PIPED DISTRIBUTION OF IRRIGATION IN SSP: MAKING SENSE OF THE CHAOS

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Abstract

Piped distribution of irrigation water has helped in faster expansion of sub-minor distribution network of the *Sardar Sarovar* Project (SSP). An ITP study across six minor canal commands though shows that majority of the intended beneficiaries continue to depend on surface-lift or ground water sources for irrigation. The defunct status of WUAs, responsible for managing operation and maintenance at sub-minor level, in most of these locations raises question on the efficacy of the present participatory model. Farmers are however arranging for irrigation through private initiatives and are able to access assured irrigation using the same canal water. Is it time we provide legitimacy to these initiatives to enhance utilization of the SSP water?

1. BACKGROUND: HISTORY OF PIPELINE INTRODUCTION IN *SARDAR SAROVAR* PROJECT

The foundation of the Sardar Sarovar Project (SSP) was laid in 1961 and since then, the project has been embroiled in multiple controversies and encountered several obstacles in its path to implementation. While the main canal was inaugurated in 2008, the project was nowhere near achieving its potential command area of 1.8 million hectares. One of the key hindrances in fulfilling last mile delivery was reluctance on part of the farmers to give up further land for construction of sub-minor distribution network. In 2010, IWMI researchers suggested the use of underground piped distribution network as an alternative to open channel sub-minors (Shah *et al*. 2010). Based on poor precedent set by previous government managed piped distribution projects, the idea was not welcomed by the Irrigation Engineers initially. Following the first phase of sub-minor implementation, wherein open surface channels were constructed, the SSNNL changed its stance about underground piped distribution. In addition to farmer resistance to giving up land delaying expansion of the command area, the unlined open channels were prone to frequent damage. On top of that, the farmers at the head of the sub-minors would block the open channels to irrigate their own fields, resulting in almost no water being available for the farmers at the tail end. These difficulties prompted the SSNNL to initially pilot the underground piped distribution system in 17 locations and later on, implement it all over the Sardar Sarovar Project Command.

A key difference between the IWMI suggestion and SSNNL's implementation of the underground pipeline (UGPL) system is in the institutional design. IWMI suggested an Entrepreneur-based model with Individual Farmers or Farmer Cooperatives playing the enterprising role of laying the pipelines and recovering the cost via selling irrigation to farmers in the command area while SSNNL would take care of volumetric release of water, akin to how they release drinking water to Municipal Corporations(Shah *et al*. 2010). SSNNL however went ahead with laying the pipelines themselves, with a 97.5%-2.5% cost sharing model between SSNNL and the beneficiary farmers (C*f*ID 2016). In most of the locations, the buried piped distribution system has been functional for 2-3 years which is ample time for farmers to form an opinion on its functionality. In fact, SSNNL has begun converting the Phase I open channel sub-minors into underground piped systems. Through this paper, we are

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attempting to understand if the present model of implementation has been a success or is it time to look for an alternative before the SSNNL embarks on laying further buried pipeline systems.

In this study, 11 minors across ten districts in the command of SSP have been sampled through convenience sampling covering districts in south, north, central Gujarat as well as Saurashtra region. In each of these districts, SSNNL authorities were interviewed to collect secondary data as well as understand the overall situation of UGPL in the district. In the selected minors, four FGDs were conducted with farmer groups spread across head and tail of each of the minors to understand their dependency on the UGPL and their perception of the system.

2. UGPL IN SSP

2.1 Technical Design

The Main Canal, Branch Canal, Sub-Branch and Distributaries constitute the 'Conveyance System' that are meant to deliver water to the smaller canals: Minor, Sub-Minor and Field Channels which form the 'Distribution System'. Each Minor Canal serves a command area of 300-500 Ha, referred to as the Village Service Area (VSA). Under each Minor, there are around 8-10 sub-minors on an average, each serving a command area of 30-50 Ha, the *Chak*. There are turn-out structures constructed along the length of the sub-minor, which serve a command area of 8-10 Ha, which is called the *Sub-chak.* From the turn-outs, farmers in that *sub-chak* are expected to construct field channels to carry water to their respective fields. Depending on the elevation of the land with respect to the Full Supply Level (FSL) of the minor canal, there are two types of turn-out structures:

(a) Gravity Flow turnouts and (b) Diesel Lift turnouts (CfID 2016). *(C)Gravity Flow Turnouts*

When the land level of fields in a *chak* is lower than the FSL of the minor canal, the water flows from the minor canal to the UGPL via gravity. The turnout structures consist of a valve that when opened allows the water to flow which can then be carried further to all the fields in the *sub-chak* via field channels. To take care of head-tail conundrum, in this system, water flows to the tail-end turnout first and as long as the valve in the last turnout is open, the preceding turnouts will not have sufficient pressure for water to flow to their fields. Once the farmers in the command of the end turnout are done irrigating their fields, they will close the valve and those in the command of the next turnout can irrigate their fields. The cost of irrigating the fields is Rs. 357 per Ha per watering for gravity flow turnouts that is to be paid to SSNNL as User Fee.

(a) Diesel Lift Turnouts

In cases where the elevation of the field is higher than the FSL of the minor canal, diesel lift based turnouts are constructed, wherein water is lifted from the turnouts using a diesel pump provided by the SSNNL. While water is being lifted from one turnout, the flow rate of the UGPL does not allow uptake from the other turnouts. Hence, farmers have to jointly schedule their respective turns for irrigating their fields. As in this system farmers bear the cost of diesel for operating the pump, the User Fee to be paid to SSNNL is one-third of the gravity flow system at Rs. 119 per Ha per watering.

2.2 Institutional Design

The management of water distribution upto the minor canals is overseen by the SSNNL. Under each Minor canal, the VSA-level management of irrigation distribution, as well as, maintenance of the minor, sub-minors and field channels is the responsibility of the Water Users' Associations (WUAs) using Participatory Irrigation Management (PIM) principles. In fact, to ensure the sense of ownership of VSA level assets among farmers, the design of each sub-minor has to be finalised by the contracted agency in consultation with the beneficiary farmers. Further, the cost of laying the underground sub-minors includes a 2.5% contribution (monetary/labour) by the beneficiaries. All beneficiaries in each *Chak*constitute a WUA and are represented at the VSA level by a *Chak Mantri.* Those beneficiaries who intend to use canal water have to fill a demand form specifying the crop, area under cultivation and number of turns of watering required. Based on the demand forms submitted, SSNNL can then estimate the volume of water to be released for each VSA. The water released has to be then shared using *warabandhi*system by the WUA members. User fee from each beneficiary has to be collected by the WUA season-wise, of which they can retain a specified portion, based on collection efficiency, for maintenance of the VSA-level canal network.

3. UGPL: SITUATIONAL ANALYSIS

3.1 Water Availability

SSP has been designed to provide supplemental irrigation in Kharif and Rabi. Farmers are expected to arrange for excess water for water intensive crops on their own. In summer season, the canal operation is stopped for maintenance activities. In Table 1 we see, out of all the minors that were a part of the study, in three instances water is not available at all in the turn-outs. The availability of water in the turn-outs is sufficient in only five minors out of the eleven minors sampled in this study. Even among these five minors, except for Kaundh, in other four minors we can observe inequitable distribution between the villages along the head and tail of the minor. In all four instances, the tail-enders have complained about excess withdrawal by lifting/siphoning from minor or distributary at head end villages, resulting in very little water flowing to the tail-end sub-minors. In Pipalvada minor, even though from the number of turns of watering received, there seems to be no divide between the head-end and tail-end villages, the quantity of water received by the tail-end villages is limited. Head-end villages not only withdraw excess water via lifting from minor and distributary canals, they also block the water flow in the canal to irrigate larger area in their own villages. Head-end farmers in Malsan minor admit to this practice owing to the fact that with respect to the total farm land in the village, only a small area comes under the designated command of the canal. So, they block the flow to the next village in order to irrigate their own out-of-command farmlands. Kaundh minor is yet another example, where only 20-30% of the total village farmlands is under the canal command. Even then, the remaining 70% of the farmlands are irrigated by direct lifting of water from the distributary and minor canals. In fact, there are farmers with farmland 200-300 feet above the canal. These farmers have subsidised electric pump connections received under the *Jyotigram* Scheme for groundwater withdrawal. They use these electric pumps to lift water from the canal.

Along with sufficiency of irrigation water, another factor that is important is the availability of water at the right time for the crops. Untimely availability of water is an issue in four out of eleven minors. Even in locations where water is available in sufficient quantity, in Kharif season we observe that water is provided primarily at the

end of the season due to which, farmers either use tubewells or lift water from canal for initial turns of watering.

Table 1: Summary of Field Studies

Name of Minor	Location	UGPL Work Completion Years	WUA Status	Water Availability in Turnout		Alternate source usage	Additional Comments
	Head (H)/Tail (T)			Kharif	Rabi		
Nadoliya (Mehsana)	H	4	Active	1-2 rounds at the end of the season	Sufficient	Tubewells in Kharif	Rampant lifting from branch and distributary canal observed
Nadoliya (Mehsana)	T	3	Inactive	1-2 rounds at the end of the season	Untimely; Insufficient	Tubewells; Lifting from Minor/Distributary	
Bakarthali (Surendranagar)	H & T	2	Inactive	No	No	Lifting from Minor/Distributary	15% of farmers have laid down own underground pipelines
Kaundh (Morbi)	H & T	1 (incomplete for some farms)	Inactive	Sufficient	Sufficient	Lifting from Minor/Distributary	In case of delay in water release, initial watering done by lifting from canals; 70% of total area being irrigated out of canal command
Thorimubarak (Ahmedabad)	H	2	Inactive	1-2 rounds at the end of the season	2-3 rounds	Tubewells in Kharif	
Thorimubarak (Ahmedabad)	T	2	Inactive	Insufficient	Insufficient	Tubewells	Most of the canal water used by head enders; When tail enders submit their demands, head enders receive water without paying any fee
Meethapur (Bhavnagar)	T	1	Inactive	Insufficient; Untimely	Insufficient; Untimely	No other source	Faulty design as well as blocking of canal water flow by head end village farmers resulting in insufficent flow of water in the turnouts
Pipalvada (Kheda)	H	3	Inactive	2 rounds	2 rounds	Tubewells	The number of turns received per season is not sufficient
Pipalvada (Kheda)	T	3	Inactive	2 rounds	2 rounds	Tubewells	Head enders block of water in the minor canal
Samadhiyala (Botad)	H & T	Minor work incomplete since past 1 year	Inactive	N/A	N/A	Tubewells	
Arjansar (Patan)	H & T	2	Inactive	Insufficient; Untimely	Insufficient; Untimely	Tubewells; Lifting from Minor/Distributary	Lifting from distributary/minor preferred due to the reliability of water availability
Golap (Banaskantha)	T	2	Inactive	No	No	Lifting from Minor	Due to faulty design, even when minor is running at FSL, water does not go beyond second turnout
Malsan (Banaskantha)	H	2	Active	Sufficient	Sufficient	No other source	Minor directly connected to Branch canal resulting in better availability of water; Farmers admit they block water flow to the Tail village to supply water to their own out-of-command farms
Ankadiyapura (Vadodara)	H	1 (previously open-channel sub-minor)	Inactive	No	No	Tubewells; Lifting from Distributary	Since conversion to UGPL, no water has been available in the turnouts.

3.2 Design Issues

As already mentioned, the design for constructing sub-minors should be finalised in consultation with the beneficiary farmers by an agency that has received the contract for construction. However, in few locations farmer responses revealed either no consultation was done with them before construction of the sub-minors, or, in some cases such as in Ankadiyapura and Golap, the design was not as per their suggestions. In Golap, farmers said influential farmers were able to persuade the contractors to put the turn-out structures on their farms instead of following the design as per consultation.

As a result, in gravity flow sub-minors, the gradient of the sub-minor is not sufficient for the water to flow beyond the first two turn-outs in Golap. Moreover, instead of the prescribed RCC turn-outs, here the turnouts have been constructed using brick masonry. In Ankadiyapura, farmers complained that they had suggested the turn-out locations based on the land slope. However, their suggestions were ignored and some of the turn-outs have been constructed such that water will flow only in one direction, and hence, the farms on the other side will not be irrigated even after being part of the sub-chak. In Meethapur also farmers have the same complaint. Additionally, here in gravity flow chaks the flow is limited due to lack of sufficient

pressure. There are issues of leakage in the pipelines and turn-out structures already even though the sub-minor is just a year old.

3.3 Status of Wuas

As the beneficiaries were expected to take care of operation and maintenance of the canal system VSA-level onwards in a participatory manner, they were organised into WUAs with the help of locally-based NGOs. The WUA formation involved five phases: (a) Survey of individual farmers; (b) Formation and Registration of WUA; (c) Training and Capacity Building; (d) Awareness Generation; and (e) Handing over of Operations and Maintenance to the WUA members. The NGOs were to receive their incentives at the end of each phase for completion of work in that phase. In many cases, the NGOs completed the first two phases and withdrew, leaving out the most important phases incomplete. As a result, in most locations studied, the WUAs have been registered on-paper but are inactive except for in the villages at the head of Nadoliya minor and Malsan minor.

In Nadoliya, the NGO has continued to support PIM activities even after completing four years of functioning of the sub-minor. They ensure beneficiaries fill and submit the demand forms every season, aid in collection of user fee and preparing schedule for water sharing among the farmers. Even then, the WUA members have not been able to prevent lifting of excess water and as a result, the villages at the tail of the same minor are suffering. Shah (Shah 2005) argues in his paper that PIM as an institutional arrangement may generate high pay-offs if implemented successfully, but the transaction cost involved in such an arrangement is also high. It is driven by the notion of spontaneous participation of farmers in participative management of resources, an idea spread on the basis of a few successful cases of PIM. But in all successful cases, an NGO or local leader has played significant role in bringing down the transaction cost of mobilising large number of beneficiaries. In the absence of such hand-holding support, the high transaction cost involved has prevented the WUAs from performing, as is evident in the case of the villages studied where the WUA is inactive.

Even in Malsan, the WUA is active but it has not been able to ensure strict scheduling or prevent farmers from watering out of command farms.

In locations where the WUA is inactive, farmers never submit any demand form or pay the irrigation fee. A nominal unofficial fee is often paid to the canal operator for releasing water, but it is not done collectively. SSNNL continues to supply water irrespective of whether any demand form has been submitted or not since the ultimate objective of SSP is to provide irrigation and support farmers. The SSNNL authorities are unable to enforce the regulation of not providing water unless 51% of command area farmers submit their demand forms as it will hurt the agricultural economy.

But what ensues due to the prevailing anarchy in the system is inequitable distribution of irrigation among the beneficiaries and has reduced the SSP sub-minor network to an extremely unreliable provider of irrigation service.

4. ALTERNATE SOURCES OF IRRIGATION

So, are farmers who do not receive irrigation water reliably through the sub-minors doing rain-fed cultivation? While in some Kharif crops rain-fed agriculture is not uncommon, most of the command area farmers have access to alternate sources of irrigation. In areas where the groundwater level is shallow, farmers depend on

tubewells (electric as well as diesel). Irrigation markets are thriving in these regions with farmers who do not own an electric or diesel pump, buying irrigation from the pump-owners. In regions where groundwater is depleted or is saline, direct lifting or siphoning of canal water from minors, distributaries or branch canals is done by farmers. Distributaries or branch canals are preferred over minors for lift irrigation as they provide higher degree of assurance of water availability. Farmers far from the distributary or branch, however, also lift from minors.

Affluent and entrepreneurial farmers have laid their own privately-owned pipelines connected to the distributary or branch canals. While some farmers use rubber pipelines, those with the capacity for capital investment have also laid down underground PVC pipelines, extending longer than a kilometre.

Another interesting practice to ensure greater control over irrigation water is siphoning the canal water and storing it in tanks or farm ponds. This ensures availability of water even after water flow in the canal has been stopped for the season. In regions with non-functional sub-minors this is especially common. Individual as well as groups of farmers collectively irrigate their fields by storing canal water in this manner. In some regions this practice helps the farmers in cultivating a summer crop.

Table 2 shows the cost incurred in irrigating using these different alternate irrigation sources. The expenditure is much higher compared to the user charges of SSNNL. However, the fact that farmers continue to depend on these more expensive sources shows their willingness to pay for an assured irrigation service.

Table 2: Irrigation cost for alternate sources

	Lifting From Distributary (Pump owner)	Lifting From Pond After Siphoning (Farmer Group)	Lifting From Distributary (buyer)	Electric Tubewell (Buyer)
Pumpsize	5 HP	-	-	-
Pump Cost	Rs. 16000 (2001)	Rs. 50000	-	-
Rent (per hour)	-	-	Rs. 50	Rs. 60
Pipeline	Rs. 70 per feet	Rs. 1500 per 100 feet	-	-
Diesel	Rs. 70 per litre	Rs. 70 per litre	Rs. 70 per litre	-
Kerosene	Rs. 50-60 per litre	-	-	-
Fuel Requirement (Diesel)	1 L/hour	20 L for 24 hours	1 L/hour	-
Fuel Requirement (Kerosene)	-	-	-	-
Hours to irrigate	4-5 hours per acre	3 hours per acre	6 hours per bigha	6-7 per bigha
Irrigation Cost using Diesel (per Ha per turn)	Rs. 865	Rs. 433	Rs. 3110	Rs. 1814
Irrigation Cost using Kerosene (per Ha per turn)	Rs. 730	-	Rs. 2851	-

5. CONCLUSION

The use of underground pipelines for the expansion of the SSP command is a technical marvel. It has helped expand the command area to about 1.1 million Ha in the last five years, which is commendable. But, the widespread anarchy in the system raises questions on the efficiency of the system. End of the day, SSNNL is providing irrigation service to the farmers.

So naturally, when owing to multiple reasons, the service is not reliable, farmers resort to different measures to ensure assured availability of irrigation. It also allows the informal irrigation markets to thrive even though the irrigation rates offered by these markets are higher. Irrigation using sub-minor might be a cheaper alternative, but it is unable to compete with the private irrigation service providers on account of its undependable service.

Expecting WUAs to bring about discipline and order into the system is unfair considering in absence of assured irrigation service, the WUA members have no incentive to work together. The relatively better performance of WUAs in Nadoliya minor head and Malsan minor head is testament to the fact that guarantied irrigation availability can definitely boost the functioning of the WUA, albeit under the guidance of a supporting NGO in the former case.

While SSNNL needs to curb the problems of unwarranted siphoning and lifting of water from canals, it must also acknowledge it's a humongous task to monitor such a large canal network. In such a scenario, it must ponder whether expecting farmers to use a system that is unreliable is fair or should providing legitimacy to the informal institutions established by farmers a better way to serve the beneficiary farmers.

6. REFERENCES

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