Water, Environment, and Climate Change: Knowledge Sharing and Partnership

Title of abstract: *Rain Drops Count – Revisiting 'Finnida' Rainwater harvesting jars after a decade*

Authors: Dr. Sanna-Leena Rautanen*, Chief Technical Adviser, Rural Water Supply and Sanitation Project in Western Nepal Phase II (RWSSP-WN II)/FCG International,

E-mail address: sannaleenar@gmail.com

Telephone: +981 98011 23334 and / or Skype: sannaleenar

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ABSTRACT

The Rural Water Supply and Sanitation Project in Western Nepal core thrust is to reach the unreached and to serve-the-unserved. In Western Nepal this often means mountain top locations where gravity flow water systems are not possible. In these locations, rainwater harvesting has proven a life changer. Women used to spend a substantial number of hours and energy trekking downhill to collect water. Rainwater harvesting and storage has provided a far better standard of living and water security, even when it cannot provide a service all year round. Since 1995 Finland has supported rainwater harvesting projects, initially in water scarce districts such as Gulmi. A 2016 review found that over 80 % of the systems in a Gulmi village were operational and still in use after 20 years. A rainwater harvesting approach can serve many purposes in these remote villages. It provides water for drinking, personal hygiene and sanitation, home gardens and livestock. It reduces the workload of women and offers time and opportunity for alternative livelihood options. Rainwater harvesting systems at home raise water security and improve living conditions for elderly and disabled people. Ponds, recharge pits and other climate change resilience measures depend on catching the rain. Climate change induced variations in rainfall patterns are nowadays affecting demand for rainwater harvesting systems. Instead communities request lift schemes which may not be always economically feasible. WASH policies should include rainwater harvesting as an option that enables the right to access to water (for most of the year), in locations where distant water sources currently prevent adequate access to sufficient water supply.

INTRODUCTION

Collecting rainwater for various household uses is a very old practice all over the world. Examples of RWH systems can be found in all the great civilizations throughout history. A wide range of RWH systems have been developed where conventional water supply systems cannot meet peoples' needs, both in developed and developing countries. There are several technical options available, from using banana leaves or stems as temporary gutters into highly sophisticated systems with first-flush and filtering systems. (Rees & Ahmed, 2008). RWH should be an increasingly important component of integrated water resources management, having a role to play both in domestic and agricultural use and recharge of water sources. RWH is an important shift towards household water security, being an example of decentralised water resources management and a component in overall poverty reduction. (Smet & Moriarty, 2001).

Climate change will evidently influence rainwater harvesting. (Mahmood & Hossain, 2017)studied the feasibility of Domestic Rainwater Harvesting in South Asia region using rainfall climatology, remote sensing and water balance concept. They concluded that that it is *"a viable option in most of Bangladesh, Sri Lanka, Himalayan range, North-Eastern, Central, Eastern and coastal parts of Southern India as the rainfall and household architecture can satisfy potable (7.5 liters per capita per day-lpcd for drinking and cooking) water demand for significant portion the year even in worst case scenario".* (Mahmood & Hossain, 2017). (Bailey, Beikmann, Kottermair, Taboroši, & Jenson, 2018) studied the sustainability of rainwater catchment systems for small island communities, surveying 152 households. These authors applied water balance modeling to estimate end-of-day stored rainwater volumes for each day of the 1997–1999 time period. Even if there was at that time an El Niño-induced drought, their results indicated that the community was "*resilient to drought, although the majority of rainwater collection systems were depleted of rainwater and hence community sharing was required"* (Bailey et.al, 2018). (Haque, Rahman, & Samali, 2016) investigated the climate change impacts on RWH systems in five locations in Australia. The authors concluded that *that "the results indicate that performances of a rainwater harvesting system will be impacted negatively due to climate change conditions in the future,"* and recommended among others that both policy makers and those constructing the systems need to understand the impact and select such as tank sizes accordingly (Haque et.al, 2016).

Water, especially safe drinking water, is scarce in many parts of Nepal. The access to safe water supply in many areas is still low even if notable improvements have taken place over the years. Due to geographical realities, there are vast rural areas along the mountain (in Nepal often referred to as 'hills') tops where piped water supplies, gravity flow systems, or either hand-dug or tube wells are not feasible. In Nepal the winter rains are now largely missing, and this has influenced communities interest in rainwater harvesting schemes. There is an increasing demand for lift water supply schemes instead, even where it is obvious that the electricity bill alone will become a burden. Pretus (2009) studied the feasibility of rainwater harvesting for human consumption and for livelihood enhancement, and observed that *"the availability of other water resources partially determines the use and dependency on rainwater harvesting. (...) In those communities with acute water scarcity, households are making the most of rainwater."* (Pretus, 2009).

Rural Water Supply and Sanitation Support Programme (RWSSSP) Phase II, Nepal-Finland cooperation, introduced a RWH system into its menu of technical options in 1990s. It consisted of jars specially constructed for the longer-term storage of rainwater. The shape was adjusted from a smaller tanks that were observed in Thailand, based on the traditional shape of the Nepali water vessel, "*gagri*". The design was improved over the years, and such additional

features as PVC nets and tightly fitting lids were introduced since the first schemes. To protect the water from contamination from the rooftops and gutters, the RWH system has a 'first flush' to divert the very first and usually dirty water away from the RWH jar. The design did not have any filters for the incoming water.

The RWH system was targeted to the 'hill' (mountain) top areas where other forms of water supply were not possible to provide, or where the traditional water sources were getting scarce due to environmental degradation. The RWH system received appreciation from the communities in terms of providing easy access to water that is needed for a wide range of activities in an agriculture-based rural home. RWH could have been an option for the arsenic affected plain (Tarai) areas, but it did not get popular due to easy access to shallow tube well water, even with arsenic. During the three years of the RWSSSP Phase III the total number of 5592 RWH jars were constructed in four districts.

OBJECTIVES AND METHODOLOGY

Rural Water Supply and Sanitation Support Project Phase III (RWSSSP, also known as 'Finnida' project and 'Lumbini project') supported total 5,592 rainwater harvesting (RWH) jars within three years of Phase III. This study revisits the learnings from RWSSSP. This paper is based on the author's own field reports and data collected for the project purpose in 2002-2004 but never published, and a visit by the author to one random RWH jar location in Gulmi district in 2016 where the RWH jars were completed over 15 years ago.

What did we learn at the time of RWSSSP, and to what extent these are still valid learnings at this time? Are the RWH systems constructed over a decade ago still being used? What could the present projects, such as Rural Water Supply and Sanitation Project in Western Nepal (RWSSP-WN), do in very practical terms in promoting RWH? Should rainwater be promoted as *drinking* water source, or should the policy shift towards sustainable livelihoods approach from the health-centered approach, and look at all the benefits that follow from having access to the water next to the house? Recharge is another highly critical aspect of RWH, but this is not included in this study.

FINDINGS

RWSSSP was promoting RWH as safe drinking water. However, it had been claimed that the RWH water was not often used for drinking and that the quality was not necessarily up to the drinking water quality standards. On the other hand, it was assumed that even if the RWH water was not used for drinking, it was a useful asset for many other purposes. That is, even if *drinking* water was still carried from the previous sources, the sometimes very long water fetching trips could be reduced radically when RWH water was available for other purposes. RWSSSP unpublished reports and the author's own field notes explore the RWH issue from various perspectives. For this paper, the focus is on who benefited and what changed.

As a background, in theory rainwater from the well-maintained system should be able to meet the highest water quality standards. Water has also a long storage life in a RWH jar in terms of maintaining its qualities. This is due to the low mineral content of the rainwater. Furthermore, water which is relatively clean on entry to the tank can improve in quality if allowed to sit for some time inside the tank. Bacteria entering the tank will die off rapidly if the water is relatively clean as there would be no breeding ground for it. Algae will grow inside a tank if sufficient sunlight is available for photosynthesis. The RWSSSP RWH jars were designed to be dark with closely fitting lids and painted white outside to keep the water inside cool. In theory, the water

is safe to drink. However, in practice the quality is not always maintained. There are several ways of bacterial contamination or making water aesthetically not pleasing to use. Rainwater can become contaminated by anything that it comes in contact with, whether before it enters the RWH jar, in the RWH jar, or later on, when taken out from the RWH jar.

The survey in 2002 included total 100 households, 50 in Thanapati and 50 in Daugha VDC, both in Gulmi district. In Thanapati the RWH jar water was used for a range of household purposes, including washing, cleaning and toilets, as well as for animals. Half of the respondents stated a variety of these uses but not drinking. No respondent stated drinking alone as the primary use, although one respondent stated various kitchen and cooking uses, and 18% stated all uses, including drinking. In total 55% responded that they used the RWH jar water for drinking, with one person clarifying that they used it for drinking after boiling.

In total 86% agreed that the water from the previous source tastes better. In Daugha 90% stated that the RWH jar water was also used as drinking water, sometimes "because there were no choice". In the cross-checking question later on, 98% stated that all drink water from the RWH jar. Health concern was expressed by 56% who specified their concern for bird droppings and other potential health hazards. These responses were consistent with the previous question about whether they drink the RWH jar water. None of those who expressed the health concern had earlier stated that they drink the RWH jar water. On the other hand, those who stated that RWH jar water affects throat were drinking it. In Daugha 50% stated that the water from the previous source did not taste better or different to RWH water. Figure 1 captures various responses, overall indicating satisfaction with the RWH jars.

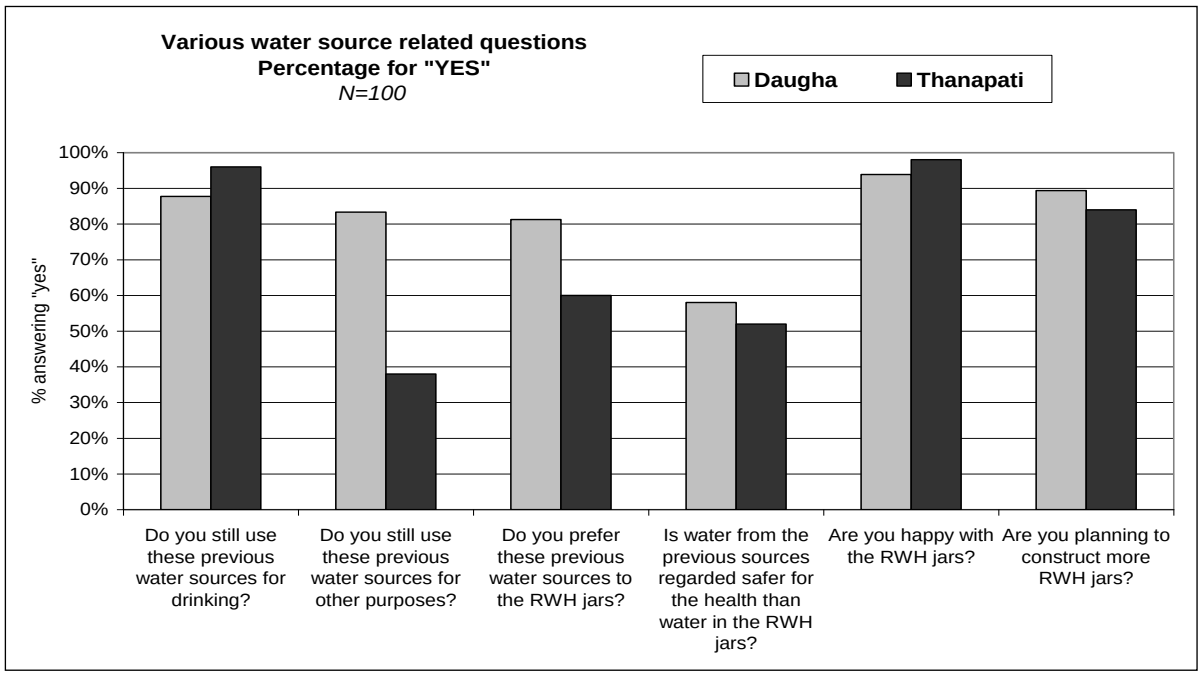

Figure 1. Preferences related to the use of previous water sources and rainwater

Is there a difference between women and men in using rainwater? In Thanapati 56% of the respondents agreed, in Daugha only two percent. From those who answered "yes" in Thanapati, 85% stated that women simply do more work and thus, need more water. In Daugha the only respondent did not elaborate reasons. The opinions were fairly similar when asked whether there were any difference between old and young as 44% in Thanapati and two percent in Daugha stated "yes" there is a difference. Out of those who stated "yes" in Thanapati 67% claimed that older people use more water, and 10% that younger people use more.

As expected, females including mothers, daughters and daughters-in-law, were carrying most of the water home. In Thanapati 47% stated that there has been changes in who is carrying the water, most persons (47%) reporting that it had become more easy and that less trips were needed, and more specifically that smaller vessels were needed and thus, there were no need to carry heavy loads (7%). Others reported that "now everybody carries water" (20%) and also that "males carry, husbands faster" (20%). In Daugha everybody stated that that yes, there has been changes in who carried water home. The obvious reasons included that much less time is used and it is easier to get water (30%) and that water can be carried in small vessels and thus, much less heavy work to do (28%). The change affects all in the household as "only" 10% reported mother as the main water carrier, everybody else stated that all carry water.

In response to the question who has benefited the most, the answers in Thanapati follow the answers given to the first question about who carries most water. Also 26% recognised that everybody has benefited. In Daugha 81% stated that everybody has benefited and 13% that mother has benefited. See figure 9 for the water carriers and the beneficiaries. The respondents also estimated the times and number of trips that were made to fetch water for various purposes.

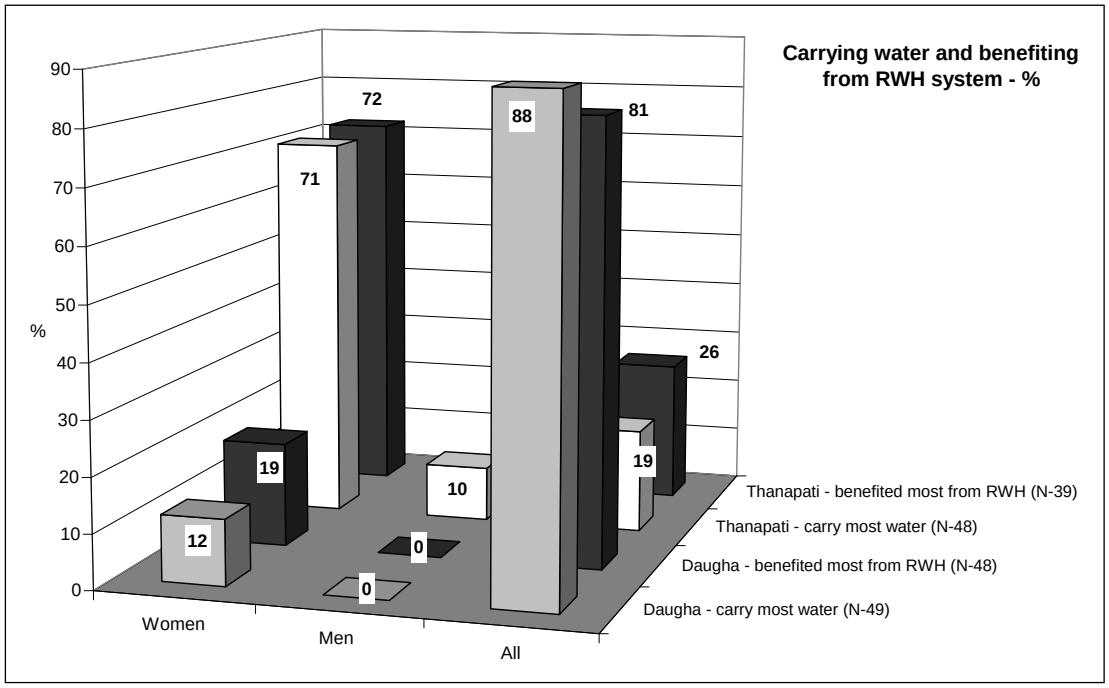

Figure 2. Water carriers benefit most from rainwater harvesting

What did the women think about RWH jars?

This chapter captures some highlights that I recorded in Tanahun district in 2002. Generally, the RWH systems had been received well after the communities had seen a working RWH system. Where the concept and technology were completely new, where nobody had ever seen such a system, the initial attitudes were somewhat reserved. This was the case for instance in both Purkot VDC and Basantapur VDC in Tanahun District where none of the several persons interviewed admitted having seen RWH jars or systems before the construction began in the village. Both schemes were finalizing the construction at the time of the visit, and thus, had no long-term maintenance experience. In Purkot the total number of 27 RWH jars were being constructed to serve a total population of 166, and in Basantapur the total number of 37 RWH jars were constructed for the total population of 242. Both communities had planned to go for the next phase to construct more RWH jars as the technology was now familiar to them, and

the rest of the households were eager to join the scheme. In total they were planning to construct some 80-90 RWH jars more.

The visit was made at the heat of the rice planting season and thus, it was not possible to interview all the families. However, especially older female household members were available for the discussions and happy to share their experiences both with the RWH jars and other issues such as past and present hygiene practices, hygiene and sanitation, training, and how the RWH jars had influenced the families already even though they were very new.

When reading the following comments about people carrying water for home, note that a lot of it is needed for the animals. In all houses there were one to three buffaloes, couple of goats and chicken, and possibly a cow as well. Because of the steep hills, the bigger animals cannot be taken to the water, the water has to be taken to them, I addition to the fodder. All the following comments are from the women (unpublished Field Report by Rautanen, 2002):

- *We used to wake up at 4 am to start fetching water before going to work on the fields. In the evenings when we came back, we had to start carrying water again. We used to go to sleep very late. Now we do not have to do that anymore. We can also rest.*
- *Even if the RWH jar would be only of seasonal help, it is exactly the right season. This rainy season is the most busy agricultural time for us. We spend long days at the field. Now we can concentrate on that as nobody has to spend time carrying water.*
- *The RWH jar has already made a difference in our lives. Even if we are not using the water from the RWH jar for the drinking yet, it is a great relief. We used to have to walk nearly an hour to collect water. That is one trip only. And that is not including the waiting time at the spring.*
- *No more backache.*
- *The personal hygiene in this household has definitely improved. We wash ourselves and our hands much more than we did before when we had to carry all the water.*
- *I would like us to have more RWH jars. We know now how to do it and I think that we will.*
- *I have no space in my yard, as you can see, but I really wanted to have a RWH jar. I now have made an arrangement with my neighbour so that that the jar can be on that land. That is not my land. I would also like to have a latrine, but where can I build it?*
- *I just cleaned the jar. There were plenty of water in the there. I invited the neighbours to wash their clothes here. Look at those. They are not all mine!*
- *We used to collect rainwater to that plastic tank over there. Now it has been circulated in the village to provide water wherever the RWH jar has been constructed. It takes a lot of water to prepare the jar and then to cure it. We will save the tank for the future. When you have a wedding or some other party, you do need a lot of water in the house.*

Revisiting Baletaksar VDC, Gulmi, in 2016

More than a decade later, Jhepakhola Khursanikhet electric lift water supply scheme was under construction in Baletaksar VDC Ward number 4, Gulmi district, supported by RWSSP-WN Phase II. This scheme serves 504 people. Among its beneficiaries are 22 households with 'Finnida' RWH jars. In total RWSSSP supported 473 people with the RWH system in Baletaksar VDC. I was curious to know whether the RWH jars were still maintained and used, even when the winter rains were largely missing a decade later, and the new lift scheme was being constructed. In September 29, 2016 I visited 18 of these 22 households with RWH jars, see the Photo 1. Status of RWH Jars in Baletaksar VDC in Gulmi District in 2016 was as follows:

- Out of 18 households, there were only three cases where the RWH jars were not used, all for a reason: one RWH jar belonged to a derelict house where the owner had died and nobody had claimed the property thereafter; one RWH jar had remained higher than the new house and hence, was not getting water; and the third belonged to a very poor household where a single elderly lady was living alone: this house was struggling to maintain anything, and the community had constructed a new private tap-stand for this lady, connected to the new lift scheme.
- 15 RWH jar households with their total present population of 70 were actively using their RWH jars for a range of uses except for drinking.
- Drinking water is still carried from other sources. Depending on the location of the household in the cluster, it takes in between 20 – 45 minutes round trip to collect this water. When there is no rainwater, all water is carried from these locations.
- In ten cases the first flush system was still used, and all those who used their jars, also cleaned it. Majority cleaned it once per year, only one reported 'every three months' and another one 'every 6 months'. All jars had a lid, more or less fully covering the top, but none had the mosquito net that we promoted at the end of RWSSSP Phase III.
- The jars, their taps and covers were were fully functional.
- Water was available from 2-8 months, depending on the number of users and purposes of use. In several cases the RWH jar pipe was connected directly to the toilet, and/or a separate connection was made for the animal sheds and garden.
- In five cases a larger 8 m^3 RWH jars were observed, bigger than the standard 2.5 or 6 m^3 models. Reportedly these households had invested more construction materials from their own side during the construction. The 8m^3 RWH jars were typically constructed instead of two smaller jars.

Photo 1. Rainwater harvesting jars after more than a decade in Gulmi district

CONCLUSIONS AND RECOMMENDATIONS

RWH can be used both for domestic and agricultural purposes. This study was concerned with the domestic use where the requirements for the water quality are high. RWH is not the definitive answer and end of all water problems. A complex set of inter-related factors have to be considered in promoting rainwater as safe drinking water. On the other hand, water quality concern should not prevent us from promoting rainwater harvesting: water has numerous other uses as well. Seasonal variations and variations in monsoon over the years as well as other water sources, their quality, quantity and reliability are part of the calculation.

Household-specific technological options, such as rainwater harvesting, should be further developed to alleviate the burden of carrying water for long distances, in saving time for more productive activities, or simply allowing some rest or time to study for the children in the middle of the already heavy rural life. It reduces the workload of women and offers time and opportunity for alternative livelihood options. Rainwater harvesting systems at home raise water security and improve living conditions for elderly and disabled people. Even if drinking water was still carried from the previous water sources, the sometimes very long water fetching trips could be reduced to one or two trips per day. Sanitation, hygiene, home gardens, livestock, various rural livelihoods, these all need water: because of the steep hills, the bigger animals cannot be taken to the water, the water has to be taken to them.

RWH represents people-oriented technology that is an aspect of household water security. Thus, it requires an intense participatory approach as its future use and maintenance is up to its' owners. RWH approaches need to recognize the role of the household, and give emphasis in capacitating the community members in maintaining what essentially belongs to them. Technically the RWH system has to be made paying attention to locally available materials for the necessary repairs and improvements.

Ponds, recharge pits and other climate change resilience measures depend on catching the rain. Climate change induced variations in rainfall patterns are nowadays affecting demand for rainwater harvesting systems. Instead communities request lift schemes which are not economically feasible, or which are not used for pumping all water that is needed for various reasons. These reasons include such as high electricity cost, hence, reduced pumping hours, or simply the capacity of the water source itself, or the pump. RWH may not be a popular option for safe drinking water, but it does serve its purpose. We should keep this option in our agenda.

WASH policies should include rainwater harvesting as an option that enables the right to access to water (for most of the year), in locations where distant water sources currently prevent adequate access to sufficient water supply. As also recommended by Pretus (2009), a widespread installation of rainwater harvesting tanks favors an enhanced "range of choices" in drought management and consequently, an improved capacity to overcome extreme events. The policies should promote rainwater harvesting and recharge structures as part of other technical choices, adding resilience by acknowledging that there are multiple water sources for multiple water uses, and not all the sources are available around the year.

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