WASH Field Note FN/18/2019

Using Solar Powered Water Systems to Improve Climate Resilience in Rural Myanmar

SUMMARY

- Since 2012 UNICEF Myanmar has been working with the Department of Rural Development, to construct Solar Powered Water Systems (SPWS) in rural, off-grid communities.
- Communities contribute up to 60% of system costs and are solely responsible for system management which creates a strong sense of ownership and financial sustainability.
- The community-based management model and user fee collection system has been successful because of strong community cohesion and supervision from DRD.
- Major challenges for scale up include the initial high cost of investment, weak local markets and the availability of trained technicians in rural areas.

Introduction

Myanmar is located the monsoon region of Asia, between Bangladesh and Thailand (Fig.1). The country's climate is significantly impacted by its geographic position and its topological relief. The north-south alignment of the country's mountain ranges and valleys creates a pattern of alternate zones of heavy and scarce precipitation. The west coast is subject to tropical cyclones and sea level rise.

The Climate Risk Index ranks Myanmar as the third most vulnerable country to the impacts of climate change, based on extreme weather events, including flooding, droughts and cyclones (Fig.1). Observed evidence of climate change over the past 60 years has included a nationwide increase in temperature of on average around 0.08°C per decade and an increase in total rainfall (29-215 millimetres per decade), leading to increased flooding.

Mother and child stand beside their flooded village in southern Myanmar

Changes in the duration of the monsoon season have been observed as well as the recurrence and severity of extreme weather events. At the same time, increased water scarcity is occurring, particularly in the central regions, leading to recurring drought. These impacts are undermining the safe provision of WASH services and are expected to intensify further in the coming years unless urgent action is taken.

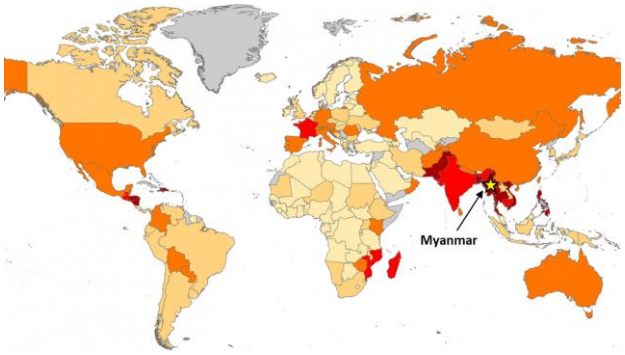


Fig.1 World Map of the Global Climate Risk Index[i]

KEY POINTS

- Myanmar has recently been ranked as being the "third most vulnerable country to climate change" in the world.
- These impacts of climate change are set to worsen in the coming decades, underming the provision of WASH services.
- Solar powered water systems are an effective method of ensuring safe, climate resilient water supply to off-grid rural communities and avoid the carbon emissions associated with a diesel pump.
- In Myanmar, the systems are being used to replace unimproved water sources, providing a higher level of service to communities, as outlined in the SDGs.

Description of Intervention

Overview

In order to addres the impacts of climate change, UNICEF and the Department of Rural Development (DRD) are working together on drought resilience programming in rural areas. Efforts have focussed on increasing year-round access to safe water supply and increasing water storage in dry-zone regions.

UNICEF Myanmar and Rural Water Supply Divison (RWSD), the former government department responsible for rural water supply, first began piloting the use of Solar Powered Water Systems (SPWS) for off-grid communities in 1989. The systems back then only point of source. The efficiency and durability of solar powered water systems has increased significantly over the past 20 years. Starting in 2012, around 36 new systems with pipe network and water meters have been installed in rural areas (Fig.2).

UNICEF Myanmar is prioritising the installation of SPWS for those communities with the worst water access – for example, those communities relying on untreated surface water sources and living far away from the national grid.

The systems are also being used to replace tradtional, hand-dug wells which are vulnerable to both flooding and drought (they often dry up during the dry season). SPWS also, importantly, offer a higher level of service to communities, through the use of piped water, as stipulated in the Sustainable Development Goals (SDGs).

Diesel-generator based water pumping systems are not considered a sustainable option as they are costly to maintain. They also break down frequently and have expensive fuel requirements, which emit greenhouse gases, such as CO_2. Additionally, they are are noisy and are prone to damage from heavy rain and flooding.

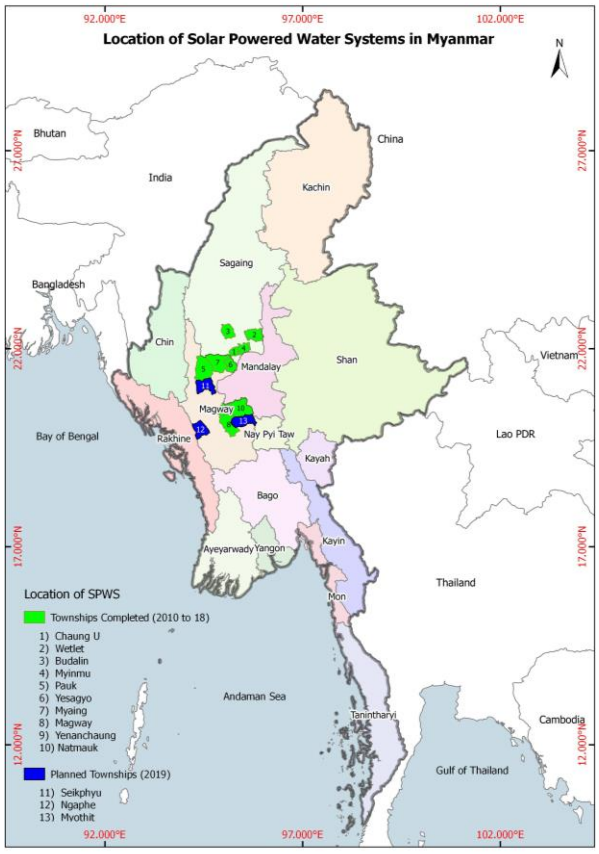


Fig.2 Map showing locations of UNICEF-DRD supported Solar Powered Water Systems

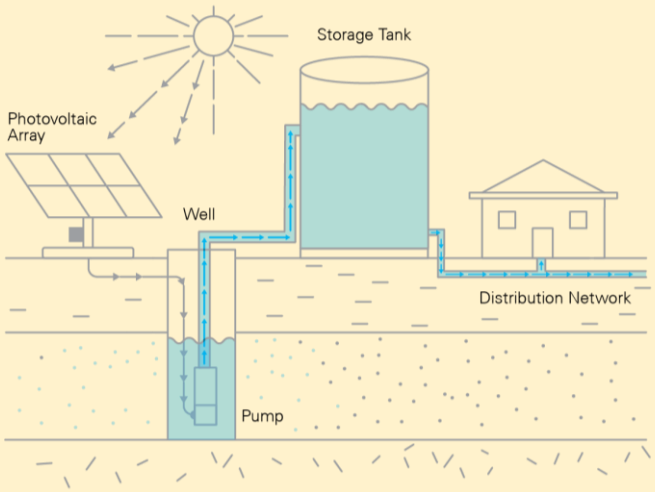
System Design

A typical system design consists of a solar array, submerisble pump, control panel and storage tank (Fig.3). Systems are designed according to the needs of the population and environmental factors such as solar irradiation and water depth.

A Solar Powered Water System in Natmauk Township

Wherever possible, agricultural and livestock needs are also taken into consideration (allowing the SPWS, furthermore, to be classified as Multiple Use Systems).

Fig.3 A Typical Solar Powered Water System

Schematic	Technology description
	• Solar irradiation is converted to AC power via the photovoltaic array. • This AC is converted to DC power, through an invertor, which powers a submersible pump. • The submersible pump pumps water to an elevated storage tank. • Water is then distributed, via gravity flow, through a piped water network directly to households and water meters are installed in each household.

Costing

Myanmar's National WASH Strategy (2016-2030) states that communities should provide up to 40% of initial system installation costs.

Table.1 gives a breakdown of the average cost of a solar powered water system in Myanmar.

Table.1 Average cost break down for a UNICEF-DRD Solar Powered Water System in Myanmar (funded by DfID)

Activity	MMK	USD
UNICEF Contribution	**9,374,000**	**5,874**
i) Solar Pumping System Installation	4,915,000	3080
ii) Spare parts kit	2,115,000	1326
iii) Pipes and fittings	2,344,000	1469
Community Contribution		
i) Cash	**6,298,025**	**3947**
a. Construction of overhead tank	2,000,000	1253
b. Tube well drilling	3,068,500	1923
c. Water meter	189,000	118
d. Pipe fittings	570,525	358
e. Foundations of support structure and fencing	350,000	219
f. Transport Charges	120,000	75
ii) Labour contribution	**381,000**	**239**
a. Digging of trench line	231,000	145
b. Plumbing	150,000	94
TOTAL	**16,053,025**	
Cost Per Beneficiary	**85,845**	**53.80**

System Management

Once the system has been successfully constructed, the community is responsible for all aspects of sytem management, including O&M, repairs and the collection of user fees. DRD provides supervision and coordination with tehcnicians as required. WUCs have direct access to township DRD office, and the collaboration between the local government and community is strong.

Water User Committees (WUCs) oversee the day-to-day management of the water systems. Water meters are used to monitor household water consumption and fees are collected each month by WUC members based on useage. These fees range from 100-300 Kyat (MMK) per m^3 ($0.06-$0.20), with the average household paying 1500 kyat ($1.00) per month. This is approximately half the price of a diesel generator-based water pump.

User fees are agreed upon democratically by the community during the project's inception phase in order to ensure that they affordable for all (including the poorest households).

Willingness to pay is high, due to a higher level of service provision (water is now piped directly to households) and appreciation that fees will be used to maintain the system and potentially fund other community projects.

Depending on date of construction, most communities have now amassed savings exceeding a thousand dollars. In many cases, these excess savings are being used to fund other community projects ranging from road construction, electricity generation to garbage disposal systems.

A girl collects water from her household connection to the SPWS

Water user displays her payment receipt in Pauk Township.

Outcomes

A Higher Level of Service

Around 40 systems have now been completed through the UNICEF-DRD SPWS programme. The programme has allowed 40,000 people, living in off-grid communities, to gain access to safe water.

SPWS have allowed them to gain a higher level of service – with safe water being piped directly to households. This has led to multiple time-saving benefits (people now have more time to engage in economic and social activities). Having water located closer to home has also many households to upgrade their traiditional latrines to an improved pour-flush design with a running water taps now being available for handwashing.

Strengthend Community Management Structures

The initiation of WUCs has helped to strengthen existing community management structures. The participation of women in the committees has been strong, many also work as tariff collectors, meaning they are able to earn additional months source of income.

Households appear more willing to pay for the higher level of service they receive. User fee savings are being used to effectively sustain systems and fund other community-based projects (such as road construction and electrification).

The project has also further strengthened the relationship between WUCs and the DRD, without the need for private contractors, allowing UNICEF to effectively hand over projects to communities once construction is completed.

The strong relationsip between DRD and the communities has meant that any technical issues are addressed in a timely manner.

However, it is important to note, that desite the strong relationship with the Government, communities retain full ownership and responsibility for their systems. This has been reinforced by the community contribution mechanism (for both installation and user fees).

Climate Change Resilience

The systems are improving drought resilience in rural communities, particularly those located in dry zone areas. The systems are mostly replacing hand-dug wells or stream water (which dry up during the dry season), providing water to communities 365 days a year. The design of the system (water storage tanks) ensure SPWS have a "water buffer" for cloudy days.

At the same time, user fee collection ensure that water is effectively conserved at the household level.

The systems have proven to be flood resilient, particularly in the southern states which experience heavy rainfall during the rainy season (see picture below). The systems also provide enough water for livestock, strengthening livelihoods, reducing poverty and improving overall community climate resilience.

A functioning SPWS is resilient to the impacts of rising flood waters during the rainy season.

Challenges and Mitigation Measures Applied

Supply Constraints

The main factor currently inhibiting the further scale-up of SPWS by DRD in Myanmar is cost. In Myanmar, the market for SPWS remains weak and there is poor availability of system components and spare parts locally.

It not currently possible to purchase higher quality SPWS brands, such as Lorentz and Grundfos, locally as the companies do not have a strong official presence in Myanmar. Solar panels are available locally, but their quality remains low (most have lifespans of 10 years or less). Major barriers for private sector expansion include the need for import licenses and other lengthy process which leads to higher transaction costs for the private sector.

The presence of poor quality components (including imitation products) and spare parts, often imported from China, ultimately leads to issues with durability and overall confidence in the scale-up of SPWS.

Because of these challenges, UNICEF currently procures from their Supply Division in Copenhagen, which remains costly in terms of transport. The higher costs associated with these SPWS limits the number of communities both UNICEF and DRD can support with the systems. Opening up local markets would allow both UNICEF and DRD to really take the systems to scale.

Capacity Constraints

Local capacity to carry out both major and minor repairs is limited. Technicians are therefore sourced from Yangon to make required repairs. This is both costly and can increase repair times. More training is required for local technicans to address the current capacity gaps in rural areas.

Environmental Constraints

SPWS are not suitable for all locations. In the dry zone in particular, water depth can often exceed 300m. Solar powered systems which use a DC/AC converter are much higher in cost. Surface water solar pumps are now also being piloted in some regions as an alternative.

Once completed, it is vital that solar panels are cleaned regularly, particularly in the dry zone where dust rapidly accumulates. Vegetation growth can also shade panels if not adequately maintained.

Both these factors have the potential to significantly reduce system output and must be an important component of O&M plans.

Equity Constraints

The National Water Strategy states that communities must be willing to contribute up to 40% of system costs to be eligiable for a SPWS. This means that the poorest communities are often unable to afford to to participate in SPWS project and are instead left with tube wells and other unimproved sources. However, it is important to note, that due to the relatively low (democratically-decided) water tariffs, every household within the water supply project villages has access to safe, piped water supply.

The DRD currently provides alternative water sources to unserved communities. However, this represents a missed opportunity for DRD and UNICEF to significantly reduce water equity gaps, by providing the poorest communities with access to a safely managed water system. In addition, it is vital that solar powered water systems are prioritized for districts with the worst WASH and poverty indicators to maximise their health and poverty reduction impact at the regional level.

Water User Committee members stand beside their SPWS in Pauk Township.

Lessons Learned

The community-based management model for solar powered water systems works well in Myanmar, arguably better than in many other countires, because of the country's very specific social and political context. Myanmar has very high levels of social capital, a limited history of dependence on external agency's support and significant Government capacity to monitor and support communities. If these attributes are not present in other countries, a private utility-based model may perhaps be a more effective option for system management.

The strength of the relationship between UNICEF and DRD and DRD's subsequent relationship with communities, has been a key driving force in the success of the project. This relationship, which excludes the need for a private contractor, ensures a real sense of community ownership and responsibility. This is reinforced by the fact that communities also contribute towards the cost of the project and also pay user fees.

It is important that the Government creates a supportive enabling environment for the SPWS private sector and support the expansion of local markets to reduce costs and increase the availability of quality products and spare parts.

Following system installation, it is vital that regular follow up occurs with communities, to ensure that effective O&M is being consistently practiced. Panels must be cleaned regularly (particularly in the dry zone, which are prone to high levels of dust) and vegetation must be cleared to prevent shading. Not doing this, can lead to major reductions in system output. The township DRD offices have committed to provide technical assistance to the WUCs, to help overcome such challenges moving forward.

Water demand is particularly high during the dry season. Communities also require water for their agricultural and livestock needs, something which

is vital for resilience and poverty reduction. Wherever possible, the future dimensioning of systems should take these needs into account (i.e. creating Multiple Use Systems).

Next Steps

In 2019, UNICEF will continue to scale up the use of solar powered water systesm to an additional 10 communities.

DRD has a target of ensuring improving water supply for 2000 communities each year. For the most remote, off-grid rural communities, it is hoped that a significant number of these will be solar powered water systems.

UNICEF will work to ensure that priority is given to the poorest, off-grid communities, particularly those currently relying on untreated surface water sources.

In order to achieve SPWS results at scale, it is vital that local markets are expanded. The policy environment must be strengthened to allow reputable SPWS companies to enter Myanmar. This will ultimately lead to an increased availability of supplies and a reduction in overall programming costs. The private sector could also play an important role in training and certifiyng technicians in SPWS technology and will be vital in improving WASH sector capacity around SPWS in the future.

UNICEF and DRD are currently working with the private sector to develop a list of certified, trusted, locally available technicans who can fix systems as required. This would help reduce repair time frames and improve the capacity of communities to manage their own systems (without relying on DRD to facilitate).

In order to improve the efficiency and accountability of user fee collection further, mobile payment technology options could also be explored, in collaboration with the major mobile phone companies in Myanmar. The technology is already successfully being used in other countries.

UNICEF and DRD will also explore the potential for joining forces with other agencies currently involved in rural electrification programmes. This makes sense because all the SPWS communities are also off-grid, so also desperately need electricity (which can also in turn be used for water supply). There is real potential for the use of micro-grids in these areas. As such, partnerships could be formed with the World Bank, UNDP or other agencies, along with major donors such as the Green Climate Fund in order to combine resources and implement joint programming at scale.

References

UNICEF Solar Powered Water System Assessment (2016) https://www.unicef.org/wash/files/UNICEF_Solar_Powered_Water_System_Assessment.pdf

Myanmar National WASH Strategy (2016-2030)- https://www.unicef.org/myanmar/WASH_Strategy_Final-1.pdf

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[i] https://www.germanwatch.org/sites/germanwatch.org/files/publication/20432.pdf

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