



# Lift water schemes functionality

## Learning from 100 schemes

### RWSSP-WN BRIEF 10-2018

#### SERVING THE UNSERVED WITH LIFT WATER SUPPLY SYSTEMS

The Rural Water Supply and Sanitation Project in Western Nepal Phase II (RWSSP-WN) core thrust is to reach the unreached and to serve-the-unserved. In Nepal, the lift water supply schemes are typically high in demand where the gravity flow water system is technically not possible. In Western Nepal it is likely that if the gravity flow system can be built, it is probably already built. The unserved populations live at the mountain ("hill") tops where they are relying on multiple sources depending on the season, including rainwater harvesting and carrying water. Unfortunately, due to missing winter rains, the rainwater harvesting systems are not an adequate option alone, and there is an increasing demand for lift water supply systems.

Over the past 8 years, RWSSP-WN has supported 172 lift schemes, both solar and electric. This study contains exactly 100 lift water supply schemes that had been in operation for at least 12 months at the time of survey: 37 electrical lift, 39 solar lift in the mountain ('hill'), and 17 were electric and 7 solar lift overhead tank schemes in Tarai ('plains'). Are these functional and providing services as expected?

#### RWSSP-WN II Vision:

The right to access to water, sanitation and hygiene for all

This brief focuses on technical aspects and functionality. There will be another brief that explores the social aspect by exploring the impact on women taking the time saved as the point of entry, and another one that focuses on the financial aspects, both in terms of capital expenditure and operational costs.



Scheme locations in Provinces 4 and 5 in Western and Mid-Western Nepal

This Brief was prepared by Sanna-Leena Rautanen. See 'Acknowledgements' for all who contributed to the individual scheme surveys and the number of schemes covered.

Project Support Unit, RWSSP-WN II / FCG International

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## WHERE?

The following shows the (rural) municipalities by district, with the number of schemes surveyed in each

### Arghakhanchi district:

- ◆ Bhumikasthan (1)
- ◆ Malarani (1)
- ◆ Sitganga (1)

### Baglung district:

- ◆ Bareng (2)

### Gulmi district:

- ◆ Ruru (1)
- ◆ Satyawoti (2)

### Kapilvastu district:

- ◆ Banganga (1)
- ◆ Bijayanagar (4)
- ◆ Budhabhumi (7)
- ◆ Shivraj (2)

### Nawalparasi district:

- ◆ Hupsekot (3)
- ◆ Pratappur (2)

### Parbat district:

- ◆ Bihadi (4)

### Pyuthan district:

- ◆ Airawati (1)

### Rolpa district:

- ◆ Lungri (1)

### Rupandehi district:

- ◆ Devadaha (1)
- ◆ Gaidhawa (1)
- ◆ Lumbini Saskritik (1)
- ◆ Marchawari (1)
- ◆ Sainamaina (4)

### Syangja district:

- ◆ Bhirkot (1)
- ◆ Chapakot (4)
- ◆ Fedikhola (1)
- ◆ Galyang (1)
- ◆ Harinash (9)
- ◆ Kaligandaki (2)
- ◆ Putalibazar (1)
- ◆ Waling (5)

### Tanahun district:

- ◆ Bandipur (3)
- ◆ Bhanu (9)
- ◆ Bhimad (1)
- ◆ Byas (4)
- ◆ Devghat (1)
- ◆ Ghiring (4)
- ◆ Rhishing (7)
- ◆ Shuklagandaki (6)

## WHERE, WHO AND WHY THIS STUDY?

The study was done in 11 districts in Western and Mid Western Nepal (Provinces 4 and 5), in total 72 municipalities, see Side Bar in this page for the locations and the next page for the beneficiaries. The data was collected by a number of RWSSP-WN and municipality staff over the winter of 2017/2018, see 'Acknowledgements'.

All utilized mobile-phone based 'KoBoCollector' for data collection. This allows putting the data in the map (as illustrated in this Brief). This information will be used for more detailed location-specific analysis as the overall landscape and topographical features in each case are unique.

## WATER USERS AND SANITATION COMMITTEES (WUSCs)

WUSCs have a leading role in planning and implementation of their scheme, and later on, in its operation and maintenance (O&M). RWSSP-WN Phase II WUSCs were also in charge of all procurement. Step-by-Step approach allowed systematic WUSC capacity strengthening through training and learning by doing.

As is evident from the Technical Details Side Bar next page, the WUSCs have completed major infrastructure works in often in very challenging topographical landscape.

The WUSCs in this sample can be described as follows:

- ◆ 74% of WUSCs have gender balance 50:50
- ◆ 81% of the WUSCs with 'well-functioning' scheme had gender balance, compared with 71% of those with 'need minor repair', 33% of 'need major repair' and 44% of 'need rehabilitation' scheme WUSCs.
- ◆ 93% of WUSCs reported that the WUSC membership is representative of the users in terms of caste/ethnicity
- ◆ 50% have WUSC meetings monthly, 17% bi-monthly, 12% quarterly, 5% three times per year and 7% two times.
- ◆ WUSCs in 63% of 'well-functioning' schemes had a monthly meeting, while only 24% of WUSCs with 'minor repair' needs and 33% of the 'need major repair' and 'needs rehabilitation' practiced the same
- ◆ Nine cases had no meetings at all over the past 12 months, four of the operating an electric lift OHT and five solar lift.
- ◆ 28% had WUSC Annual General Assembly over the past 12 months
- ◆ 90% of WUSCs were registered

Is anyone taking care of the scheme?

- ◆ 90% have appointed Village Maintenance Worker (VMW)
- ◆ 78% have no female VMWs while three schemes have no male VMWs
- ◆ There are only four female Pump Operators, compared to 53 schemes where there is one male and 15 schemes where there are two males.
- ◆ In 77 cases the VMWs have received training, compared to 49 schemes where also the Pump Operators have been trained.
- ◆ 77% of WUSCs have adequate tools for O&M. In Five cases the WUSC reported no tools at all.

## WATER SAFETY PLAN AND FUNCTIONALITY

- 54% had O&M plan with WSP++ and 10% had O&M Plan
- 9% had no O&M plan, but has WSP++
- 27% had no O&M Plan or WSP++
- 58 WUSC received training for WSP++ and implement it while 6 received the training but are not implementing
- Overall, 64% received training for WSP++
- Out of well-functioning schemes, 72% was implementing their WSP++
- Out of schemes that were 'well-functioning' and 'need minor repair', 86% were implementing WSP++, compared to only 13% of those schemes that needed major repair, rehabilitation or were closed down.

## FINANCIAL MATTERS COUNT

What is the income of the WUSC? Do they collect water tariff?

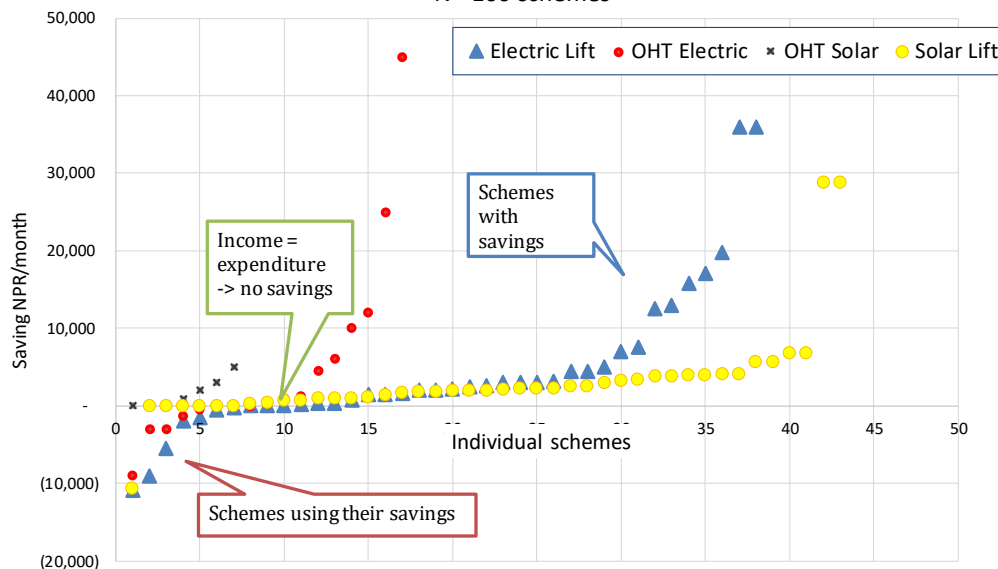
- All hill electric lift schemes collect water tariff. 'No water tariff' was reported from 2 solar lift, 4 Solar OHT and 1 electric OHT.
- Yes, but only when needed, both electric OHT
- Yes, Flat System: 54
- Yes, Meter System: 37
- If flat system, median NPR 200 per household
- 87% of WUSCs pay their maintenance worker/pump operator, while seven do not even if they do have VMW/Pump Operator
- 83% pay in cash, in one case in kind, and in three cases VMW works as volunteer

Monthly electricity bills range from minimum zero (no pumping!) to median NPR 5,000 to Mean NPR 8,964 to maximum NPR 35,000 for electric lift schemes, the corresponding figures for the electric OHT being Mean NPR 8,694, Mean NPR 8,000 and maximum NPR 33,000.

The following chart displays the difference in between the total estimated monthly income and the total estimated monthly expenditure. Eight schemes could not provide this. The closer the difference in to zero, the less WUSC has savings for anything unusual. Those operating in negative are utilizing O&M funds collected at the time of the scheme implementation, i.e. consuming their savings. This is the most unsustainable system.

### CHART 1

Average monthly savings by technology type  
(Average monthly income *minus* average monthly expenditure (NPR/month)  
N - 100 schemes



## BENEFICIARIES

Total 100 schemes

Total population :

- at design time: 68,334
- at present: 54,554
- An average 5.2 persons per hh at present (5.8 at design time)
- Electric lift schemes 6.1 persons per hh at design, 5.5 at present
- Solar lift: 5.9 persons per hh at design, 3.9 at present (number of hh have increased even if the population has decreased)

Total households (hh):

- at design time: 11,696
- at present: 10,384
- Min at design: 6 hh
- Max at design: 1000 hh
- 39% at present benefit from electric lift and 37% of OHT electric; 20% benefit from solar lift and 4% of OHT solar.
- biggest decrease in OHT electric where there are 1,141 households less at present than at design
- biggest increase in solar lift schemes where there are 386 households more at present than at design time

Connections:

- Total 4,049 private connections of which 3,753 are metered
- Total 1,318 public taps
- Total 110 schools and institutions connected at present
- In 7 schemes meters are installed but not used
- In 56 schemes there are no meters at all
- In 37 schemes meters are installed and used

## TECHNICAL DETAILS

- ♠ Total vertical head: 15,516 m
- ♠ Mean vertical head: 220 m
- ♠ Median vertical head 195 m

- ♣ 87% have one stage lift
- ♣ 10% have two-stage lift
- ♣ 3% have three-stage lift

### Pumping hours:

- 💧 Electric lift: 1 to 9 hours (median 3.0 hrs)
- 💧 Solar lift: 0 to 12 hours (median 6.0 hrs)
- 💧 Electric OHT: 0 to 16 hours (median 3.0 hrs)
- 💧 Solar OHT: 6 to 10 hours (median 7.0 hrs)

- ♦ Total transmission lines: 79,717 meters (79.7 km)
- ♦ Total distribution line: 394,802 meters (394.8 km)

### Physical conditions of transmission line & its crossings:

- ♥ 84% no need for repairs
- ♥ 13% need minor repair
- ♥ 2% need major repair
- ♥ 1% need rehabilitation

### Physical conditions of distribution lines:

- ♣ 66% no need for repairs
- ♣ 23% need minor repair
- ♣ 6% need major repair
- ♣ 3% need rehabilitation

### Physical conditions of reservoir tanks, valve chambers & distribution chambers

- ♦ 72% no need for repairs
- ♦ 23% need minor repair
- ♦ 4% need major repair
- ♦ 1% need rehabilitation

### Water tap functionality: % of taps with water flow

- ♥ 59% has 100% of taps with water flow
- ♥ 29% has 90% < 100% taps with water
- ♥ 2% has 50% < 75% taps with water
- ♥ 7% has 75% < 90% taps with water
- ♥ 3% has none working

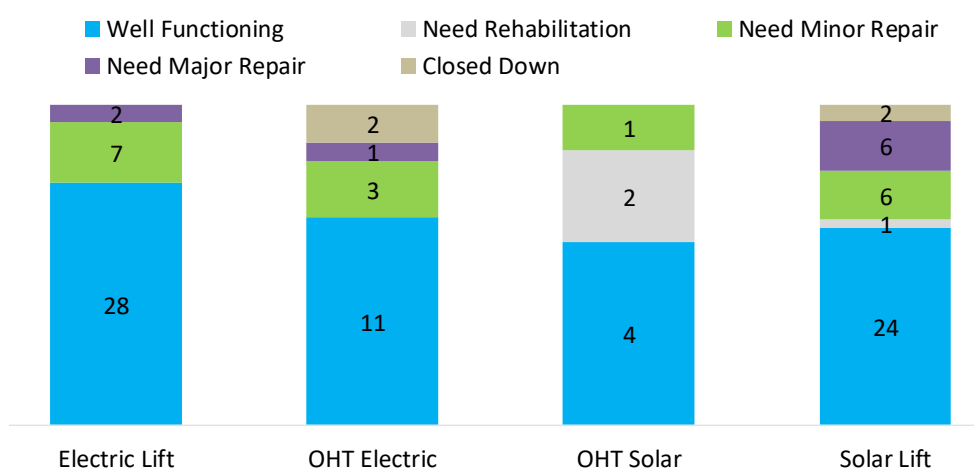
## TECHNICAL FUNCTIONALITY

Overall, 84% of all lift schemes were described as 'well-functioning' if we accept that the need for minor repairs are not affecting the overall functionality. The 'minor repairs' mean such repairs that WUSC and their Village Maintenance Worker (VMW) should be able to carry out themselves. The percentage is 67% if counting only those schemes that do not need even minor repair. This compares very well to NMIP figures for 'well functioning': 19% for the Western development region and 17% for the Mid-western region. (NMIP, 2011).

Over the past 12 months, 65 schemes did not report any technical failures, while 17 schemes reported one and 12 schemes two technical failures. One solar lift scheme reported seven and another solar lift reported ten technical failures within a year. Total 82 WUSCs know how to claim warranty. Total 17 (of which 12 solar lift) have claimed warranty once, one scheme twice (also solar lift). Out of all warranty cases, 74% were solar cases, and out of all solar schemes, 30% claimed warranty, compared to 9% of the electric lift schemes. These cases are worth a further study to understand why the warranty cases arise.

CHART 2

Functionality by Technology Choice  
Total 100 lift schemes



## Q-A-R-Q INDICATORS

- 💧 **Quality:** all tested, 64% tested over the past 12 months; 96% tested 'Absence' of coliform bacteria. 78% no treatment and 22% roughing filter only. 71% 'Good, no possibility of contamination', 21% 'Moderate, likely to be contaminated' and 8% 'Poor, high chances of contamination'
- 💧 **Access** (round trip water fetching time for most of the beneficiaries in the scheme): 74% less than 5 min (35% private connection), 24% 5 to 15 min, and surprising 2 schemes with up to 30 min.
- 💧 **Availability** (water supply hours per day): while 27% provide water for 12 hours in a day, there are also 14% that provide 2 to 3 hours per day and another 38% providing water only for two hours per day. The others are in between. The service hours are fairly equal in between the electric and solar.
- 💧 **Quantity (litres per capita per day, lpcd):** Only one scheme has over 100 lpcd, and five schemes serve n between 65 and 100 lpcd. Third (29%) of the schemes serve 45 < 65 lpcd and 60% serve 25 < 45 lpcd. Third of the solar lift (27%) and one out of four electric lift (24%) have design flow 25 < 45 lpcd.



### CHART 3

Scheme functionality  
by Fiscal Year when the scheme was completed  
Total 100 lift schemes

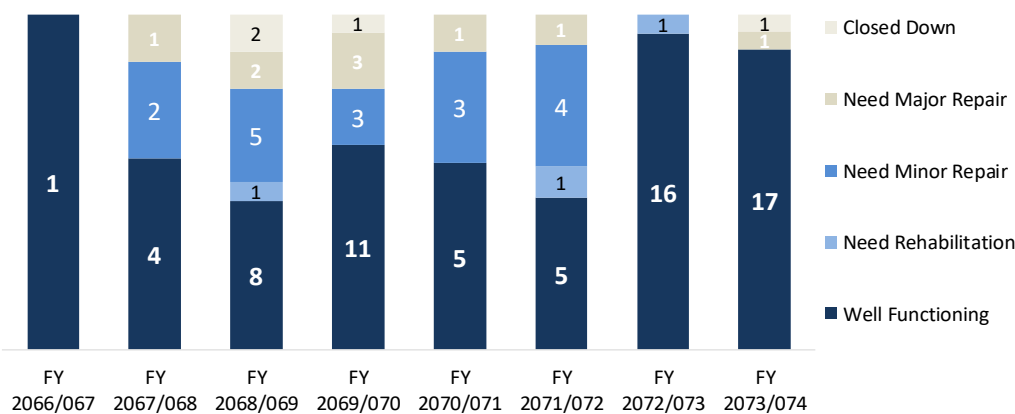


Chart 3 shows that the functionality does not correspond the with the year the scheme was completed after two years in operation: there are fairly equal proportion of well functioning schemes in each year out of all schemes completed within that specific year.

## KEY FINDINGS WITH RECOMMENDATIONS

The functionality context is entirely different in peri-urban type of Tarai plains where water quality and other interests have driven the overhead tank system construction, compared to the rural mountain ('hill') communities where water scarcity and related hardship does result in genuine demand from the community's side for a lift water supply system.

**Overhead tanks:** need professional semi-urban approach from the beginning, both in planning and implementation, and later in operating the system. These cannot rely on volunteer maintenance, unmetered connections, non-payment of water tariff and passive management. There must be genuine demand if the approach expects anyone to pay later on!

**Solar lift:** need to learn more from the warranty cases, and to convey this first hand user experience to the solar companies. Solar should be the future in a country like Nepal where most of the year sun is certainly available.

**Electrical lift:** the operational cost needs to be taken seriously already at the Feasibility phase. The first electricity bill must not be a surprise! WUSCs are now saving in pumping hours, people returning back to their (seasonal) water sources to avoid the electricity bill. There are also major delays in getting these schemes completed due to hurdles with the electricity authority for getting the transformers and connections.

The present population is less than what is was at design phase, particularly in electrical lift schemes. This is a problem when it is time to pay the electricity bill and other costs that were considered acceptable with more households. Overall, the water tariff questions needs to be taken seriously already at the Feasibility phase: no scheme should move ahead if there is no clear understanding of what it is going to cost to maintain it. Now water tariff is largely collected, but it just covers the monthly expenditure.

While lift schemes do save time and provide good quality water, the quantity is still at the lower end and as such, lift schemes do not qualify for a higher service level categories if considering the new Sector Development plan. In this sample of one hundred schemes only one qualified for Service Level 1!

## WHAT ABOUT PUMPS?

- 95% submersible volumetric pumps
- 34% horizontal and 65% vertical position
- 99% of electrical components have earthing
- 64% have lightning arrester
- 62% have Alternating Current (AC)
- 35% have Direct Current (DC)
- 3% have both AC and DC
- 40 solar schemes are off-grid stand alone type, six are hybrid (connected to grid)

What kind of solar panels?

- 33 schemes with monocrystalline
- 12 schemes with polycrystalline

How many watts per solar panel?

- Minimum 120 W, maximum 315 W
- Median 190 W

## THE WAY FORWARD

- Operation and maintenance costs needs to be counted carefully already at the Feasibility phase. Water tariff needs to be taken seriously, too many schemes continue to operate at break-even point.
- Trained staff is a must! These are not gravity schemes that can be maintained by anyone: at least the Pump Operator needs to know what s/he is doing!
- Post-construction support is a must, with one final monitoring still coming up after the scheme has been in operation for a full 12 months (through all seasons)
- Water source protection and recharge needs more research: large and costly schemes move ahead with very small design flows.

## ACKNOWLEDGEMENTS

Scheme survey by:	# of schemes
Bashu Pandey	21
Dipendra Khatri	16
Bishnu Gurung	15
Aura Liski	8
Jeevan Bajracharya	8
Rajesh Gupta	8
Suraj Oli	5
Tej Ojha	5
Prashanna Pandey	4
Rajan Ranabhat	3
Tej Bohara	2
Bipin Poudel	1
Lokendra Oli	1
Ram Sharma	1
Sangita Khadka	1
Suman Basnet	1
<b>Grand Total</b>	<b>100</b>



**Photo:** Hoarding board of a typical lift scheme. Water is first pumped to the top reservoir located above the community, from where it flows to the taps.

Digging distribution pipelines is a typical community contribution part.

## REFERENCES & BACKGROUND DOCUMENTS

National Management Information Project (NMIP) (2011) Nationwide Coverage and Functionality Status of Water Supply and Sanitation in Nepal. DWSS, Panipokhari, Kathmandu.

Rautanen, S-L. & Ghimire, D. (2018) 101 Lift Schemes – Comparing Electric Lift And Solar Lift Water Supply Schemes In Western Nepal. International Conference on "Water, Environment and Climate Change: Knowledge Sharing and Partnership", April 10-12, 2018, Kathmandu, Nepal.

## RESULTS INDICATORS FOR RWSSP-WN II

*This Brief relates to the RWSSP-WN II Overall objective: Improved health and fulfilment of the equal right to water and sanitation for the inhabitants of the Project area.*

Particularly to the following result areas:

Result 2. Access to safe, functional & inclusive water supply services for all achieved and sustained in the project working municipalities

*The impact level indicator:* Decreasing disparity between the worst- and best-served municipalities with regards to sanitation and water supply coverage.



**FCG**

Rural Water Supply and Sanitation Project in Western Nepal Phase II is a bilateral development cooperation project funded by the governments of Nepal and Finland, and implemented through local governments and users' groups under the Department of Local Infrastructure, Ministry of Federal Affairs and General Administration. RWSSP-WN II works in 14 districts in two Provinces of Western and Mid-Western development regions in Nepal, thorough municipality-based programmes.

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