural India Foundation (TRIF)'** in preparation of Jharkhand Micro Lift Irrigation Manual being developed with a vision to augment income generation of rural farmers through lift irrigation in farm-based livelihood is laudable. This irrigation manual has tried to cover all the possible aspects for establishing micro lift irrigation powered by solar, diesel and gravity. It has been elaborated lucidly to make it convenient for stakeholders at different level beginning from the field level extension workers, supervisors and monitors to the policy level decision makers.

Utilisation of available surface water without spending much on creation of water sources is one of the highlights of the project whereby the cost of the units could be minimised. Selection of irrigation type depending on the local situation and choices and priorities of the farmers. It has helped to establish community managed micro irrigation systems which are easy to replicate in other similar areas and can be made long lasting in nature with no or less modifications, in time to come.

The state of Jharkhand is in desperate need of assured irrigation to increase the cropping intensity and crop diversification as majority of lands are either kept fallow or found nonarable. This project has established a large number of micro lift irrigation system with renewable solar energy within a short span of time, benefitting significant number of small and marginal farmers of Jharkhand state.

I would like to congratulate my colleagues, experts, community institutions, water user group members for putting in their best efforts and help bringing in this simple training manual. This may be found beneficial to other departments, agencies and non-government organisations while taking up similar projects.

I am confident that the information furnished in this manual will go down as an important milestone in this sector in times to come.

Sahay

(Nancy Sahay)

Ashok Kumar
Director, (Farm Prosperity)

TRI TRANSFORM RURAL INDIA

Setting the Context

Transforming Rural India Foundation (TRIF) is intensively engaged with the rural communities of Eastern and Central areas of India with the vision of making India's villages places of equal life time opportunity.

Jharkhand is a high rainfall and low irrigation area and the rural economy is primarily agrarian. A lot of surface water is there that required to be lifted to farmers' fields using sustainable energy. To support the livelihood and agriculture specific needs, investments in energy access and control over water by smallholders through a community-led decentralised intervention is required. With this idea, we initiated the work to develop a user manual, a guide which has been well researched and user friendly for all the Irrigation needs of various stakeholders.

This is an outcome of the successes of various irrigation interventions which were implemented with the support of the Jharkhand State Government by jointly setting up **'State Irrigation Execution Cell (SIEC) under JSLPS, Rural Development Department'**, Government of Jharkhand.

These improved practices of Community Managed Micro-Irrigation Schemes (CMMIS) have resulted in bringing significant land under irrigation, higher agricultural productivity gains, reduced input costs and optimal use of available water resources. TRIF has assisted more than 8,000 farmers to adopt Micro Irrigation Systems to improve water use efficiency and soil and water conservation practices.

TRIF's intent to reach all the farmers in the geography shall be fulfilled with a supporting tool for professionals, researchers, implementors and farmers themselves. It will be a true success, when the knowledge is shared and implemented for now and future.

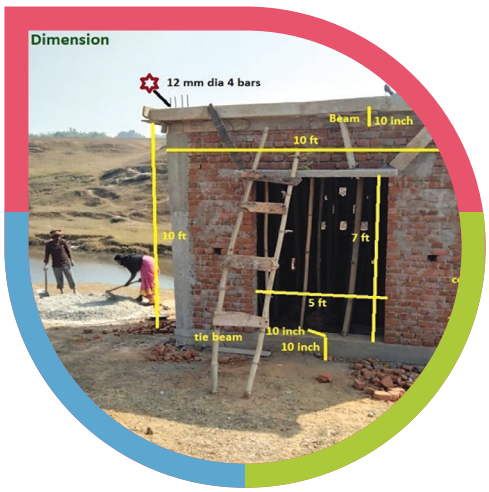
With this strong belief we present to you the Irrigation Manual.

We would welcome your thoughts and feedback to strengthen our resources and to serve the community better.

(Ashok Kumar)

309/C, Rajmandir First Floor, Ashok Nagar Near Gate No 2, Road No 2,
Ranchi, Jharkhand - 834002


Layout of Pump House
10 ft
10 ft


Dimension
12 mm dia 4 bars
Beam
10 inch
10 ft
10 ft
7 ft
5 ft
tie beam
10 inch
10 inch

Md. Karimuddin Malik
State Programme Officer

JHARKHAND MICRO LIFT IRRIGATION PROJECT: RESULTS & LEARNINGS

Transform Rural India Foundation with the support and guidance of the Department of Rural Development and Jharkhand State Livelihood Promotion Society has initiated the **"Jharkhand Micro Lift Irrigation"** Project as a collaborative effort aimed at catalysing the process of augmentation of income of farmers through technologically enhanced and sustainable irrigation solutions in farm-based livelihoods.

Agriculture in Jharkhand is adversely affected by pressing issues characterized by high dependence on natural rainfall, poor irrigation practices, monocropping, lack of access to agri-input resources, capacity to use modern farm production technologies and practices, sub-optimum quantities of pesticides, and others, amongst many. This results in poor agricultural produce which negatively impacts the holistic growth of a farmer's household. Approximately 20 million farmers countrywide are impacted by this phenomenon.

Jharkhand agriculture is largely rain-fed, with only 12 percent of the cultivated area under assured irrigation and this over-dependence on rain-fed agriculture has drastically led to a vicious cycle of low productivity, low income, and poor financial linkages through the last two decades. The **Community Managed Micro Lift Irrigation Program** was launched as an effort towards mitigating the aforementioned bottlenecks in Jharkhand by promoting best practices for irrigation and multiple cropping practices to enhance the annual income of small and marginal farmers.

It is a futuristic model to mitigate irrigation deficit in Jharkhand. The pilot of this program covered 7 blocks impacting the life of the farmers through enhancing irrigation facilities and cropping intensity. This manual focuses on promoting the best practices of irrigation and its role in balancing the ecology through the utilization of renewable energy for effective water utilization for on-farm livelihoods thus impacting productivity to ensure an escalating trend of sustainable returns to the producers.

(Md. Karimuddin Malik)

CONTENTS

1. Introduction

Irrigation led development of Agriculture Production Clusters (APC) is one of the time tested strategies to address small and marginal farmers' livelihoods and reduce food insecurity. Micro Lift Irrigation, denoting smaller command area, 10-30 acres benefitting even number of small and marginal farmers, referred as Community Managed Micro Irrigation Schemes (CMMIS), has evolved as important developmental initiatives in early 80s. The project conceptualisation and piloting of micro irrigation schemes was done by civil society organisations. In Jharkhand state, during the last three decades approximately 1,000 schemes have been implemented by different NGOs whereas a few have been executed by some DRDAs too.

Key impact indicators of such schemes;

- Large tract of barren and unproductive land put under agriculture
- Substantial increase in cropping intensity (above 200%)
- Huge shift in household crops from cereal to cash crops
- Reduced migration and renewed interest in farming amongst youths
- Address nutrition and food security and increase in cash income
- Enhanced linkage with market and negotiation with stakeholders

However, CMMIS has not received the desired traction in the mainstream. CMMIS thus receives no state financial assistance and lack of dedicated funding for micro irrigation has pushed CMMIS into state of hibernation and implementation almost halted.

A study by Dr Bibek Debroy[1] pointed out high success rate of these schemes, and stressed lack of institutional framework for hindering implementation of such schemes in Jharkhand, which has huge potential to address poor people's livelihoods and food & nutrition security in the state.

In this backdrop, Government of Jharkhand launched a pilot project to address the irrigation needs in six poorest blocks, earmarking a total of Rs.100 Crore in FY 2016-17. Jharkhand State Livelihood Promotion Society, JSLPS was made the nodal agency for implementing the pilot project.

TRIF signed MOU with JSLPS, in June 2017 to facilitate project implementation by setting up State Project Management Team, referred as State Irrigation Execution Cell (SIEC) to support project implementation. TRIF envisaged changing the irrigation ecosystem. A summary of the planned changes are;

Particular	Past	Present
Project Funding	Funded from existing Government schemes (BPDP MESO, sub activity of watershed programme etc.)	Government funding
Implementation agency and team	NGOs	Community Based Organisations like Village Organisations and Water User Groups taking charge with the support of Government agency, Government staff and vendor
Vendor selection- Procurement of goods (Irrigation)	Local Vendors, identified by NGOs and WUGs	National tender to attract the credible vendors from across the country

1 Currently part of the Niti Aayog

Particular	Past	Present
Proposal development	Manual processes, able to generate limited number of proposal (DPR)	Simplify and standardised community transaction/interface, automation using IT enabled platform to produce quality proposals in time bound manner
Staff training and development	NGO staff, deputed for irrigation project. The training and capacity development remains in-house affair.	Quality training and capacity building done through involvement of external consultants drawn from across the country and academic institutions.
Outreach and Community interface	Limited outreach restricted to few pockets where NGO is operational	Saturation approach, entire block is operation area
Stakeholders participation, ownership and influencing	Limited and restricted to Government departments and some vendor/supplier. The NGO remained the key to success of the project.	Multi stakeholder participation envisaged; Community, Government, Vendors, Media, NGOs etc.
Asset utilisation, Cluster or Agriculture Production Clusters development	Sub optimal or did not take off	300% cropping intensity and Vibrant APC emerges

The project would formulate strategies and action plan to address some of the Sustainable Development Goals (SDGs) as given below;

GOAL 1: No Poverty	Y	**GOAL 7:** Affordable and clean energy	Y	**GOAL 13:** Climate Action	Y
GOAL 2: Zero Hunger	Y	**GOAL 8:** Decent Work and Economic Growth	Y	**GOAL 14:** Life Below Water	
GOAL 3: Good Health and Well-being	Y	**GOAL 9:** Industry, Innovation and Infrastructure		**GOAL 15:** Life on Land	
GOAL 4: Quality Education		**GOAL 10:** Reduced Inequality	Y	**GOAL 16:** Peace and Justice Strong Institutions	
GOAL 5: Gender Equality	Y	**GOAL 11:** Sustainable Cities and Communities		**GOAL 17:** Partnerships to achieve the Goal	
GOAL 6: Clean Water and Sanitation		**GOAL 12:** Responsible Consumption and Production			

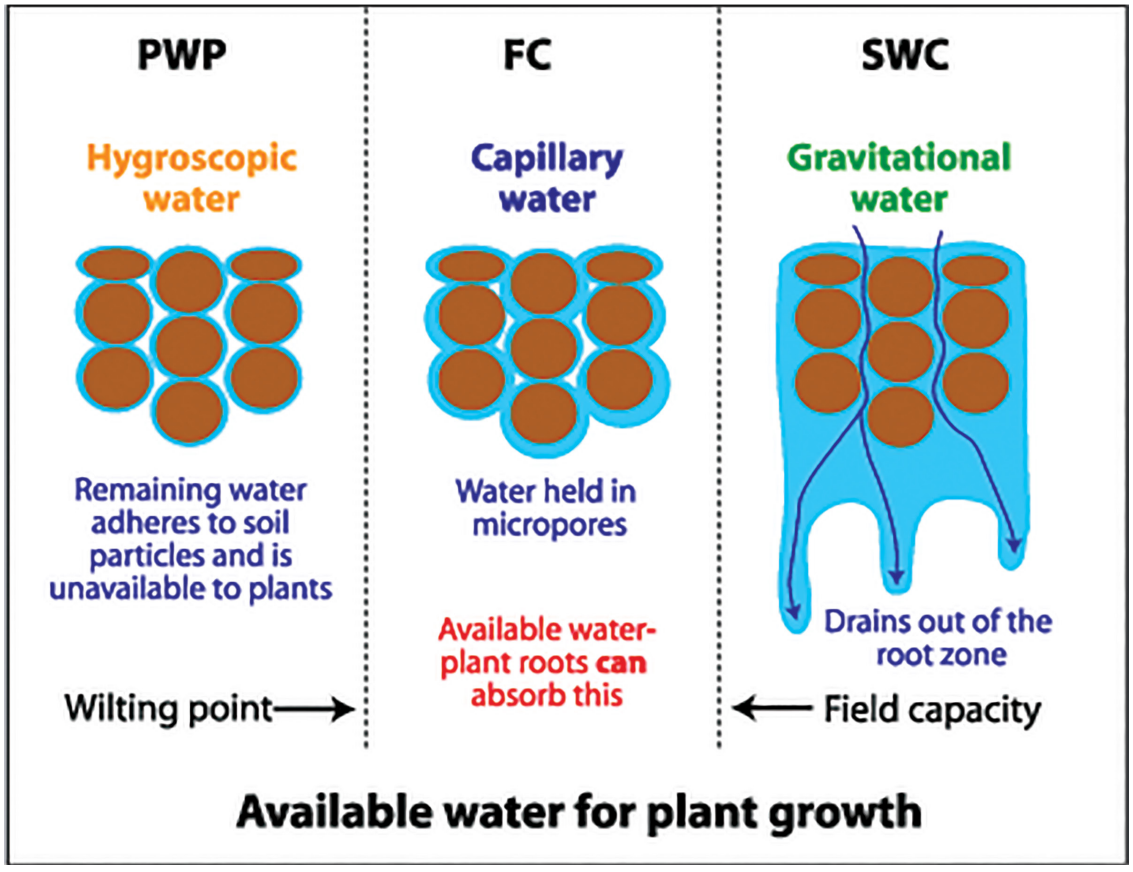
This document is primarily for the project staffs who are expected to implement approximately 1000 schemes benefitting 15-18,000 small and marginal farmers in 3 years' time (2017-2000). Envisaged role and responsibilities are;

a.	Community mobilisation	f.	Facilitate WUG in scheme implementation
b.	Identification and appraisal of irrigation sites	g.	Coordinate with vendors in scheme implementation
c.	Data collection and interpretation	h.	Scheme handover to WUG and
d.	DPR preparation & Approval	i.	Scheme closure formalities (Technical/finance)
e.	WUG promotion and training		

2. Irrigation basics

Irrigation is the controlled application of water to agriculture fields to supply crops with the water requirements not met from water retained in the soil or from natural precipitation during that period. Generally, 2 inches of water is applied per irrigation however, it depends upon various factors like crop, soil type, available soil moisture etc. Irrigation should be applied in right quantity in right time as per the soil moisture condition. There are three (3) such conditions of soil moisture, we need to understand while applying irrigation.

- **PWP (Permanent Wilting Point):** This is hygroscopic water i.e., remaining water adheres to soil particles and is unavailable for the plants. We need to irrigate the crop field in such a way that it should not attain Permanent Wilting Point.
- **FC (Field Capacity):** This is the soil moisture condition conducive for the plant. In this condition the capillary water held in micro pores that is available water for the plant roots to absorb. This is the condition we need to achieve after irrigation.
- **SWC (Soil Water Content):** This is the condition when the water drains out of the root zone of the plant. We need not irrigate the land beyond this point because over irrigation does neither benefit the crop nor the soil /living beings in the soil / beneficial microorganisms.



Command area is area which can be reliably irrigated from a water source; it is expressed either in hectare (Ha) or Acre (Ac). 2.5 acres is one Hectare.

Locally other terms like *bigha* and *kattha* are also used, but this varies from state to state or even change within small geographical area within a state or even district.

Catchment area: Is the geo-hydrological unit which drains at a common point. If a scheme receives water from drainage line (stream/river etc.) area from which that drain receives water is the catchment area.

Elevation: The elevation of a geographic location (the command area) is its height above or below a fixed reference point (Water source). The elevation difference from the water source level to the highest point in the catchment (Last outlet) is also known as the **Static Head.**

Friction Head Loss: When the fluid passes through a pipe, the inner surface of the pipe resists the flow due to friction, resulting into friction head loss. Velocity or fluid discharge is proportional to friction head loss. Length of pipe is also proportional to friction head loss. Higher diameter pipe has less friction head loss than lower diameter pipe.

Total Head: This is the sum of the static head, friction head loss and miscellaneous head losses that occurs while the pump runs and the fluid passes through the pipeline, bends, NRV, foot valve etc. fittings used in the irrigation system. This needs to be computed before selecting the pump.

NRV (Non Return Valve): This is a valve that should be used in every irrigation system that allows water to flow from the pump side to the main pipe line and does not allow water to flow back when the pump stops. This valve helps mostly in two important aspects.

- The water remains stored in the main pipeline during the test run. Hence, the outlets discharge water immediately whenever the pump is run next time.
- The water stored in the main pipeline can be used for priming the pump, whenever necessary.

Outlet: This is the point where water is delivered from the main pipeline. One irrigation system can have multiple outlets. The main pipeline is buried around 1meter below the ground and the outlet generally uses a TEE joint along with the Riser assembly having some reducers to deliver the water at ground level. The outlets should be kept exactly at the ground level and it should never be raised high to avoid the risk of getting damaged by the temperature fluctuations / animals / Community conflict and many other factors.

Foot Valve: This is the most important part in the pumping system that helps to keep the water filled in the suction pipe and the pump housing. This allows water to flow only in one direction i.e., towards the pump from the source.

Suction Pipe: This is the pipe used from the Foot valve to the pump. This should be laid as straight as possible or having smooth curve. It should allow the foot valve to remain at least 3 feet above the bed level of the water source. This should remain vertical in the water so that the foot valve operates properly.

Delivery pipe: This is the pipe carrying water delivered from the pump to the NRV.

Main Pipe line: This is the pipeline (generally PVC) buried approximately 1 meter underground that carries water from the NRV to the outlets.

How much water is available for Irrigation? Jharkhand receives 1255 mm (49.4 inch) rainfall on an average per annum, 80% during June to September (monsoon months). **Almost** 80% of annual rainfall is drained to lower regions facilitated by drainage system (natural slope of land/gullies/ streams/rivers). Remaining 20% of rainfall is stored in water harvesting structures (pond/tank/ dobha etc.) that is visible and can be seen through naked eyes. There is one more part, invisible and ignored, water entrapped in soil/land mass due to soil saturation that occurs naturally. After monsoon months the water stored in soil and water harvesting structures is released slowly till summer ends through the drainage system. Most of the villages of Jharkhand are located close to one or more rivers/streams where there is continuous water flow till summer.

Sources of water: Sources of irrigation water are surface water (river/streams/reservoir/tank etc.) and groundwater (dug well/tube well)

2.1 Design of an irrigation Scheme (Step by step Approach)

Sl. No.	Checklist	Tasks to be done
1	List of farmers	Application with Format containing *khata* and plot number
2	Assessment of the historical background	Cause of the failure of previous irrigation scheme / crop cultivation, if any? How to overcome? Any social norm / infrastructural support?
3	Command Area selection	Low land / paddy fields? Medium upland / Uplands for vegetable even in *Kharif*?
4	Command area Mapping and assessment of land holding pattern	Field visit (Map showing the patches numbered with the lands as per the Sl. No. of the farmer in the list, proposed pipeline, outlets, intake structure and pump house)
5	Inclusion of farmers	Are we benefitting everyone? / Opening for any scope of jealousy / conflict in future for water sharing?
6	Legal MoU, if any	Intake well / pump house in the private / Gram panchayat land should have a legal document / MoU
7	Finalisation of options	Options 1: Gravity flow, 2: Lift using Electricity 3: Lift using Solar, 4: Lift using diesel
8	Assessment of the capacity of the source	Abundant in Summer + *Rabi* / Availability of water during HOLI? sufficient for *Rabi*
9	Technical Survey	Length of the scheme? Static head?
10	Design	Friction head loss? Total head? Specification of Pump, Pipe and fittings?
11	DPR Preparation and Approval	Preparation of detail project report and approval through technical committee meeting
12	Estimation of materials	Quotation from at least 3 suppliers and *Pro forma* invoice to be collected

Sl. No.	Checklist	Tasks to be done
13	Approximate Estimate to be shared with the community	Details of component wise cost and total estimate, subsidy, loan, grant and contribution etc. needs to be discussed and mutually agreed with formal resolution
14	Bank account opening of the WUG	Savings bank account in the name of the WUG should be opened with the resolution authorising 2 leaders out of 3 (President, Secretary and Treasurer)
15	Farmers' contribution	Collection should be shared on the basis of land holding?
16	Labour contribution	Trench digging for pipe laying and fitting and intake structure construction and installation / commissioning
17	Group ownership	Norms for water distribution, conflict resolution, water charges collection etc.
18	Training at regular interval	Motivation, leadership, communication etc. soft skills to be developed along with running and maintaining the scheme.

Before we enter into basic calculations related to irrigation design we need to know some units of measurements and conversions.

2.2 UNITS OF MEASUREMENT AND CONVERSION TABLE

LENGTH

Millimeters	Centimetrs	Meters	Kilo meters	Inches	Feet
Mm	cm	M	Km	In	ft
10	1	0.01	0.00001	0.393701	0.032808
1000	100	**1**	0.001	39.37008	**3.28084**
1000000	100000	1000	1	39370.08	3280.84
25.4	2.54	0.0254	0.000025	**1**	**0.083333**
304.8	30.48	**0.3048**	0.000305	**12**	**1**

AREA

Imperial Unit	Unit Symbol	Imperial Equivalent	Metric Equivalent
square inch	in^2		1 in^2 = 6.4516 cm^2
square foot	ft^2	1 ft^2 = 144 in^2	**1 ft^2 = 0.0929 m^2**
square yard	yd^2	1 yd^2 = 9 ft^2	1 yd^2 = 0.8361 m^2
Acre	Acre	**1 acre = 4840 yd^2 =43560 ft^2**	**1 acre = 4046.9 m^2**
square mile	$mile^2$	1 $mile^2$ = 640 acres	1 $mile^2$ = 2.59 km^2

Metric unit	Unit Symbol	Metric Equivalent	Imperial Equivalent
Square centimeter	cm^2	1 cm^2 = 100 mm^2	1 cm^2 = 0.1550 in^2
Square metre	m^2	1 m^2 = 10,000 cm^2	**1 m^2 = 10.764 ft^2**
Hectare	ha	1 ha = 10,000 m^2	1 ha = 2.4711 acres
Square kilometre	km^2	**1 km^2 = 100 ha**	1 km^2 = 0.3861 $mile^2$

VOLUME

Centimeter cube	Meter cube	Liter	Inch cube	Foot cube
cm3	**m3**	**Ltr**	**in3**	**ft3**
1	0.000001	0.001	0.061024	0.000035
1000000	**1**	**1000**	61024	**35**
1000	0.001	1	61	**0.035**
16.4	0.000016	0.016387	1	0.000579
28317	**0.028317**	28.31685	1728	**1**

How much water is required for irrigation?

Calculation of irrigation water requirement for 25 Acres, assuming 2 inches of water requirement per irrigation

1 Acre=4047 Square meters = total area = 25 x 4047 = 101175 Sq M

Depth of irrigation: 2 inches= 2 x 0.0254= 0.0508 meters (1 inch= 0.0254 meters)

Volume of water required to irrigate = 101175 (A) x 0.0508 (D) = 5139.69Cum = 51, 39,690 litres

Irrigation interval: Irrigation interval is number of days between two consecutive irrigations, it varies from crop to crop and also several other factors like variety, land location, soil type, climatic condition etc.

Let's assume irrigation interval as 14 days.

Water volume per day-Litres per day (LPD) = 5039690/14= 3, 67,120 litres

The irrigation is through a pump, let's assume it runs for 12 hours a day

Water volume per hour (Litres per Hour, LPH) = 367120/12= 30593 litres per hour

Water volume per minute (Litres per minute LPM) = 30593/60= 510 lpm

Water volume per second (Litres per second, LPS= 520/60= 8.5 lps

Let's assume irrigation efficiency as 80% = 8.5lps / (80/100) = 8.5lps /0. 8= 10.6 lps

Hence, required discharge for irrigating **Command area:** 25 acres of land with **depth of irrigation:** 2" per irrigation, **irrigation interval:** 14 days, **hours of operation:** 12 hours per day and **irrigation efficiency:** 80%. Thus, we can say as a thumb rule that approximately 1 lps discharge is needed for 1 hectare of command area.

3. Identification and Appraisal of Irrigation sites

- Irrigation site identification process
- Different appraisal parameters
- Tools and techniques of appraisal

Finalisation of irrigation schemes involves in-depth understanding of technical, social, agriculture and existing utilisation of irrigation in the concerned village. This requires multiple interactions with farmers, data collection, analyses and interpretation to prepare detailed project report (DPR) required for project financing and act as guides to implement the scheme. Before finalising the site it needs to be looked through three major factors i.e., (a) whether it is socially accepted or not, (b) the site is technically feasible or not, (c) whether the scheme will be financially viable or not. DPR preparation is lengthy and time-consuming process which has been simplified through development of web based software to improve data quality, bringing uniformity and meeting timeline.

3.1 Campaign: Like most community development projects awareness generation events are conducted to inform farmers about the irrigation project, site selection criteria, project financing, implementation process, role of farmers, role of project staff etc. These events are referred as Campaign, and are held in project villages, block office and local *haat* etc. Campaign data is captured in prescribed format given as an Annexure-1.

3.2 Farmers Application: Campaign is expected to create interest and demand for irrigation. Interested farmers formally apply for the scheme in a prescribed Application form. This Application has total 15 data point; Name of the key Applicant, Mobile number, Geographical location-district/block/GP/Village/hamlet, Type of water source, local name of water source, duration of water availability i.e., how long water is available in a year, number of farmers, command area, power source, picture of water source andpicture of command area. Farmers' Application form is given as an Annexure-2.

3.3 Desktop Review: Farmers Application is scrutinised by project staff to know if there is suitable water resource and agriculture field nearby. Topo-sheet and Google Map are used to scrutinise the application, sites which have irrigation source and command area in close vicinity are accepted and subjected to further scrutiny. The desktop review form is given as an Annexure-3.

3.4 **Technical Feasibility**: Sites which are found suitable in Desktop review are further subjected to Technical Feasibility. This is detailed analysis of the site, it seeks to scrutinise technical aspects- water sources, command area and socio-economic data. Issues like maximum water level during the flood situation and chances of getting the pump house emerged or damaged are also to be scrutinised at this point of time.

There is chance of rejection/acceptance of a site after Technical Feasibility

3.4.1 **Ground water** is one that is available below the earth surface. Ground water usually is stored in aquifers, which are water pockets beneath the earth surface. The aquifers are steady source of water, after water extraction, through natural process water level is restored through natural process called percolation. The rate of restoration is **neither uniform nor certain** and depends upon lot of characteristics not discussed in this manual.

Sources of water

a. **Ground water** (Dug well, tube well)
b. **Surface water**
b1. Static sources (Reservoir, community tanks)
b2. Dynamic sources (River/stream/ spring)

Dug Well- Existing dug well can be alternative source of irrigation. We can measure the yield of the well which can help us to know whether this well can cater to our proposed command area or not. Generally, we should measure this during April to May, during *Rabi* and summer season.

Capacity of a well		
Assumptions	**Quantity**	**Unit**
Draw down (the drop of water level after pumping)	3	Meters
Time taken to regain the water level (Recharge)	1	Hours
Diameter of the well	3.66	Meters
Calculations		
AREA OF THE WELL		
Diameter of the well	3.66	M
Radius of the well (**Diameter/2 = r) = 3.66 M / 2**	1.83	M
Area of the well (Pi X r X r) **Pi=22/7**	10.5	Sqm
Depth of draw down	3	Meters
Volume of water recharged **(Area X Depth)**	31.534	Cum
1 Cum = 1000 Lit	31534	Lit
Yield / Capacity of the well		
Time taken to recharge	1	Hours
Water recharged in an hour **(Litres per Hour (LPH)**	31534	Lph
Water require in a minute **(Litres per Hour (LPM)**	526	Lpm
Water require in a second **(Litres per Second (LPS)**	9	Lps

Hence, we can say that this well can irrigate approximately 9 hectares of land as per the thumb rule.

Tube well: Irrigation from tube well is costly and good for individual asset, due to limitation in water and command area that can be irrigated it's not much preferred for community irrigation.

3.4.2. Surface water: Surface water is one that is visible along with quantity that could be harvested from sub surface, the invisible part. Surface water further could be categorised as static and dynamic.

Static surface water source: Static is one which is fixed and stored, viz. Reservoir or community tank etc. It's easy to calculate the volume of the water and volume available for irrigation, total water depth minus dead stock that may be required by the community for multiple purpose including fish cultivation.

Volume of water:

Reservoir/tank= Submerged area (m2) x depth of water (m)

Dynamic surface water sources: Running stream or a river, for which the flow could be determined by volumetric measurement of water and most importantly how long does it flow, to which months the stream flows.

Initial assessment is physical observation, and simple technique could be by placing stones to get rough idea about how much is the flow. In the adjoining picture, roughly it indicates there is plenty of water for at least 3-4 irrigation schemes. Time of water flow is important i.e., till which month of the year.

Actual assessment is done by calculating the volume of water moving down a stream per unit of time. It is expressed in cubic meter per seconds (Cusec) or litres per second (Lps) as per the requirement.

Bucket method

The bucket method is a simple way to measure the flow rate for small streams and rivers using household bucket.

Step-1: Measure the volume of the bucket (using 1 litre plastic water bottles easily available in villages).

Step-2: Determine time how long it takes to fill the bucket with water.

Step-3: Take minimum three readin gs and then

Step-4: Take the average.

Float method: First of all we need to identify or dig out a stretch of uniform cross section in the stream and then only we can calculate the capacity of that stream.

Capacity of a stream		
Assumptions	**Quantity**	**Unit**
Top width of the cross section of the flowing water	0.75	Meters
Bottom width of the cross section of the flowing water	0.5	Meters
Depth of water	12	Cm
Average time taken by the dry leaf to cover the distance fixed	9	Seconds

Capacity of a stream		
Length travelled by the leaf	3	Meters
Calculations		
AREA OF THE Cross section of the flowing water		
Top width of the cross section of the flowing water	0.75	Meters
Bottom width of the cross section of the flowing water	0.50	Meters
Average width **(Top + Bottom) / 2**	0.63	Meters
Depth of water	12	Cm
1cm = 0.01M	0.12	Meters
Cross sectional area of the flow (With X Depth)	0.08	Sqm
Length travelled by the leaf	3	Meters
Volume of water = **Area X Length = 0.08 M2X 3 M**	0.226	Cum
1 Cum = 1000 Lit	226	Lit
Yield / Capacity of the stream		
Time taken to travel: **9 seconds for 226 litres**	9	Seconds
Water flowing in the stream in **one second**	25	Lps
Actual capacity is 2 / 3rd of the above calculation as the velocity of water touching the ground is less than the top where we used the float	**17**	**Lps**

We can say that this stream can irrigate approximately 17 hectares of land as per the thumb rule.

3.4.3 Command area:

Discharge needed by the pump is assessed on the **Total area of the command, elevation and distance**

Total Area- What is the total area expressed in Acres/Hectare.

Elevation of command from water source, it influences cost of project, pump ratings, pipe quality and water flow. Less than 20 meters are preferred.

Distance of command area from source, nearness of command area to water source. It should be less than 1000 meters to last outlet.

(Based on water availability and command area details it is possible to accept /reject a site, sites are which are found suitable at this stage are explored/scrutinised)

3.4.4 Social economic status- Whose land, social groups, class, land distribution farmers, absentee landlord/farmers, small and marginal farmers, single woman, Mahila Kisan.

Preferred group	Nos	Land holding pattern	Nos
Woman headed households		Farmers having less than 2.5 acres land	
SC		Farmers having 2.5 to 5 acres land	
ST		Farmers having 5 to 7.5 acres land	
OBC		Farmers having more than 7.5 acres	
General			

3.4.5 SHG/NRLM connects: Creation and utilisation of community assets demands collective action. Self Help Groups wherever exist has demonstrated sharing of common goal, collective decision making, mutual support and working for uplifting its members.

So, it is ideal to include families who are in SHG fold, promoted by NGOs or National Rural Livelihood Mission (NRLM).

- ✓ It is advisable to exclude villages where there is no SHG.
- ✓ Families who are not in SHG fold may be advised to join SHG functioning nearby or form into a new SHG.
- ✓ It is advised to identify and capacitate *Mahila Kisans* for project sustainability.

3.4.6 Village Livelihoods: Most rural families are dependent upon agriculture and allied activities for survival. But there is gradual shift and inclination by significant proportion of rural families for other livelihood sources and earnings; viz., seasonal migration, contractual workers etc. It would be better to know if the proposed village is one such and reasons explored for disinterest to engage in agriculture and how irrigation scheme would create interest and bring them back into agriculture.

(Total families-)

Livelihoods	Families	% of families	Proportion of family income				
			100%	75%	50%	25%	Less than 25%
Agriculture							
Livestock							
Forest produce							
Wage Labour							
Migrant labour							
Others							

Exact quantification might be cumbersome and difficult, rough estimate would be helpful to know the scheme.

3.4.7 Agriculture status: Interest in agriculture could further be assessed from agriculture practices and productivity level. Present land use and more specifically the command area give vital information on how the irrigation infrastructure would be utilised post implementation. Irrigation means extra upfront expenditure required to run and maintain the system. If agriculture is not above the thresholds, and generate surplus to meet all recurring costs of irrigated agriculture, the scheme would remain underutilised or even become defunct.

Training on agriculture- Have the farmers received any training from NGOs/Agriculture department? Are they part of livelihoods programme of SRLM?

Training to improve resource (Land and water): Have they benefitted from MGNREGA, DRIP/ Sprinkler, any step to improve soil, water holding capacity?

Training on crops: What are the recent practices adopted to minimise cost of cultivation, increase production, improve quality, and manage pest and disease?

3.4.8 Irrigation history in the village:

Most Indian villages have some percentage of irrigated land. Utilisation of present irrigated land in the village would give overall understanding of the actual demand for irrigation, how the command area would be used and ability to manage irrigation asset (Community), inclination to pay for services etc.

Irrigation source/asset: What are the sources of irrigation (Private/community), Cost of irrigation-per acre cost, system of payment etc.

Irrigated area: How much % of land is irrigated, how many farmers have access to irrigation, season wise crops mix, agricultural practices (in terms of seeds/ seed rate/ nursery/ intercultural operations/ crop protection measures etc.) season wise crop productivity, household food and nutrition security addressed, profitability per unit of land etc.

Linkages: Institutional and market linkages for inputs and output.

These are broad questions that would give enough indicators of concerted efforts to improve agriculture where Irrigation is one of the critical missing links that farmers are keen to address in partnership with different stakeholders.

FINAL ASSESSMENT OF A SITE

Parameters	A (5) Satisfactory	B (3) Moderate	C (1) Reassessment after 6 months	D (0) Reject
No. of farmers	10-25	26-35	>35 farmers	If farmers are less than 10
Land in the command	90% land owned by 90% farmers	90% land owned by 60% farmers	90% land owned by 50% farmers	90% land owned by 10-20% farmers
NRLM connect (farmers are members of SHG)	All families included in SHG	>75% families included in SHG	<75% families included in SHG	Reject if none are included in SHGs
Village Livelihoods (Household income from Agriculture)	> 80% families	80-50 % families	50-25% families	< 25%
Irrigation history in the village (utilisation of existing irrigation source by farmers)	> 80% families	80-50 % families	50-25% families	< 25%
Linkages –market and institutional (farmers market transaction for agri-produce and input)	> 80% families	80-50 % families	50-25% families	Zero transaction

(The sites which meet all the criteria listed above are subjected to further scrutiny, through conduct of Technical Survey)

4. Technical survey:

Importance of technical survey,

Technical survey interpretation and Scheme design

Equipment required:

a. Levelling staff b. Tripods stand c. Auto level

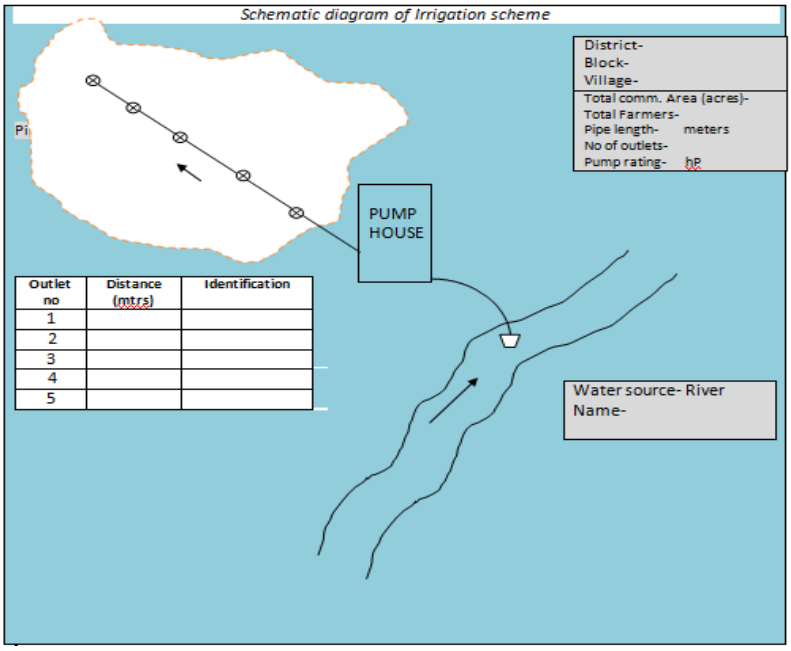
Technical surveys are conducted to assess the following;

(i) measure water quantity, (ii) suction point (exact location of from where the water is available), (iii) location of pump house, (iv) placement of pump, (v) command area estimation, (vi) Elevation of command (vii) length of pipe line, (viii) location of outlets and (ix) lateral extensions.

Point no. vi and vii are estimated through conduct of survey using Auto/dumpy level. Auto level consists of a telescope fitted with a spirit **level** and, generally, mounted on a tripod. The technical survey is done by the Technical Supervisor (TS), and it is possible to teach community people to conduct the same too. The format of the technical survey is attached below.

4.1 Suction point: The exact location of suction point is decided. The suction point should be such that the vertical distance from suction to pump house or pump location should be less than 20 ft.

Receding water- the receding water is an issue, it happens with stream/reservoir. But in case of reservoir if the submergence and shift is very rapid then it becomes a matter of concern.



4.2 Location of pump house: Is there a suitable place for pump house? Since pukka house is constructed, land should be firm and solid to support the civil structure. Another importantly aspect is who owns the land? Private/community/Government. If it's private land prior no objection certificate be obtained, specifying that s/he is willing to donate the land for community use as long as the irrigation asset remains usable.

4.3 **Placement of pump**: Ideally be done inside the pump house, but in some cases where the water source is much below the flood line, there is requirement of having pump foundation outside the pump house.

4.4 **Command area estimation**: Exact area of command be calculated summing up land each farmer owns in that command. As far as possible it should be from land records, if available. In absence of the same, PRA triangulation exercise is conducted. The data may be cross checked using mobile app.

4.5 **Pipeline Direction**: The command area is demarcated in cadastral map showing the exact path for laying the pipe including the need for lateral extensions required. As far as possible, the pipe line should be kept straight having minimum bends and curves which contributes to dynamic head and reduce water availability in the command.

4.6 **Outlet locations**: Number of outlets and exact locations of outlets need to be mutually agreed with community. Outlets are for efficient water distribution. For 1 kilometres of pipe line, 4 to 5 outlets is sufficient for up to 30 acres of command area. The location of L**ast outlet is the** highest elevation of the command area.

4.7 **Calculating total head:**

The total head against which the pump has to work: Total Static head + Friction loss in the pipeline + miscellaneous friction losses

Total static Head (A)	Friction loss in the pipeline (B)	miscellaneous friction losses (C)
Obtained from Technical survey	Derived by multiplying length of pipeline x friction loss per unit length in the pipe of selected diameter from the **friction chart**	Losses in fittings like foot value, NRV, bend, outlet and so on (10% A+B)

4.8 **Technical Survey Data**

B S	I S	F S	UP	LOW	HI	Dist	Cum Dist	RL
3.15	1.4		3.64	2.66	3.15	98	98	1.75
		0.56	0.74	0.38	3.15	36	134	2.59
3.84	1.4		4.13	3.55	6.43	58	192	5.03
		0.36	0.57	0.15	6.43	42	234	6.07
3.66	1.4		4.1	3.22	9.73	88	322	8.33
		0.33	0.49	0.17	9.73	32	354	9.4
2.08	1.4		2.15	2.01	11.48	14	368	10.08
		0.82	0.98	0.66	11.48	32	400	10.66
4.92	1.4		5.56	4.28	15.58	128	528	14.18
		0.36	0.51	0.21	15.58	30	558	15.22
2.34	1.4		2.52	2.16	17.56	36	594	16.16
		0.82	0.99	0.65	17.56	34	640	16.74

Technical Survey-Irrigation sites						
Applicant Name: Date - __ /__ /____ District - Block - Gram Panchayat- Village- Water source type : River/Stream/Reservior-Dam/Talab/Others; Local Name of the source: Site identification/Local Name : Location of Pump house: Distance from water source: mts. Height: mts.						
Water Source Alti-tude		Mts.	Latitude		Longitude	

SL	Back sight	Fore sight	UR	LR	Identification/ name of spot, also mark the outlets proposed	Out let Nos	Ap-prox. Farm-ers	Approx. Area (Acre)
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
						Command Area (Acre)		
Last Outlet Alti-tude		**Mts.**	**Lati-tude**			**Longitude**		

Do you suggest Intake well ---(Yes/No)

No

Farmers present

1

2

3

Cell No

Name of Surveyor

Designation

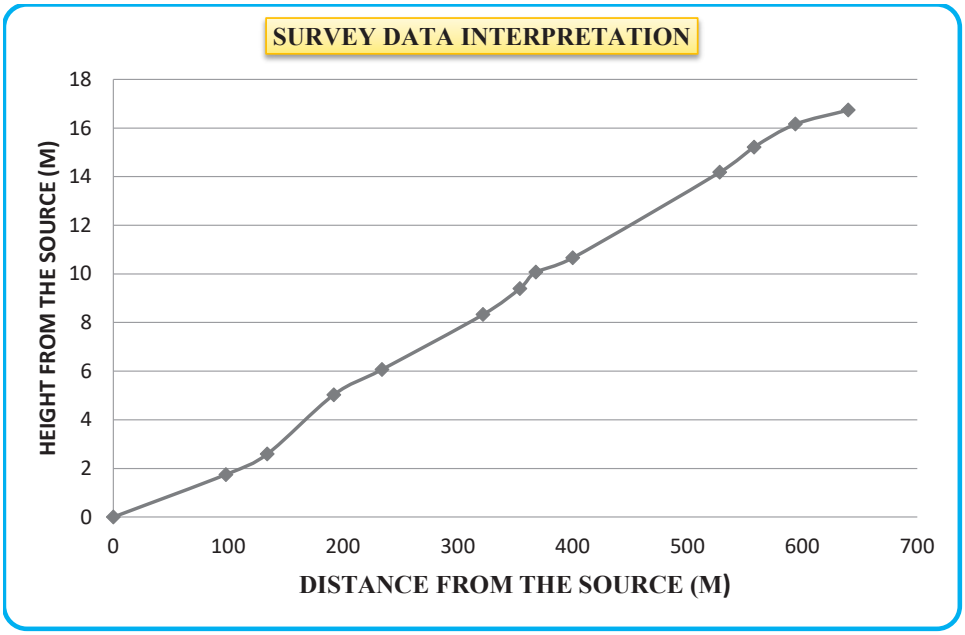
Signature:

Please draw a sketch on the back side of this page showing proposed pipe line (1 m below the ground) with approximate distance and outlets. Please also mention latitude, Longitude of the intake point and outlets.

4.8.1 Pipe Length-640 mts

Static Head	Frictional Head Loss	Miscellaneous Head Loss	Total Head	*Required Discharge	Type of Pump	Design Discharge	Pipe dia
16.74	1.0	1.77	19.52	8	Solar	9	160

Survey data graph showing Land ascent from water source to proposed commnad area



4.9 FRICTION HEAD LOSS CHART

FRICTION LOSS (M/100M) IN FLOW OF WATER THROUGH PVC PIPES

Discharge	PVC Pipe dia. in mm									
in (lit/sec)	75	90	110	125	140	160	180	200	225	250
5	3.759	1.547	0.381	0.215	0.129	0.053	0.036	0.018	0.013	0.007
6	5.267	2.167	0.534	0.301	0.18	0.074	0.05	0.025	0.018	0.01
7	7.004	2.882	0.71	0.4	0.24	0.099	0.067	0.033	0.024	0.014
8	8.967	3.69	0.909	0.512	0.307	0.126	0.085	0.043	0.031	0.018
9	11.15	4.589	1.13	0.637	0.381	0.157	0.106	0.053	0.039	0.022
10	13.55	5.576	1.374	0.774	0.463	0.191	0.129	0.064	0.047	0.026
11	16.163	6.651	1.639	0.923	0.553	0.227	0.154	0.077	0.056	0.032
12	18.986	7.813	1.925	1.085	0.649	0.267	0.181	0.09	0.066	0.037
13	22.016	9.06	2.232	1.258	0.753	0.31	0.21	0.105	0.076	0.043
14	25.251	10.391	2.56	1.442	0.864	0.355	0.241	0.12	0.088	0.049
15	28.689	11.806	2.908	1.639	0.981	0.404	0.273	0.136	0.099	0.056
16	32.327	13.303	3.277	1.847	1.105	0.455	0.308	0.153	0.112	0.063
17	36.164	14.882	3.666	2.066	1.237	0.509	0.345	0.172	0.125	0.071
18	40.197	16.542	4.075	2.296	1.375	0.566	0.383	0.191	0.139	0.079
19	44.426	18.282	4.504	2.538	1.519	0.625	0.423	0.211	0.154	0.087
20	48.848	20.102	4.952	2.79	1.67	0.687	0.466	0.232	0.169	0.095

Discharge	PVC Pipe dia. in mm									
in (lit/sec)	75	90	110	125	140	160	180	200	225	250
21	53.463	22.001	5.42	3.054	1.828	0.752	0.509	0.254	0.185	0.104
22	58.268	23.978	5.907	3.329	1.993	0.82	0.555	0.277	0.202	0.114
23	63.262	26.033	6.413	3.614	2.163	0.89	0.603	0.3	0.219	0.124
24	68.444	28.166	6.939	3.91	2.341	0.963	0.652	0.325	0.237	0.134
25	73.813	30.375	7.483	4.217	2.524	1.039	0.703	0.35	0.256	0.144
26	79.368	32.661	8.046	4.534	2.714	1.117	0.756	0.377	0.275	0.155
27	85.107	35.023	8.628	4.862	2.91	1.198	0.811	0.404	0.295	0.166
28	91.03	37.461	9.228	5.2	3.113	1.281	0.867	0.432	0.316	0.178
29	97.136	39.973	9.847	5.549	3.322	1.367	0.926	0.461	0.337	0.19
30	103.423	42.56	10.485	5.908	3.537	1.455	0.986	0.491	0.359	0.202
31	109.891	45.222	11.14	6.277	3.758	1.546	1.047	0.522	0.381	0.215
32	116.539	47.958	11.814	6.657	3.985	1.64	1.111	0.553	0.404	0.228
33	123.366	50.767	12.506	7.047	4.219	1.736	1.176	0.586	0.428	0.241
34	130.371	53.65	13.216	7.447	4.458	1.835	1.242	0.619	0.452	0.255
35	137.553	56.605	13.945	7.858	4.704	1.936	1.311	0.653	0.477	0.269
36	144.912	59.634	14.691	8.278	4.956	2.039	1.381	0.688	0.502	0.283
37	152.447	62.734	15.454	8.708	5.213	2.145	1.453	0.724	0.528	0.298
38	160.156	65.907	16.236	9.149	5.477	2.254	1.526	0.76	0.555	0.313
39	168.04	69.151	17.035	9.599	5.746	2.365	1.601	0.798	0.583	0.328
40	176.098	72.467	17.852	10.06	6.022	2.478	1.678	0.836	0.61	0.344

Friction loss per 100m = 1.152 * 10^8 * Q^1.85 / d^4.87, where, Q is in lps and d (internal dia) is in mm

While designing lift irrigation, diameter of pipe should be selected by keeping friction head loss within 0.5 m in 100m of pipe length

5. Power sources:

Power to propel water through pipes from source to command area is critical in designing the irrigation system.

5.1 **Gravity**: Force of gravity is source of power for schemes where the water is available above the command area, it's mostly found in hilly areas, where there is perennial spring. This type of schemes does not require any pump but only pipe line is required that acts as conduit. Gravity schemes are the cheapest having almost zero operating & least maintenance cost involved.

5.2 **Lift Irrigation:** The command area is located above the water source. Irrigation in such sites requires pump set and pipe line. Existing energy sources are diesel, electricity and solar. Each of these energy sources has merits and demerits as summarised below.

5.2.1 **Diesel**: It is still the most widely used energy source for irrigation pumps. It is available easily and no more a scarce resource. Similarly, there are plenty of reputed companies who manufacture diesel pumps of varying shapes and sizes from 0.5 to 30 Hp and available through outlets in each and every corner of the country, probably in all block headquarters. There is well developed service sector for repair and spares. The diesel pumps are not very costly but the running cost is becoming high, gradually.

5.2.2 Electricity: There is issues and challenges in having electricity as energy source for irrigation pumps even for villages which are electrified, firstly because the site might be away from settlement which mostly are electrified, and separate investment required for connecting the sites with existing line. On top of this supply of electricity is not very reliable. The cost of electric pumps is similar to diesel where maintenance cost is a little cheaper.

5.2.3 Solar: In last 5-7 years, solar energy has emerged as the new energy source for irrigation. There are multiple agencies that provide solar irrigation set. Solar run system has unique characteristics; it can be located anywhere in India. There are certain regions where solar power capture is more efficient like Rajasthan, Haryana and Punjab, all southern states are better compared to eastern and North Eastern States. Solar system however has limitation like it works only when there is sun or during the day time.

However, it has disadvantages also, the solar system has captive solar power generation, from solar panels/plates, which are kept in open. There are incidences of theft too. Solar plates are also brittle and prone to damage. These points should be discussed with the farmers for choosing what suits them most and how to optimise the resources by taking proper watch n ward for the assets thus created. The community need to be oriented properly as to how to increase the life span of the assets created including theft and damages.

6. Pump Selection

How to read pump performance chart

Know pump selection process

The selection of pump is dependent on total head and required discharge. Additionally which power source is preferred?

Pump Selection: Pump performance tables of different manufacturers are available, which helps to choose the pump, based on the Total Head and required discharge. Some sample performance charts are available below for reference.

Sample pump selection chart

Approximate performance of KDS+/KDS++ Series, 2 Pole, Monoblock Pumps, at Rated Voltage, 50Hz, Three Phase A.C. Power Supply:

Model	Power Rating		Pipe Size (mm)	Rated Voltage (Volts)	Total Head (meter)															
	KW	Hp			6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	40
					Capacity in litres per second																
KDS-216+	1.5	2	65×50	415	11	10	8.8	7.2	4												
KDS-225++	1.5	2	50×40	415		5.3	5.2	4.9	4.8	4.5	4.3	3.9	3.6	3.1	2.3						
KDS-314+	2.2	3	80×80	415	19	18	16	14	10												
KDS-318++	2.2	3	80×65	415		13	13	12	11	9.2	7.5										
KDS-325++	2.2	3	65×50	415			9.2	8.8	8.4	7.9	7.4	7	6.4	5.8	4.9						
KDS-335++	2.2	3	50×40	415				5	4.9	4.8	4.7	4.6	4.4	4.2	4	3.8	3.6	3.2	2.7	2	
KDS-515+	3.7	5	100×100	400		33	31	28	24	19	13										

Model	Power Rating		Pipe Size (mm)	Rated Volt-age (Volts)	Total Head (meter)																
	KW	Hp			6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	40
					Capacity in litres per second																
KDS-520+	3.7	5	80×80	400	24	23	22	21	20	18	16	14	11								
KDS-527++	3.7	5	80×65	400						14	14	13	12	10	8.7	6.4					
KDS-822++	5.5	7.5	100×100	400				27	26	24	22	20	18	15							
KDS-830++	5.5	7.5	80×65	400						19	18	17	16	15	14	13	11				
KDS-1030++	7.5	10	100×100	415				32	31	30	29	27	25	24	21	18					
KDS-1040++	7.5	10	80×65	415			24	23	23	22	22	21	20	20	19	18	17	16	15	13	9.6
Source: MonoBloc KDS+ KDS++ - Kirloskar Pumps, champaklal.com																					

7. Irrigation infrastructure (Hardware)

Irrigation schemes involve two types of infrastructures; first Civil structures (Sedimentation tank, intake well and pump house) and second category is irrigation equipment; pumps and accessories and pipe and accessories.

7.1 Civil structures

7.1.1 Sedimentation Tank: This is required only in gravity schemes and is used for harvesting the surface water before it is fed to the pipe line. These are not mandatory structures and should be done only if required. Sedimentation tanks are constructed not to store water but to get rid of sediments (sand and small size stones) that water carry and if not checked would choke the pipe line in due course of time.

Cemented structure 6x4 4 (all in feet) with or without covers could be made. Approximate cost is Rs.55,000. (Detailed estimate is furnished in Annexure- 3)

7.1.2 Intake well: Again it's not a necessary structure, required only when there is insufficient water in the stream but substantial water in the sub surface. Over a period of time these structure tends to become irrelevant.

Cemented structure 25 feet Diameter x 20 feet Depth with parameter for safety measures. Approximate cost is Rs.2,50,000/- (Detailed estimate is furnished in Annexure- 4)

7.1.3 Pump House- is to house the pump and other accessories. This is used to shelter farmers during night time for watch n ward too. This is a

mandatory structure. The size is length 10 feet x breadth 10 feet x height 10 feet with four pillars and RCC roof. Approximate cost is Rs.1,50,000. (Detailed estimate is furnished in Annexure- 5)

Additional specification of pump house:

1 no. Door 1m breadth and 2.5 m height

2 nos. Ventilator 0.45 m length 0.3 m breadth

All other specification as per Design & Estimation.

7.1.4 Outlet Chamber: Small cemented structure, length 3ft, breadth 2 ft and depth 2 feet (half buried below the field level. This is a compulsory structure to regulate water flow and reduce soil erosion beside providing protection to outlet that occurs inadvertently. Approximate cost is Rs.5,000. (Detailed estimate is furnished in Annexure- 6)

7.1.5 Trench: PVC pipes are buried 2.5-3 feet below the earth surface. For this purpose trapezoidal shape trench is made and refilled after laying the pipes. Length as per the survey report, trench dimension 2.5 ft top width 2 ft bottom width 3 feet depth. Approximate cost is Rs.5,000 per running length. (Detailed estimate is furnished in Annexure- 7)

7.1.6 Pump foundation:

Pump foundation: Cemented structure with shock absorber materials to install the pump, usually is made inside the pump house. The size is length 3 feet x breadth 2 feet x height 2.5 feet (2 feet buried below the earth surface). Approximate cost is Rs.2000. (Detailed estimate is furnished in Annexure- 8)

7.2 Irrigation equipment:

7.2.1 Pipes: Usually PVC pipes (LDPE /HDPE) are used. They are easy to handle, light in weight and cheaper compared to other materials like galvanised iron etc.

HDPE PVC pipes: As the name indicates, high density polyethylene pipes are stronger, usually black in colour, a bit flexible and can be exposed to sun. HDPE are generally used in suction side pipe entirely. Usually 90-110 mm diameter pipes are used.

LDPE PVC pipe: Light density polyethylene plastic. LDPE is light in weight, not much flexible and cannot exposed to sun. Usually it's buried 2.5 to3 feet below the earth surface. LDPE is used for entire pipe line starting from NRV to all outlets. Conventionally 140-200 mm diameter pipes 2.5 to 4 Kgfcm2 are used.

7.2.2 Foot Valve: Foot valve has sieves floating materials that might clog the pipe line. Foot valve also has a Non Return Valve, which retains water column in the suction pipe. This eliminates necessity of priming the pump.

7.2.3 Non Return Valve (NRV): Is placed at the starting of delivery pipe, to stop water flow back from the delivery pipe when the pump stops. This is very important and in absence of NRV the pressure of water column in the pipe line can unseat/damage the pump and pump foundation. NRV is made up of plastic/iron.

7.2.4 Pumps: Pump manufactured by reputed company and conforming to all ISI specification capable of delivering water as per specification of DPR. Usual range is 5-8 Hp pumps capable of delivering 12-30 Lps water having total head of 15-25 meter.

ADDITIONAL SPECIFICATION GRAVITY SCHEMES

SL. No.	Name of the Item	Specification
1	110-160 mm dia PVC pipe	pressure rating 2.5 – 4 kgf/cm2 (ISI Mark), **Make**- Finolex/Jain Irrigation/Nimbus/Oriplus/Nimbus
2	QRC Outlets	QRC outlets including clamps and other accessories (ISI Mark)

ADDITIONAL SPECIFICATION FOR SOLAR SCHEMES

Sl No	Name of item / Equipment and accessories	Specifications
1	5 Hp or higher power AC Surface water pump	ISI mark 5 Hp AC Surface Solar Water Pumping System (380-415V 3 phase, 50Hz.) delivering water @1, 90,000 litres in 7 hours (per day) at 20 meter height (head). **Make:** Soguna/Lubi/Falcon/Shakti
2	Solar PV Modules	**MNRE APROVED PV modules** – Poly Crystalline solar PV Modules - 5000W including protective enclosure (iron wire fencing) **Make:** Sova/EMMVEE/ Cybermotion
3	Solar VFD controller	Solar VFD Controller AC/DC Changeover suitable to run from grid 440 V three phase with wall mounted pre wired (IP55) Steel enclosure with Earthling System (for enclosure and PV panels) Having following Features: Run-stop-restart mode during the day, capable of detecting dysfunctions of the system and has self-protection features against over-load, under-load and dry run of pump. Harvest maximum solar energy to run the pump for maximum duration in a day by controlling the speed of the motor based on the power availability from solar panel. Inbuilt short circuit/Open circuit Reverse Polarity protection Having remote monitoring system (RMS) so that pumps-installations can be remotely monitored, with data pack for 5 years and full access to data and the server. Data stored (water discharge) should be verifiable in RMS within six months of system installation. Having facility to run from grid supply during rainy season and/or non sunny (cloudy) days. HFV having change over switch and programme option for operating two types of motors. DC cables from PV panels to Pre-Wired Enclosure- PVC sheathed non-armoured flexible 2 core 10 Sq.mm multi - strand copper wire / 1000 Volts. AC cables from Drive to Pump- PVC sheathed non-armoured flexible 4 core 6 Sq.mm multi - strand copper wire as per IS 8130 /1000 volts.
4	HDPE pipe (Delivery & Suction side)	80/110 mm flexible (ISI Mark)
5	PVC Foot valve	PVC foot valve with clamps and fittings (ISI Mark)
6	PVC NRV	PVC NRV with clamps and fittings (ISI Mark)
7	160 mm dia PVC pipes	Pressure rating 2.5 Kgf / Sq Cm (ISI Mark) **Make:** Nandi/Vishal

Sl No	Name of item / Equipment and accessories	Specifications
8	QRC outlets (CI)	QRC outlets (CI) including clamps and other accessories (ISI Mark), QRC outlets with appropriate reducer to fit the PVC pipes of 160 mm dia to the outlets

ADDITIONAL SPECIFICATION FOR DIESEL SCHEMES

Sl No	Name of item Equipments and accessories	Specifications
1	5 HP centrifugal pump Or 8 HP Centrifugal Pump	ISI mark diesel operated 5 HP water cooled engine coupled with suitable pump set delivering 8 to 34 LPS at 6 to 22 m total head, including the foundation, base plate/ channel and all fittings with provision for priming **Make/model pump** Greaves Cotton/Kirloskar
2	HDPE pipe (Delivery & Suction side)	80/110 mm flexible (ISI Mark)
3	PVC Foot valve	PVC foot valve with clamps and fittings (ISI Mark)
4	PVC NRV	PVC NRV with clamps and fittings (ISI Mark)
5	160 mm dia PVC pipes	pressure rating 2.5 Kgf / Sq Cm (ISI Mark) **Make:** Nimbus/ Supreme/Finolex/Jain
6	QRC outlets (CI)	QRC outlets (CI) including clamps and other accessories (ISI Mark), QRC outlets with appropriate reducer to fit the PVC pipes of 160 mm dia to the outlets

7.2.5 Tool Box: Each scheme is supplied with a tool box, to take care of repair and maintenance work. List of tools are given below, preferably of Taparia / Jhalani brand

Sl.	Name of Tool	Size
1	Socket Spanner	1/4" WW
2	Socket Spanner	3/8" WW
3	Socket Spanner	9/16"WW
4	Socket Spanner	7/16" WW
5	Socket Spanner	5/8"WW
6	Ring Spanner	9/16"x5/8"BSW
7	Ring Spanner	5/16"X3/8" BSW
8	Ring Spanner	12x13 BSW
9	D.E. Spanner	1/4" x 5/16" BSW
10	D.E. Spanner	12x13 BSW
11	D.E. Spanner	16x17 BSW

Sl.	Name of Tool	Size
12	D.E. Spanner	8x9 BSW
13	D.E. Spanner	10x11 BSW
14	D.E. Spanner	19x22 BSW
15	Screw Driver	6 mm x 8"
16	Flat File	10 rough
17	Hacksaw Frame	12"
18	Hacksaw Blade	12 x 1/2"
19	L. Handle	210 mm.
20	Plier	6" insulated
21	Steel Hammer	CH 340 Taparia (suggestive)
22	Slide Wrench	12 "

Irrigation equipment's cost:

Materials are procured (a) from market as per requirement, and when the number of schemes are more than 10 it is recommended to invite tender. Cost of items reflected as per tendering done in October 2017.

PRICE SCHEDULE [LOT - I]: GRAVITY BASED IRRIGATION SYSTEMS WITH ITS ACCESSORIES

Date:_____ NCB No: _____ Alternative No:_____ Page N of _____

1		3	4	5	6	7	8	9	10
Line Item No	Description of Goods	Units	Quantity and physical unit	Delivery Date	Unit price EXW [including excise duty if any]	Total EXW price per line item [including Excise Duty if any] (Col. 4 5)	Price per line item for inland transportation, insurance and other services required to convey the Goods to their final destination	GST payable per item if Contract is awarded (in accordance with ITB 14.6(a)(ii)	Total Price per line item
1	140 mm dia PVC pipes	Meters	12500		140.0	1750000	247242	359504	2356746
2	QRC outlets (CI)	Nos	125		1280.1	160013	21277	32632	213922
3	Tool kit set (as per list)	set	25		2550.0	63750	750	11610	76110
4	**Total**					**1973763**	**269269**	**403746**	**2646777**

Name of Bidder : Jain Irrigation Systems Ltd.,Jalgaon (M.S.)

Price Schedule (Lot II) Solar Powered Irrigation Systems with its accessories

1	2	3	4	5	6	7	8	9	10
Line Item No	Description of Goods	Units	Quantity and physical unit	Delivery Date	Unit price EXW [including excise duty if any]	Total EXW price per line item [including Excise Duty if any] (Col. 4 5)	Price per line item for inland transportation, insurance and other services required to convey the Goods to their final destination	GST payable per item if Contract is awarded (in accordance with ITB 14.6(a)(ii)	Total Price per line item
1	5 Hp or higher power AC Surface water pump	nos	475		251879	11,96,42,525	15,00,000	60,57,126	12,71,99,651
2	Solar PV Modules	Watt	2375000		32.00	7,60,00,000	45,00,000	40,25,000	8,45,25,000
3	Solar VFD controller	1 set	475		65000	3,08,75,000	18,00,000	16,33,750	3,43,08,750
4	HDPE pipe (Delivery & Suction side)	50 feet	23,750		83	19,76,753	1,33,114	3,79,776	24,89,643
5	PVC Foot valve	1 No	475		582	2,76,569	17,082	52,857	3,46,508
6	PVC NRV	1 No	475		582	2,76,569	17,082	52,857	3,46,508
7	160 mm dia PVC pipes	500 mts	237500		186	4,42,70,000	29,05,219	84,91,539	5,56,66,758
8	QRC outlets (CI)	5 Nos	2375		1280	30,40,238	1,87,779	5,81,043	38,09,060
9	Tool kit set (as per list)	I set	475		2550	12,11,250	74,813	2,31,491	15,17,554
	Total					27,75,68,903	1,11,35,089	2,15,05,440	31,02,09,432

Name of Bidder : Jain Irrigation Systems Ltd.,Jalgaon (M.S.)

PRICE SCHEDULE LOT-III DIESEL POWERED IRRIGATION SYSTEMS WITH ACCESSORIES									
1		3	4	5	6	7	8	9	10
Line Item No	Description of Goods	Units	Total Quantity and physical unit	Delivery Date	Unit Price EXW (Including Excise duty if any)	Total EXW price per line item (Including excise duty if any (col 4 5)	Price per line item for inland transportation, insurance and other services required to convey the Goods to their final destination	GST payable per item if Contract is awarded (in accordance with ITB 14.6(a)(ii)	Total Price per line item
1	5 HP centrifugal pump	Nos.	500		35280	17640000	1993761	3534077	23167838
2	8 HP centrifugal pump	Nos.	1		42000	42000	4747	8414	55162
3	HDPE pipe (Delivery & Suction side)	Sq. ft.	25000		83	2080793	301515	428815	2811123
4	PVC Foot valve	Nos	500		582	291125	38711	59370	389207
5	PVC NRV	Nos	500		582	291125	38711	59370	389207
6	160 mm dia PVC pipes	mts	250000		186	46600000	6583706	9573067	62756773
7	QRC outlets (CI)	Nos	2500		1280	3200250	425539	652642	4278431
8	Tool kit (As per list)	set	500		2550	1275000	169538	260017	1704554
Total						**71420293**	**9556228**	**14575774**	**95552294**

Name of Bidder : Jain Irrigation Systems Ltd.,Jalgaon (M.S.)

Financing: The entire cost of the scheme is borne by Government of Jharkhand.

- ✓ However it is advisable to have some contribution from farmers,
- ✓ Rs1,000 per acre of land for farmers having less than 2.5 acres of land
- ✓ Rs.2500 per acre of land for farmers having 2.5-5 acres of land
- ✓ Rs.5000 per acre of land for farmers having more than 5-10 acres of land
- ✓ Rs.10,000 per acre of land for farmers owning more than 10 acres of land

The total contribution be collected in bank account opened in the name of Water Users Groups after project is sanctioned and before the scheme implementation. This fund be utilised as per WUG rules and regulations discussed in chapter 10.

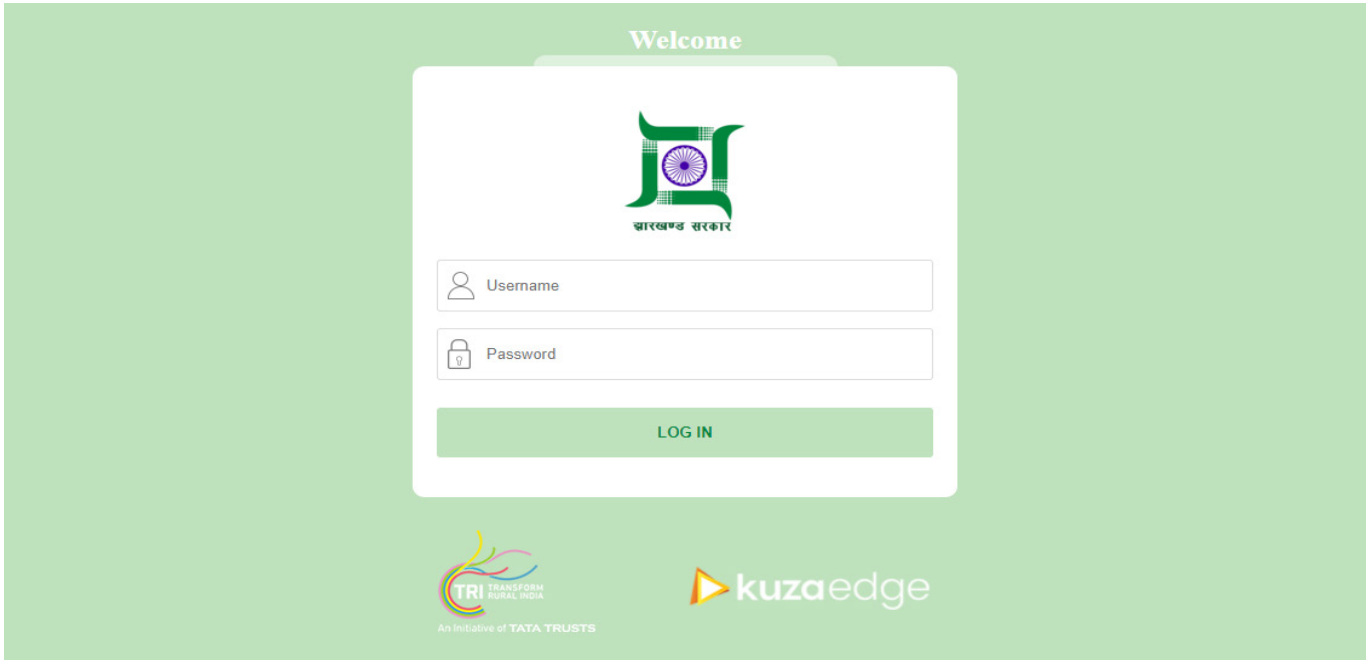
8. Irrigation software

Designing of irrigation schemes involves capturing, analysis and interpretation of real time data related to water source, command area, farmers details etc. Data collection starts on the first day when project staff interact with farmers of a site, come to know about reliable water source, command area nearby and farmers socio-economic data. The interaction with farmers continues and more information is collected to validate the scheme and finally turn it into a project proposal for financing. Field data analysis, computation and designing irrigation system and DPR preparation is time consuming and monotonous, if scale is large.

Web based Irrigation Software was envisaged and developed to generate site wise DPR. The field interaction, data collection, site feasibility are segregated and assigned to different project staff based on their skill set and project responsibility.

Cloud Application: http://jmis.kuzaedge.com/jmis

Tab Application: http://jmis.kuzaedge.com/app



Activity: Campaign, Desktop review, Technical Feasibility, Technical survey.

Project staff: Community Field Supervisor (CFS), Technical Supervisor (TS), Block Project Manager (BPM)

Activity matrix:

Activity	Purpose	Time line	Responsibility
Campaign	Create awareness about the irrigation project	-	Community Field supervisor
Farmers application	Demand generation	7-15 days after the campaign	Community Field supervisor
Desktop review	Data validation- Water source, closeness of command area to water source from secondary data source-Topo-sheet and Google Map	Within 7 days of receipt of Farmers Application	Block Project Manager
Technical Feasibility	Detailed site verification, data (water source, land data, crop, practices, farmers socio and economic data, market etc.	Immediately after desktop review	Block Project Manager
Technical survey	**Auto level survey** of sites to determine site elevation wrt water source and length of pipe line	Only for sites which are technically feasible. Within 7 days of Technical Feasibility report	Technical Supervisor
Farmers data	Family member details, land data, existing and proposed Crop mix, crop productivity, price realisation	Only for sites which are found suitable after Technical survey. Within 7 days of Technical survey	Community Field Supervisor

9. Project Sanction and fund disbursement

The DPR, having details of the irrigation including cost estimates, are accorded Technical sanction and Administrative approval by competent authorities. In case of Jharkhand state, there is a Technical Committee, constituted by the Department of Rural Development, Government of Jharkhand to scrutinise and sanction the DPR. However, the technical committee can be constituted or reconstituted depending on the necessity. Technically sanctioned schemes are further given administrative approval by the Chief Executive Officer, JSLPS.

Subsequently, the fund disbursed to the Village organisation/Water Users Groups for civil works and a communication both to the empanelled vendor as well as the VO/WUGs for installation of Solar/Diesel/gravity powered irrigation system. Payment for all components of the scheme is done by WUG/VO.

10. Scheme Implementation

10.1 Block Level Planning Meeting: Post sanction block level meeting is organised to appraise the concerned Village Organisations and Water Users Groups . This event is attended by block level i-PFT and SIEC members.

Agenda of planning meeting:

1. List of sites approved with financial and technical details
2. The fund flow mechanisms
3. Fund utilisation norms
4. Technical details of each structures
5. Introduction of vendors their role
6. Role of VO
7. Role of WUG
8. Role of i-PFT
9. Role of SIEC/State Team

10.2 WUG planning meeting: Post block planning meeting, the WUG and i-PFT meet for preparing implementation plan

Agenda of planning meeting;

1. Sharing of project information technical and financial details
2. Likely date of fund release
3. Role of WUG and VO
4. Work plan for each components of the scheme
5. Materials required, process of procurement, minimum three quotations, GST bills,
6. Linkage with vendors

Irrigation schemes entail execution of series of activities (a) civil structures and (b) irrigation equipment (pipe, pumps and accessories). Within these two broad categories there are several sub activities, some of which (*viz. pump house*) could be taken up as a stand-alone activity and some activities as dependent on others (*viz. pipe placement and fittings to be preceded by trenching*). These activities are implemented by different agencies (WUG/VO and Vendor).

A. **Civil works are executed by WUG/VO** - 1. Pipe trench- digging and refilling, 2. Water collection structure (Intake well /sedimentation tank), 3. Pump house

B. **Hard ware/Irrigation equipment executed by vendors**- 1. PVC pipes, 2. Pumps, 3. Solar panels 4. Accessories of pipe and pumps.

10.3 Training of WUG: The WUG has huge responsibilities to guide implementation and also execute certain activities themselves. One day training is organised to discuss various technical, material purchase and financial aspects.

List of items required:

Type of Structure	Dimension	Bricks (No.)	Cement (Bags)	Sand (cft)	Stone chips (cft)	Iron Bar (Quintal)
Pump House	10ft × 10ft × 10ft	2626	69.5	290	261	6.4
Sedimenta-tion Tank	13ft × 10ft × 3ft	2032	30.5	175	96	0.73
Intake Well	23ft × 18ft	2390	130.5	1499	110	2
Outlet	4ft × 3ft × 2.5ft	168	1.4	12	0	0

Material Purchase and financial norms

Vendor: Purchase only from vendors who have GST number.

Quotation: minimum 3 quotations to be collected

Payment terms and conditions: Avoid cash transaction and cheque/bank transfer when amount exceeds Rs.20,000

10.4 Civil works

10.4.1 Construction of Sedimentation Tank

Location:

Where maximum seepage/water flow is available,

Land available for civil structure and

Minimum obstruction in trenching works and pipe installation.

10.4.2 Pump House Construction: The location of pump house is decided on the following points.

Suction point: In case of river and streams the suction point should have ample stored water required for at least a day. If natural flow is insufficient the WUG take the responsibility to create storage space.

Shifting suction point: In some sites suction point shifts with dry season/spells. In such

cases embankment or trench is constructed to ensure steady uninterrupted water supply.

Farmers contribution: If some construction is required which is not estimated, should come from farmers as contribution.

No objection certificate from owner of land who donates the land.

Flood level: Located above the flood level

Elevation: Maximum elevation of pump house/pump foundation from water source 20 ft

Construction of pump house:

Pump house (10 ft x 10 ft x 10ft) costing Rs.1.54 lakh is constructed by the WUG.

WUG procures materials (bricks/sand/cement etc.)

Technical Supervisor gives layout for pump house and monitors construction

10.4.3 Trench Excavation:

- Pipe line/trench should be straight as far as possible and the depth has to be more than 1 meter.
- Mark the pipe trench using measuring tape or rope
- The trench excavation and refilling be done manually as far as possible.
- Discard large and heavy stones that might come in contact with PVC pipe and cause leakage.

- In case there is stone fill with sand to avoid direct contact of stones with pipe

In case the pipe line requires to cross highways/train line, look for nearest culvert, and cover the pipe using sand cement mixture.

10.4.4 Pipe installation:

Ensure that pipes are supplied as per specifications; make and pipe diameter and pressure and damage free are only installed.

The suction pipe should be air tight. Any leakage in suction pipe may drastically affect the performance of the pump.

Number of Bends, Elbows and other fittings should be as minimum as possible to reduce head losses.

The horizontal length of the suction pipe should be straight to avoid air trapping in pipe. It should not be inclined towards the pump.

Check quality of foot value to avoid priming problem. The foot value should be selected in such a way that the suction area in the foot value should be more than the suction size of the pump. Circular foot value is ideal.

Minimum 3 persons should be engaged during pipe fitting.

The end points of pipe be scratched with sand paper, and sufficient solvent cement applied

Once pipes are fitted, be laid down back in the trench and intermittently covered with loose soil for any dislocation of pipes during day time.

10.4.5 Intake Well

An intake well is not required in all cases. Should be aligned and close to pump house. Consider creating water storage is viable option or an intake. It is for such sites where surface water dry up and enough water is available as subsurface flow. Deep sand bed is an indication of subsurface flow, which could be tested by inserting iron/bamboo poles (10-15 ft depth is considered good).

Construction of intake well

Intake well is generally constructed during April-June.

RCC rings and brick /stone lined intake wells are constructed depending on sand depth in the river/stream.

If the sand bed is deeper than the depth of the intake well, the bottom of the intake well is sealed to restrict water entry in the well.

Parapet of 2-4 feet above river bed is constructed for easy cleaning at regular intervals.

10.4.6 Water Outlets Construction:

- Maximum outlet per site is 5
- Each outlet on an average should irrigate 4-5 acres of land

- Location is decided mutually by farmers
- The farmers should donate land for outlet

10.4.7 Pump Foundation:

- Inside or outside the pump house
- Aligned to suction and delivery pipe line.
- When inside the pump house, there should be enough clearance (2-3 ft) from the pump house wall.
- Foundation generally is close to water source should not exceed 15 ft in height and 50 ft in length.

A concrete foundation (1:2:4 mix of cement, sand and stone chips) dimensions to seat the pump, for diesel it is 4 ft x 3 ft x 3 ft and for solar 3 ft x 2.5 ft x 2.5. Foundation rises above the ground maximum 1 ft, on which wooden planks placed to absorb vibration (especially required for diesel).

4 numbers of foundation rods, threaded on the top used to fasten the pumps. Proper curing is a must, generally 2 weeks followed.

10.5 Work Execution by Vendors: Vendors are qualified for technical assessment during their empanelment through tendering process. It is assumed that they have technical competence for the job. However it is the responsibility of State Team to keep a close watch on materials they supply and technical soundness in scheme implementation. It is important to visit first few sites (10 sites) and then periodic check to sites chosen on random basis. 10% of all completed sites are to be verified by the State team.

Intimation is given to empanelled vendors;

1. To supply and install pipes and pumps and handover the running scheme to WUG.
2. To train WUG and pump operators (2 per sites) on irrigation system operation and maintenance. Provide tool box
3. To provide uninterrupted service in case of any technical glitches free of cost for 5 years from date of handover of irrigation system to WUG

✓ WUG however, is responsible to check and ensure that the vendor supply quality items as per tender and work order and installation done as per technical parameters

✓ WUG to support in terms of showing the exact location of site so that they can start layout for solar enclosure, pump foundation etc.

✓ WUG is responsible to hand over pump house as per agreed time line

✓ WUG would receive, count and check quality of all materials from Vendor

- ✓ WUG on receiving become custodian of the received materials
- ✓ WUG should take possession of Irrigation scheme only after uninterrupted trial run of seven days.

10.5.1 Inspection of Pre-delivery and Other Materials: This is done by the state level team to assess and verify quality of materials, conformity to standards specified in tender.

10.5.2 Solar Panel Installation

The WUG should ensure following;

1. Provide 30 ft x 40 ft area close to the pump house (within 50 ft) from pump house for solar enclosure.
2. The area be shed free and no trees nearby (100 ft from the enclosure)
3. Are area should be located on high ground, with clear drainage and do not get submerged during rainy season
4. Area should be suitable for carrying out civil works (Foundation solar pole) suitable for civil construction

10.5.3 Solar Pole:

The solar panels are mounted on iron poles that can withstand wind speed of 250 km/hr.

Solar Irrigation Pump System contains following equipment

1. Solar Module
2. 5 HP Surface Motor Pump
3. Pump Controller
4. DCDB
5. Tracker Motor
6. Solar Tracker Controller

10.5.4 Solar Modules: The PV modules are installed by qualified personnel provided by the vendor. Since all equipment's and accessories are delivered in the villages before installation and delay in installation (up to 6 months) the WUG need to be made aware on different precautionary measures to be followed while storage;

- ✓ Do not drop the PV module or drop objects onto the PV module.
- ✓ Do not attempt to disassemble the modules, and do not remove any attached components from the modules.
- ✓ Do not scratch or hit at the back sheet, the glass, the terminal box. Do not pull the cables or touch them with bare hands.
- ✓ Do not drill holes in the frame or scratch the insulating coating of the frame.
- ✓ Keep the PV module packed in the carton until installation.
- ✓ Do not use modules near equipment or in places where flammable gases may be generated.

Installation Safety: This is again the task of vendors, but the work of installation is sublet to small players who might not follow instructions. The WUG are to keep strict vigil during installation;

- ✓ Do not install the modules in rain, snow, wet or windy conditions.
- ✓ Wear protective head gear, insulating gloves, safety shoes, and insulated tools when installing the modules.

10.5.5 Pump Installation (Solar):

The centrifugal monoblock pumps are connected to a balanced three phase, 50 cycles AC supply with voltage range from 300-415 volts. Three phase monoblock pumps rigidly built

and designed for many years of trouble free operation. The vertical distance between the water level at the suction side and the pump should not exceed 25 feet.

10.5.5.1 Solar pump controller:

Solar Pump Controller is a versatile, high performance, variable speed motor controller for solar powered pumping.

10.5.5.2 DCDB (DC Distribution Box)

A distribution board (also known as panel board or breaker panel) is a component of an electricity supply system which divides an electrical power feed into subsidiary circuits, while providing a protective fuse or circuit breaker for each circuit. The solar power generated is fed to the **DCDB.**

- ✓ Make sure water doesn't go inside DCDB box.
- ✓ DCDB box should be mounted on strong structure support.

11. Scheme closure

The Irrigation project is being implemented in multiple locations; sites are dispersed in large geographical area, some of them are inaccessible too. There are multiple agencies involved in project implementation, the WUG/VO, the Vendors and all being supervised and monitored by the Block level i-PFT and State Team called SIEC.

Scheme closure process involves

(1) Physical verification of different structures along with different specifications as mentioned in Technical estimates and Tender document/work order

(2) Financial verification is to assess/check expenditure if as per financial guideline and fund utilisation and settlement.

a. Physical

i. Scheme completion report from i-PFT

ii. Scheme completion report from Vendor

iii. Measurement book

b. Financial

iv. Accounts settlement

Scheme completion report/i-PFT contains information of different activities (Civil works plus Irrigation machinery), start date and completion date for each components, make, and technical specification along with photographs. The completion report is prepared in prescribed format provided as an Annexure-16.

Party/agency	Proof of verification
i-PFT	The scheme closure done by the Tech Assistant/BPM with technical specification of all civil and equipment plus water pumped in LPS *(in prescribed format)*
Vendor	The scheme closure done by Vendor with technical specification *(in prescribed format)*
MB	i-PFT prepare the MB in prescribed format
Scheme verification (*Satyapan*)	i-PFT with the help of VO/WUG prepare the details of expenditure and submit all bills and vouchers to Account Section, SRC, JSLPS

Scheme Completion report/Vendor, captures details of materials supplied, make and technical specification duly verified by the water users groups and i-PFT. The completion report is prepared in prescribed format provided as an Annexure-17.

Measurement Book: Civil works are executed by WUG/VO in direct close supervision of i-PFT. The work completion report is prepared by i-PFT supported by measurement book with unique identification number issued by the state. The completion report is a dynamic report, prepared as the activity is complete.

Accounts settlement: The details expenditure along with bills and vouchers are submitted by the Water Users Groups. The process of accounts settlement is being facilitated by the i-PFT. The accounts settlement is done as per prescribed format referred as *satyapan*-LIS. The prescribed format is attached as Annexure-18

12. Water Users Groups

Farmers of each site constitutes WUG and their role evolves with passage of time, during site identification to provide relevant data of site, land use, agriculture status and their socio- economic condition. They play key role in scheme implementation, in completion of all civil works and guiding the vendors work. Post scheme implementation their role shifts from project beneficiary to owner of the scheme; scheme operation, maintenance and finally realising cherished dream of successful farmer i.e., fulfil household food requirement and provide nutrition security and enhance cash income.

Constitution of WUG: Once the site is finalised, after Technical Survey the farmers are finally constituted into Water Users groups. The WUG is facilitated to have deliberation on the following;

I. Select their office bearers; President, Secretary and Treasurer
II. Identify 2 Pump Operators
III. Draft WUG bye-laws
IV. WUG have bank account
V. Identify members who would operate the bank account
VI. Prepare /collect necessary document for opening bank account
    a. Group Application
    b. Xerox of WUG resolution/minutes book
    c. WUG Bye-laws
    d. KYC of farmers' who would operate accounts
    e. Letter from JSLPS
VII. Decide subscription from members for bank account
VIII. Decide water charges
IX. Fund management
X. Introduce meeting register
XI. Decide WUG meeting periodicity, venue of meeting and time
XII. Season wise crop planning

Post sanction meeting: The project fund is released to VO. i-PFT facilitate meeting between VO and WUG representatives. The WUG/i-PFT share the scheme implementation plan having time line and details like when and how much fund is required. The WUG coordinate with VO for fund release and submission of all expenditure bills.

Civil works:

I. Start date of Sedimentation tank/intake well/pump house
II. Likely completion date Sedimentation tank/intake well/pump house
III. Start of trench digging

Pipe and pump installation:

I. Date of pipe and accessories fitting
II. Date of pump installation
III. Trial/testing of pump
IV. Handover of asset

Post Scheme commissioning: The WUG meet fortnightly meeting for -

1. Operation and maintenance:

   WUG will monitor and operate the irrigation system by their own committee. There will be three pump operator trained by Vendors. They will regulate the machine as per the requirement of WUG. For smooth operation of system, few maintenance/water charges need to be collected for using water. It should be done as per operation hour or acre of irrigation need. One resister needs to be maintained by WUG for water charges collection and it's expenditure as per requirement.

Activity	Rate per hour
Maintenance charge	25 /- to 30/-
Operator Charge	15/- to 20/-
Overall operation and maintenance charge	40/- to 50/-

   WUG should engaged night watchman in pump house to minimize the risk of theft of the machineries. Remuneration for night watchman could be maintained from the water charge collected from farmers.

2. Crop planning Linkage with vendor

3. Linkage with agriculture department and NGOs/agencies

Maintenance schedule of solar schemes:

- Regularly carry out a visual inspection for dirt, dust, bird dropping, leaves, and other detritus covering the modules.
- If there is a build-up of dirt or dust on the module surface, wash the module with clean water and may be sponge. Never use chemicals on the surface of the module.
- Regular electrical and mechanical inspection by a licensed professional will keep the system safe and operating at maximum efficiency.
- PV systems require very little maintenance, but involve monitoring and inspection of performance, mounting and cleaning.

- Cleaning of the surface is recommended once at the end of the winter season. Do not use high pressure water spray or chemicals to clean the module.
- Under no circumstances should dirt be scraped or rubbed off the modules, as this can cause micro scratches on the surface of the modules and reduce the transparency of the module glass.
- Snow does not reduce the system output more than expected because performance during winter is already lower than during the rest of the year.
- In order to ensure proper operation, please check all wiring connections, condition of the insulation and mechanical connections once every year and report any problems immediately. The surge protector and the string combiner box should also be checked for proper functioning. All cleaning and maintenance operations are to be done by a trained person only.

13. List of Contributors

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