APPLICATION OF SOLAR ENERGY FOR WATER PUMPING : *A CASE OF BHUJIKOT*

Guna Raj Dhakal, Mukti N Raut*

Group for Rural Infrastructure Development Nepal (GRID Nepal)
GPO Box 9957, Kathmandu, Nepal
Wise Use House, Jwagal, Kupondol, Lalitpur

Abstract

Clean Water is essential for all living beings in this earth. Many people especially women of rural communities spend long time to fetch the water needed for household consumption. Access to clean water supply can make a vital difference to the health and quality of life of a rural communities. The time saved from that is needed to collect a 'Gagri' of water can make reasonable difference to women living in rural community. Women dedicated to family can utilize their available time to broad sphere development of household activity. Similarly, agriculture can also be promoted with irrigation facility made possible by PV-water pumping. Our first initiation of PV water pumping project was applied at Bhujikot after being awarded by Nepal Development Marketplace with the support of World Bank announced nation wide competition for the services provided in the conflict affected areas with the theme of "Launa aba ta kehi garaun". Nepal Development Marketplace was looking at innovations in providing and improving basic services to rural populations affected by the conflict. Purpose of this program was to generate fresh thinking and to test new ways of delivering basic services in Nepal's conflict affected areas. This Project is the environmental friendly renewable energy source to lifting clean water using photo voltaic which is more appropriate technologies than pump driven from conventional energy sources.

Keywords: *PV Module, Grundfos SQFlex submersible pump,*

BACKGROUND

For villages with no or insufficient water supply system, existing approaches are gravity water supply system when water source is available at higher elevation; and use of electric pump powered by national grid or local micro hydro for villages with water source available at lower elevation. But both of these approaches are not applicable at Bhujikot due to lack of national grid there and no suitable site for micro hydro scheme at or around the village. There is no third option in existing practice to fulfill the need of such villages.

In Nepal, one fourth of people left out from their daily water needs that are mostly infeasible in terms of gravity, electric and other technical options. People (generally women and children) have to walk down for several hours to collect few litres of water for drinking and cooking purposes. In such a situation talking about water for irrigation is far beyond the capability of villagers. Reason is that villages are situated at the peak of hills, whereas water sources are far down. Due to this reason, gravity water supply system, easiest method of water supply has been found impossible. That is why; people are facing difficulties to overcome on their water need. And People of these villages were far from safe drinking water and plenty of fertile lands remain barren

Use of solar energy to pump water supply system in villages is the most appropriate option where national grid and micro-hydro schemes are not possible.

INTRODUCTION

Bhujikot lies in two VDCs- Khairenitar and Dulegauda of Tanahu district. This village is comprised of 67 households with a population of around 435. The majority of the populations are Dalit & Janjati.

This village is located at the peak of hill with a historical royal palace, it is a beautiful place having a promising potential for tourism. There is plenty of fertile land in the village, which was not fully utilized due to lack of water.

Before completion of project people were compelled to collect water from a point source located about one Km steep down from the village. The fetching time to collect a Gagri water is about 1.5 hours (two ways walking, and waiting to fill up the Gagri).

Our first initiation of PV water pumping project was applied at Bhujikot after being awarded by Nepal Development Marketplace with the support of World Bank announced nation wide competition for the services provided in the conflict affected areas with the theme of "Launa aba ta kehi garaun". Nepal Development Marketplace was looking at innovations in providing and improving basic services to rural populations affected by the conflict.

*Corresponding Author: Tel: +977-1-5550452, 5553870, 5524188, 5011013, E-mail: gridnepal@wiseuse.org.np

The purpose of this program was:
(a) to generate fresh thinking and to test new ways of delivering basic services in Nepal's conflict affected areas; and
(b) to promote a culture of partnerships in national entrepreneurs in providing basic services.

BENEFICIARIES OF THE PROJECT

All the population of Bhujikot is the principle beneficiaries of the project, however, women, children (particularly girls) and farmers are the primary beneficiaries of this project. They can use their saved time for the improvement of education, and in various income generating activities.

PROBLEMS

Drinking water in itself is a major issue and creates several associated problems. Basically, it can pro vide broad impact in livelihood system being primary resource of life; agriculture is also highly dependent on water. Agriculture including animal husbandry and kitchen gardening also requires volumes water supply in the village. Nutritionally, people are poor. Sanitation and hygiene factor are other problems due to lack of water. The collected water becomes very expensive so that people can not use sufficiently so that sanitation and hygiene becomes problem. Education and migration are influenced with availability of water. These factors affect the whole socio-cultural system and are impulsive to migrate for easier livelihood.

OBJECTIVES AND APPROACH

Providing safe drinking water supply

Improving sanitation system and reducing health hazard

Improving environmental health

Developing irrigation system to uphill fertile land

Creating local employment and promoting income generating activities

Reducing drudgery among women and children

TECHNICAL CHARACTERISTICS OF THE PROJECT:

Discharge	0.343 lps
Net Head	153 m
No of Household	67
No of Populat ion	335
Transmission Pipe line	450m
Cable length	230m
PV Module 80 Wp - 10 x 2	1600 Wp
Grundfos SQFlex submersible pump	2 No
Supply and distribution pipe lines	2780 m
Intake	2 nos.
Capacity of storage tank near source	8 cu.m
Capacity of intermediate tank	3 cu.m
Capacity of distribution storage tank	16cu.m
Public tap stands	8 nos.
Average Peak Sun Hour per day at site	5 hour

System with Grundfos Pump for RE Application:

Item	Type	Quantity	Total
PV Module	80 Wp - 10 x 2	20	1600 Wp
Pump	Grundfos SQFlex submersible pump	2	

In this configuration, the pumping is done in two stages use 10 nos. of 80Wp PV modules (800 Wp) were connected in series for each stage. One pump lifts water from the collection tank near the source to an intermediary tank to be situated at around half the net head and the other pump lifts the water from this intermediate tank to the reserve tank using 50mm f 10kgf/cm2 HDPE Pipe. The Modules were mounted in aluminum structures fixed on wooden pillars. The SQFlex submersible pump was fed DC power directly from the solar array. These pumps can be powered both by DC (30 – 300 VDC) and AC (90-230 VAC) power supply

An 8,000 liter capacity collection tank was built near the water source. The intermediary tank of 3,000 liter capacity was built at around half the net head and a reserve tank of capacity 16,000 liters was built at the required head from where water was distributed to a number of taps by gravity flow.

POSITIVE ASPECTS

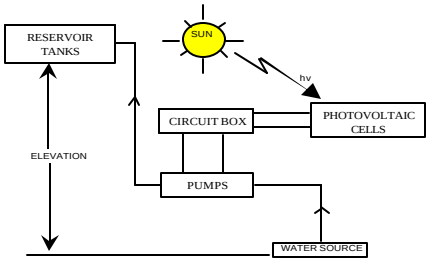
The system is comparatively simple in its installation

The scheme can be locally managed, operated and maintained with training input to the local

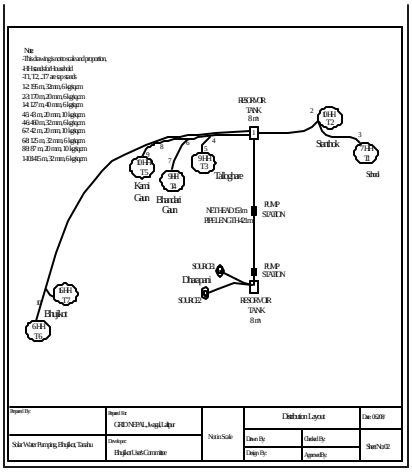
This will able to reduce water-born diseases in rural community

Increase in farm production and supportive to livestock husbandry for dairy and meat production

Saves time of women and children and able to improve their education



CONCEPTUAL FRAMEWORK OF SOLAR PUMPING



DESCRIPTION OF SOLAR PV PUMPING SYSTEM COMPONENTS

Solar PV Module:

In total 20 nos. of 80 Wp Solar PV Modules were used with the system. The used Solar PV Modules were made in Spain by Isofoton S. A. The manufacturer of the modules provides 25 years power warranty against 20% power loss on all its range of modules.

Solar Pump:

SQFlex submersible pump is used for the pumping purpose. This pump, especially designed for renewable energy applications, is made in Denmark by Grundfos, a renowned pump manufacturer in the world. SQFlex submersible pump are highly efficient and economic. The pump has helical spring rotor for lifting the water. The pump can be powered both by DC (30 – 300 VDC) and AC (90-230 VAC) power supply. The pump is provided with dry run protection sensor which helps to switch off the pump as soon as the water level in the tank falls below the sensor. Again when the water level increases, the pump starts automatically.

The SQFlex submersible pumps were provided with dry run protection sensors. As soon as the water level in the tank fell below this sensor, the pumps were switched off automatically. The pump remains off for next ten minutes after which the pump started by itself and if at that stage also the water level was below the sensor level, the pump again switched off. The pump started again only when the water in the tank was above the sensor level.

Grid Nepal is worked in co-ordination with user's group, different local groups, local organization and consultants to address all challenges. GREAT Nepal consultants were hired for survey and design for civil engineering related structure and ITD Nepal Pvt. Ltd. for electro mechanical components and quality control. Pump set and solar panel (the all appliances are guaranteed as per specification technically and functionally were procured through national bidding competition among certified suppliers and installers.

OUTCOMES OF THE PROJECT

- Saving of women's time for more productive work such as for income generating, social awareness and environment conservation programs, and girls can use their time for study and homework.
- Contribution to health and sanitation
- Less number of patients with water-born diseases
- Higher utilization of land, cash crops, vegetables fruit farming will be encouraged
- End of inhuman hardships of carrying the "gagro" in the foreheads of villagers would be ended that would be the greatest physic relax
- It reduces the time needed to fetch water, thereby forcing the womenfolk from a major burden.
- Improvement of income through improved farming and tourism development etc.
- Unemployment reduction
- Migration rate will be reduced.

- public participation will be enhanced
- Socio-cultural settings will be empowered and becomes easier livelihood

LIKELIHOOD OF SUCCESS

Establishment of kitchen gardening provides nutrition and lowers cost in purchasing vegetables. Agricultural activities can be made successful by developing water supply system at village level. The people will be trained in animal husbandry made possible due to availability of water. The incomes from the agricultural activities open new avenue for development so that the success of this project is sustained.

RATIONAL OF THE PROJECT

Sufficient amount of water at the nearest point from their houses will make villagers' life not only convenient, but also more productive and healthy. When water will be available next to their houses, women and girls will not spend hours to bring water from distant sources. This will save their time, which they can utilize in productive works. Usually in villages, children have to look after cattle, assist their parents in housework apart from collecting water. Most of the children, especially girls are busy all the day. It is hard for them save some time for study and homework.

With enough water available for cattle feeding and irrigation, farmers can have more number of cattle and use more land to grow more vegetables and crops. This will improve their economic condition. Hence, the project encourages people to stay in villages, and contribute to control accumulation of population in headquarters and capital city. By playing important role in the improvement of sectors like health, education and agriculture, the project contribute to the overall development of villages in particular, and the country in general.

INNOVATIVENESS OF THE PROJECT

For villages with no or insufficient water supply system, existing approaches are gravity water supply system when water source is available at higher elevation; and use of electric pump powered by national grid or local micro hydro for villages with water source available at lower elevation. But both of these approaches are not applicable at Bhujikot due to lack of national grid there and no suitable site for micro hydro scheme at or around the village. There is no third option in existing practice to fulfill the need of such villages.

Solar energy has been used in Nepal for lighting, battery charging, heating and drying purposes, so far in Nepal. Use of solar energy to power a water supply system in villages is definitely a new approach.

SUSTAINABILITY OF THE PROJECT

Following are the characteristics that suggest sustainability of the project beyond funding phase:

- Ownership of local users' committee
- The scheme can be locally managed, operated and maintained with training input to the local people.
- The system is easily installed and no fuel needed.
- The system is comparatively simple in its installation
- Enthusiasm of local people to have this project in their village,
- This facility is associated with one of elementary requirement - 'clean drinking water'
- Minimum 5 hours of sun available for at least 340 days

REPLICABILITY OF THE PROJECT

There are hundreds of villages like Bhujikot where there are no other options except solar pumping. According to the government data, there are 20% population left out from the water supply facilities that are mostly infeasible in terms of gravity, electric and other technical options. Once this project is successfully implemented, there are high degree chances of replicability by government agencies, INGOs, NGOs, DDCs and VDCs.

BUDGET

Total budget of the project was NRs. 1417911.99 (1.417 million). This covers the hard good cost of Solar PV Pumping System components including PV modules, pumps, mounting structures and installation materials as well as transportation to road head and installation charges.

Expense detail:

Total NDM 2005 funding requested Rs.1245000.00

SN	Items	Sub-Totals (NRS)
1	Personnel	164760.00
2	Materials and Equipment	1079112.51
3	Training	10000.00
4	Travel	36953.49
5	Evaluation/Information Dissemination	20672.00
6	General Administration/Overhead	59,413.99
7	Others	47000.00
Total Expenses		**1417911.99**

CONCLUSIONS AND RECOMMENDATIONS

Villages with no or insufficient water supply system, where gravity water supply system is impossible and use of electric pump powered by national grid or local micro hydro also not available have to rely on Solar water pumping. Solar PV technology for pumping water is must suitable due to its social acceptability, environmental friendliness, economical viability; this technology can be introduced in any country having mountainous features like Nepal.

Repeated measurements showed that the pump in average lifts around 25 liters of water per minute from CT to IT and IT to RT at peak sun. Considering average solar insolation at the site to be 5 hours per day, the total water yield would be 7,500 liters a day which was sufficiently above initial target of 7,000 liters per day.

The feedback from the community people was very encouraging and they were very eager to participate in any forthcoming project. The current successful work had definitely brought sunshine in their days in the form of increased agricultural production, utilization of spare time in best alternative activity such as like study, health and sanitation had been improved and people felt that there life style had been upgraded.

REFERENCES

[1] www.renerg.pub.ro
[2] www.aepcnepal.org
[3] www.gridnepal.org