# Household water security using rainwater harvesting

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## Introduction

Household water security (HWS) is a relatively new concept that has been introduced to the water sector research. The rapid increase in the irrigation sector, specially among the developing countries, urbanization and industrialization have increased the demand for adequate water at household level. While there had been much debate on food security and environmental security, precious little is known about the appropriate combination of policies, institutions and market mechanisms that governs household water security in water stress environments. At a time when market dimensions of water are gaining momentum, it becomes increasingly important to understand the non-market dimensions of water too. Understanding "household water security" its impacts and implications to the society at large will be the challenge researchers will have to face in the new millenium. Household water security is an important component in the complicated water supply mix, where demands for, economic efficiency, agricultural growth and ecosystem integrity are expected to be met simultaneously. Especially where supplies for more than one of these demands have to be provided at the same time.

One of the primordial aspects of household water security is the "water entitlement" and "water needs". It is most important to establish these terms to understand HWS. Water entitlement is the measure of water that is basically required by human beings for survival. This can include water for drinking, hygiene, sanitation and modest household requirement for food preparation. One could argue that every human being has his/her entitlement right for water, which he can demand in case of short fall. On the other hand, water needs goes beyond the scope of water entitlement, where one could demand for all water needs of a household. This includes, water needed for home garden agriculture, water for livestock and "other" needs that falls beyond the realm of entitlement. This means that water needs are higher than water entitlement in quantitative terms.

One of the important issues in understanding HWS is, quantifying water entitlement. Water entitlement can vary depending on the climatic regime, age, and occupation of individuals. As such there is no universal water entitlement that can be used for living beings. However, research conducted on water use by different scholars have suggested water entitlement rates that vary from 20 to 50 liters per capita day (lpcd). These figures are taken as the basic minimum "life line" values for human survival. However, in certain cases the "life line" values have been quoted as high as 100 lpcd. Any water use in excess of these values can be taken as the "water need" of a specific household at a specific location in a given time span. The highly exaggerated per capita water use values used in design purposes is to take care of the "water need" and of course to account for water losses in conveyance. Considering theses two aspects, household water security will have to cater to the "water needs" of a household. In certain communities extra-entitlement water needs are more important than basic entitlement needs. Research conducted in Sri Lanka, on water use of rainwater user communities in the wet zone have indicated that water for household livestock and

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water for tea seedlings are as important or more important than basic human water needs. Similar findings have been reported from the Boran pastoralists of Ethiopia, where the increase availability of water due to rainwater harvesting have increased the water consumption of livestock by three fold. Hence, the pastoralists have decided to invest the increases water availability to make gains in productivity. Thus, the indication is that water needs of this community is very much higher than the basic water entitlement of the community.

The complex nature of household water security is such that, it is highly sensitive to macro level policy changes or meso level sectoral changes and micro level environmental changes. Given that the first two levels are to attain HWS, and there is adequate availability of water, the micro level household environment can be a determining factor in achieving HWS. Often one finds that lack of adequate and able labour, old age and sick and opportunity cost of time, have a direct impact on household water security. Hence, enhancing the water availability within accessible distance can mitigate the negative factors in the immediate environment thus, improving HWS.

## Concept of Household Water Security

Household water security envisages availability of water as the central focus. However, this does not mean that mere availability of water is sufficient to meet the household water security. The idea of water security allows water to be considers as a natural resource a commodity and entitlement. These are all complementary perspectives that goes to establish household water security.

There are three critical factors that determine household water security. Availability, accessibility and usage. The degree of combination of these factors will determine the HWS at a given point of time. Availability of water depends on environmental factors to a greater extent and on human factors to a lesser extent (supply function). On the other hand the available water has to be distributed to households for effective use (distribution function). This means that both storage and flow of water to the households must be adequate, reliable and sustainable. Experiments with rainwater harvesting in Sri Lanka indicates that by storage of rainwater, adequacy and reliability can be attained with respect to HWS. However, due to capacity limitations and bad management practices sustainability of HWS over a long period can not be predicted.

Access to water depends on the physical location and timely availability of water as a commodity. This ensures that there is a firm control of water as a commodity by the households. Access to water can be sensitive to national policies and investment priorities. Access to water can also increase the demand for water. The type of access to water alone is a determinant in total water use. Gleick reports that, when the distance to the water source varies from more than one kilometer (stand post) to household connection, the water consumption increases by as much as 15 to 40%. In Sri Lanka, enhanced access to water by household roof water harvesting has contributed 50% to 70 % to the total household water requirement. Hence, improved access to water acts in two ways. It can either increase the total water use or contribute substantially to the total water budget, thus, reducing on the opportunity cost of time.

Water use, basically relates to ones entitlement rights. However, the entitlement rights depend on the quality of water, status of the household, environmental constraints, opportunity cost and awareness. Environmental constraints and awareness has been two major impediments to water usage among some of the rainwater communities in Sri Lanka.

While these factors consist of the main thrust of household water security, it is not without risk and uncertainty. Sever water shortages due to droughts or water table depletions due to over abstraction can affect HWS. On the other hand removal of subsidies, unavailability of labour to fetch water or sick or death of water carries can sharply increase the opportunity cost of water carriage. Therefore, determining household water security warrants multidimensional attention beyond a single sector focus.

**Definition of Household Water Security**

Many researchers have defined household water security depending on how they perceived the concept of HWS. One of the simplest forms of household water security is **the ratio of water supply to water demand**. If the water demand is higher than water supply then there is a water deficit while the opposite is a situation of water surplus. Under a surplus situation, it can be theoretically assumed that HWS is satisfied.

Household water security is also defined as, **"access by all individuals at all times to sufficient safe water for health and productive life".** While this definition encompasses most of the salient features of HWS, definition of "safe water" can be debatable. Safe water can mean clinical safety, cultural safety or even perceptional safety. Though this definition ensures "sufficient water", it however, does not mention "reliability" and "timely availability" of water. In a holistic definition of household water security, these factors are essential. Hence, the definition is further revised to read as" **Accessibility' reliability and timely availability of adequate safe water to satisfy basic human needs".** These are some of the definitions, which are used in defining household water security. However, it appears that much work needs to be done to fine tune the definition of household water security.

**Use of multiple water sources**

People use multiple sources of water to achieve water security. In the absence of good quality water on a continuous basis from a single source, people have adopted using different sources of water to meet water security needs for different activities. Among the rainwater harvesting community in rural Sri Lanka, people have used from two to six sources to satisfy household water needs. The increase in number of sources depend on the climatic regime, availability of water, sustainability of the source and quality of water. The latest addition to the list of water sources in rural Sri Lanka is rainwater harvesting.

Traditionally, in the wet zone people use two to three sources of water to satisfy their household water needs. These sources are generally limited to dug wells and natural springs, which are found in large numbers in the central and southern wet zones. Though dug wells are the most common source of household water, the number of dug wells can vary depending on the need and time of water demand. It is not uncommon to find people using two separate dug wells, one for drinking and other for bathing. Usually these two activities are not mixed to maintain the quality of water. Rainwater harvesting is the third sources that had been included in most pats of the wet zone. An intricate combination of water use from these sources, ensure household water security for wet zone users.

In the dry zone, the use of more than three sources to meet the household water needs is common. Studies in Sri Lanka indicate that in the South Eastern Dry Zone people use at least three sources of water along with bowser water supplied by the local authorities and harvested rainwater. In the Northern Western Dry Zone on the other hand, people use up to six sources of water to meet household water security and in extreme difficult conditions it can increases up to seven. This situation is particularly prevalent when the annual average rainfall is below 800mm and the ground water is too saline to use as portable water. The sources of water in extreme conditions vary from, tube wells, dug wells, small and large surface water ponds (not traditional reservoirs), informal rainwater harvesting and water purchased from water vendors. While most under ground water is saline, the surface water collected is non-saline. The proportion of water use from different sources depend on available quantity and access.

While use of multiple sources of water is a common practice, time spent on fetching water and opportunity cost of time is a function of availability, accessibility and quality.

**Research conducted in Sri Lanka to understand Household Water Security**

An attempt was made to understand the HWS in rainwater communities under the European Commission supported study on "Domestic roof water harvesting in humid tropics". At the beginning of the study the concept of HWS was a new idea and there wasn't much knowledge review to fall back on. However, it was soon realized the quantity of water use per household was paramount to any study on water security. As the study was going to test whether introducing rainwater harvesting improved HWS, a purposive sample of 30 households were selected from rainwater users and non-rainwater users. The household water use was catrgorised into six activities, which are the commonly performed water activities in a rural household. Drinking, cooking, personal washing, washing clothes,. toilet use and "other" uses were identified as the main activities. Water use data for each of these activities were collected on a daily basis through two hydrological cycles. The wet season data consist of October to December and the dry season data consist of June to August. The individual households volunteered to record the data on a daily basis in a performer provided to them. Initial training on the concept, use and recording of correct data were given to the householders. Two research assistants supervised the data recording process on a weekly basis.

The data were recorded by number of pots of water brought to the house for consumption. In the context of the study, consumption included all water related activities except for bathing and washing clothes out side the house. These activities usually take place at the village reservoir or irrigation canal or in small streams. Water use data were recorded by number of pots for each activity separately. This was the most difficult part of the study as the process of repeating this function over a six month period tends to be laborious and time consuming. However, with close supervision, we presume the data is at least 60% to 70% accurate.

The recorded data were converted to liters of water use, by multiplying with a factor of 12 for a pot of water. In rural areas the usual alloy pots used to fetch water contains 12 liters of water. In general most household used these type of pots, therefore, it was safe to assume a figure of 12 to convert the number of pots into liters of water use.

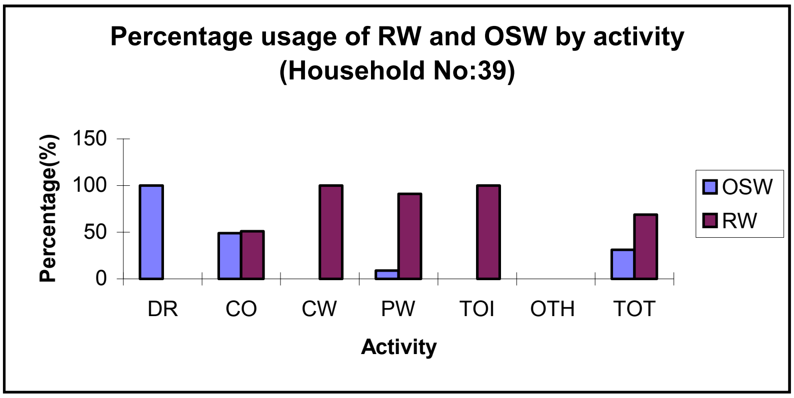
The total water use per household was divide by the number of water users in the household to arrive at liters per capita day (lpcd) use for each water activity. Summation of lpcd for all water use activities is the total water use per person at a given time.
In the study conducted in the wet zone of Sri Lanka, water brought from sources like dug wells, springs and tube wells were recorded separately and rainwater use was recorded separately. The total water use of a household was the sum of these two types of water used at household level.
Presentation of water use patterns for different households are based on these figures.

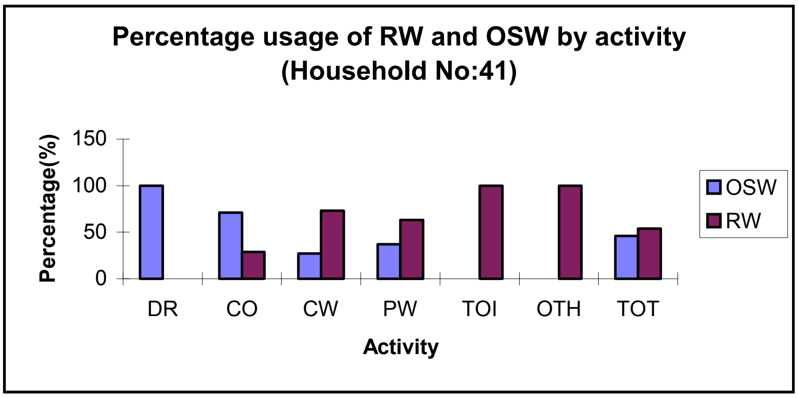
**Water use patterns of households**

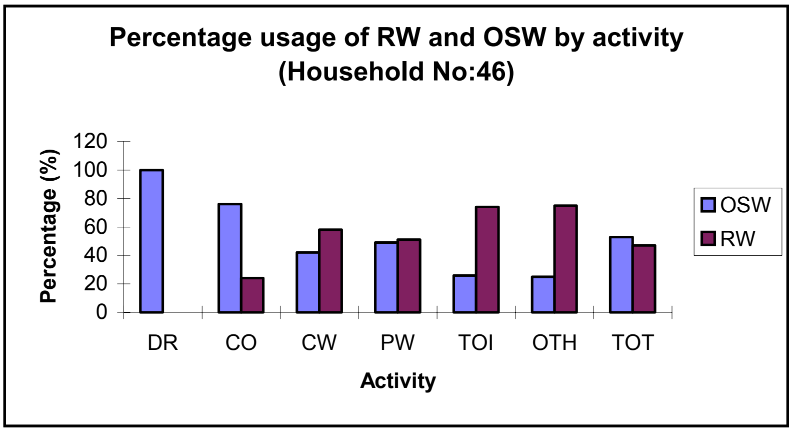
Water use pattern for three households in the Badulla district (central highlands) are presented below as a case study to indicate the impact of rainwater harvesting at household level. Badulla receives an average annual rainfall of 2400 mm. However, due to the variability in rainfall, most of the rains are received during October to January. In 1999, when the research was conducted, there was nearly 1300 mm of rainfall during these three months. Rest of the time had less than 300 mm of rain per month, with June recording just above 50 mm of rain.
Household water use patterns during both wet and dry periods indicate that there is a significant contribution from rainwater in the household water budget. However, the percentage contribution from rainwater is less in the dry season compared to the wet season. Assurance of water availability, and perceptional quality of water during the wet period promotes higher use of rainwater during the wet months. The three households in the case study, indicates an average use of 78% to 81% of rainwater use from total per capita water use during the wet season and the proportions for the dry season vary from 44% to 68%. In terms of absolute per capita water use, wet season rainwater use is almost double that of the dry season. During the wet season non-consumptive water use activities, such as, personal washing, washing cloths, toilet use, and water for small-scale agriculture and livestock are predominantly met by rainwater. Same pattern is indicated during the dry season, though there is some contribution from water brought from springs and dug wells. However, major potion of water for toilet use and livestock are from rainwater even during the dry season. Thus, it is important to note that with the deterioration of storage water in the dry season (inadequate replenishment), people tend to use rainwater for activities which does not require premium quality water. Water from dug wells and springs dominate over rainwater for drinking purposes in both seasons. One of the reasons for this pattern of use is the perceived quality of rainwater. People strongly believe that quality of stored rainwater in the dry season is not fit for consumption. However, in the wet season, during high rainfall and flowing water conditions, presumably improves the quality of rainwater. This is reflected the use of rainwater for drinking during the wet season. In the case study sample, two households have consumed 3 to 4 lpcd of rainwater during the wet season.
The proportional increase of rainwater in the household water budget has reduced the number of trips to collect water from 8 to 3 per day and time saving of about 2 hours per day. This has reduced the opportunity cost of time and improved the quality of life. The time saved due to enhanced water security, has been mostly used as quality time with the family and to improve household activities. In few instances the extra time has been invested in small-scale agricultural pursuits and cottage level income generating activities. .

## Pattern of water use in the 3 sample households during dry/wet seasons

Average water use by households( in %)
(JUN,JUL,AUG)



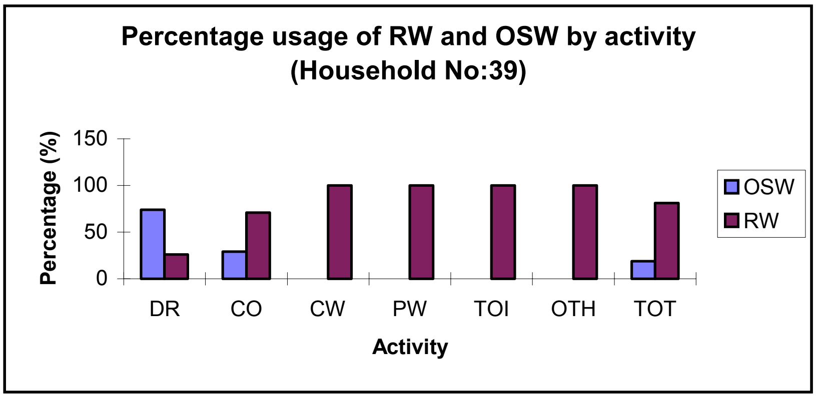



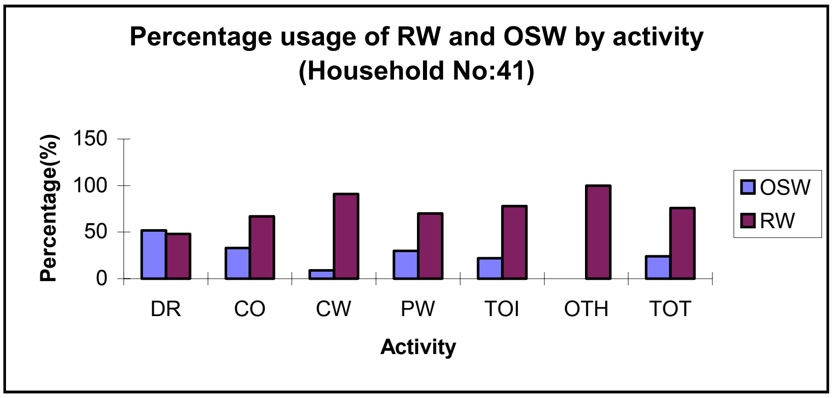



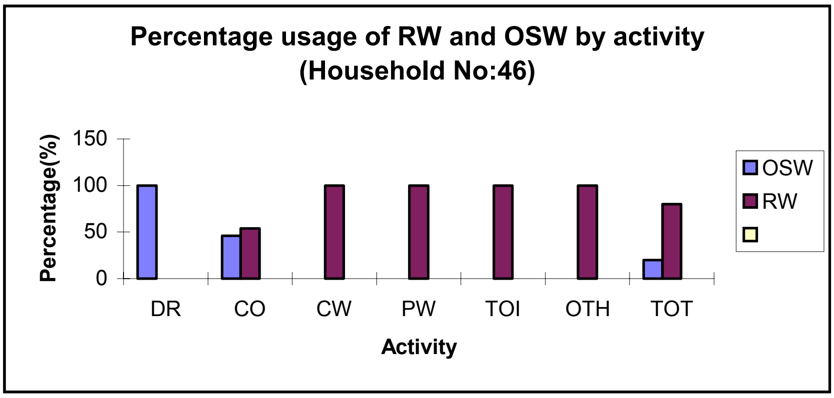

DR- Drinking
CO- Cooking
CW- Cloth Washing
PF- personal Washing
TOI- Toilet use
OTH-Others
TOT- Total

OSW- Other sources of water
RW- Rain water

Average water use by households ( in % )
(OCT,NOV,DEC )

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