2nd International Conference of SARNET

Rainwater Harvesting: A Sustainable Solution for Climate Change Resilience and Achieving SDGs

17-18 May 2023

Colombo, Sri Lanka

Abstracts

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SARNET SOUTH ASIA RAINWATER NETWORK

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2nd International Conference of SARNET Rainwater Harvesting: A Sustainable Solution for Climate Change Resilience and Achieving SDGs

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2nd International Conference of SARNET

Rainwater Harvesting: A Sustainable Solution for Climate Change Resilience and Achieving SDGs- 17 to 18 May 2023.

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CONTENT

PREFACE

Two billion people, 26% of the World population lack access to drinking water. Even as governments are striving to achieve "Water for All" by 2030, It is predicted that nearly 50 percent of the world's population will be living in areas of high-water stress by 2030. The combined effects of population pressure, pollution, and climate change impacts such as drought and floods are contributing to this precarious ecological and health crisis. In the developing world, women, children, and the elderly will be worst affected.

Harvesting rainwater at the catchment level, in soils, vegetation, reservoirs and roof surfaces offer a means to address domestic, agricultural, industrial and ecosystem water needs, while promoting sustainable resource management behaviors. There is a need to enhance global partnerships to mobilize and share knowledge, expertise, technology and financial resource to support achieving Sustainable Development Goals 6 through rainwater harvesting in all countries, especially countries with water stress.

SARNET, (South Asian Rainwater Harvesting Network) was established in 2019 to enhance collaboration and experience sharing on rainwater harvesting practices in the South Asian region. For many centuries, Rainwater harvesting (RWH) has been practiced in South Asia. Rainwater remains a major resource in driving Asian economies and society. Most South Asians countries share the same culture, tradition and also the same monsoonal rain patterns. SARNET hosted by Lanka Rain Water Harvesting Forum (LRWHF), is established to function as the repository of information and experience on RWH, networking with country based RWH organizations/institutions, private sector, academia and individual experts in the South Asia Region. Around 180 members from across Asia and other regions have responded positively and expressed willingness and interest to connect with the network and have actively participated in series of webinars hosted by SARNET held on different topics since November 2020.

The 2nd International Conference of SARNET is organized in collaboration with Lanka Rain Water harvesting Forum,) and International Water Management Institute (IWMI) with financial support from USAID. The conference provides an open platform to present research and experience and networking with the key players in rainwater harvesting in the South Asian region and other countries The papers presented at the conference will be under three key topics, “ Rainwater harvesting as a means of achieving safe water and sanitation at household level”, “Rainwater harvesting in urban areas”, “Policies and Institutions”, “Socioeconomic benefits and Disaster Risks Reduction through RWH” will provide opportunities for learning from renowned researchers and practitioners to understand the current state of practice, research and future challenges in the rainwater harvesting.

We thank USAID for financial support, the Organizing Committee, key note speakers, the authors, distinguished special guests , invited guests, participants and supporters to the Conference for their valuable contribution.

Dr Tanuja Ariyananda
Convenor - South Asia Rainwater Harvesting Network (SARNET)
Chief Executive Officer, Lanka Rain Water harvesting

Massage of Mr. R.M.W.S. Samaradiwakara
Secretary to the Ministry of Water Supply and Estate Infrastructure Development

It gives me great pleasure to send this message for the 2nd International Conference of South Asia Rainwater Network (SARNET) titled Rainwater Harvesting Sustainable Solution for Climate Change Resilience and Achieving SDGs organized in collaboration with Lanka Rain Water Harvesting Forum and International Water Management Institute with the support of USAID.

As in many parts of the world, in Sri Lanka, water sources are becoming scares due to population increase, deforestation, urbanization, and other environmentally destructive practices. Furthermore, climate change is intensifying resulting in water disasters such as floods and droughts. Consequently, the interest in and necessity of the use of alternative water sources such as rainwater are also growing. Rainwater harvesting may be an effective water source to achieve Sustainable Development Goals on water supply & sanitation.

Ministry of Water Supply and Estate Infrastructure Development through the National Water Supply & Drainage Board and Department of National Community Water Supply has installed many rainwater harvesting systems mainly in North Central province and other chronic kidney disease (unknown) prevailing areas with a national policy on Rain Water Harvesting and other legislation in effect, Sri Lanka stands to benefit significantly by the appropriate use of this technology.

This conference with the participation of many from the South Asian region as well as other regions will give an excellent opportunity for sharing knowledge, experience, and best practices among all stakeholders. I wish the conference success.

Massage of Mr. Gabriel Grau
Mission Director for USAID Sri Lanka and Maldives

The United States Agency for International Development (USAID), in partnership with many countries around the world, helps strengthen water security and establish access to a sustainable water supply. Our partnerships with countries and organizations in pursuit of these goals, is increasingly critical as climate change changes global landscapes, environments, and microclimates. Against this backdrop, USAID supports rainwater harvesting as a viable alternative to access clean water, especially during severe droughts and floods.

USAID and the Sri Lanka Mission team are deeply appreciative of the great work carried out by the South Asia Rainwater Harvesting Network (SARNET) and in Sri Lanka, the Lanka Rainwater Harvesting Forum for promoting rainwater harvesting as a low cost, uncomplicated, and user-friendly technology. Your work to build domestic and community rainwater harvesting tanks; train on operation and maintenance; and support research and development has an outsized positive impact on the lives of thousands of people.

As water scarcity quickly becomes a leading global challenge, we must continue to challenge ourselves to search for innovative ways, simple and inexpensive methods for communities to find sustainable solutions to harvest rainwater.

One voice can make a difference, but many collective voices can lead to sustainable change. I wish you all the best as you work toward a water-secure world!

Massage of Mr. M.M.M. Aheeyar
Chairman, Lanka Rain Water Harvesting Forum

On behalf of the members of the organizing committee it is a great pleasure for me to welcome all the participants to the 2 nd International Conference of South Asia Rainwater Harvesting Network (SARNET) under the theme of “Rainwater Harvesting: A Sustainable Solution for Climate Change, Resilience and Achieving SDGs”. The conference has been organized in collaboration with Lanka Rain Water Harvesting Forum (LRWHF) in association with the International Water Management Institute (IWMI) with the financial support of USAID and other sponsors.

The long years of experience of Lanka Rain Water Harvesting Forum has helped to advocate and influence several governments and other stakeholders in the South Asia region to take on rainwater harvesting as a feasible option to ensure household water security and groundwater recharging. In response to the growing interest and importance of rainwater harvesting in the South Asia region, LRWHF played a leading role in partnering with the Government of Sri Lanka in organising a regional ministerial meeting to reflect and review the national policies concerning rainwater harvesting in 2006. As a follow up to this, the government of Nepal organised the second regional higher-level meeting in 2009.

The regional deliberations held in the past highlighted the importance of having an institutional arrangement for fostering regional cooperation, sharing knowledge and best practices and unanimously endorsed the intent of the Government of Sri Lanka to establish such a regional network center and provide it with a supportive mandate to honour the region’s stated interest and decisions in rainwater harvesting. The South Asia Rainwater Harvesting Network (SARNET) formally began in 2019 to fulfil this requirement in partnership with Lanka Rainwater Harvesting Forum with the support from International Rainwater Catchment Systems Association (IRCSA) and USAID. During this short period, SARNET has been able to attract the support of many regional stakeholders and generate interest among like- minded rainwater harvesting professionals and activists in the South and East Asia regions. The network has been active in registering interested individuals/organisations and facilitating sharing of information and best practices in rainwater harvesting. SARNET has been active in sharing information via social media platforms such as the web site, Facebook page, Linked In, and Twitter and organized 11 webinars, and an international conference in 2021 engaging member organisations from South Asia and other regions.

I would like to thank the distinguished chief guests, keynote speakers, presenters both national and international and all participants for attending and supporting this important conference. I am also thankful to our main sponsor USAID for their generous support. I would also like to thank International Water Management Institute and Rainwater Catchment Systems Association for the valuable collaboration provided to organize this conference.

I wish all the participants a very successful Conference with fruitful discussions and a memorable stay in Sri Lanka

Session I

Rainwater Harvesting is a Means of Achieving Safe Water and Sanitation at the Household Level.

Paper 1 - Rooftop Rainwater Harvesting, Conservation and Management Strategies for Water Sources in Sazek Valley

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Abstract

Sajek Valley is an emerging tourist spot in Bangladesh situated among the hills of the Kasalong range of mountains in Sajek Union, Baghaichhari Upazila in the Rangamati District. The valley is 1,476 feet (450 m) above sea level. Sajek Valley is known as the Queen of Hills & Roof of Rangamati. Sajek is in the verdant hills of the Kasalong range of mountains amidst the serene and exotic beauty of nature. Lofty mountains, dense forests, sprawling grasslands, and miles of hilly tracks feature the valley. The simple and basic indigenous lifestyle of local people is just fabulous for visitors to spend a day.

Sajek is a remote hilly place in Baghaichhari Upazila of Rangamati district. Because of its green surroundings, and pleasant and peaceful conditions, it is known as the paradise of Bangladesh. But the local inhabitants of Sajek face many environmental problems and the most acute problem is the water crisis.

The aim of this research is to assess the scarcity of pure drinking water at Sajek and the viability of rainwater harvesting as a source of pure drinking water. This research was carried out by observation and questionnaire survey and in-depth interviews. The collected data has been analysed using both qualitative and quantitative methods and represented by graphical features. The local community from this region lives below the poverty line and their main livelihoods are jhum cultivation and tourism. Water scarcity reaches a severe intensity in this area because waterfalls and rainwater springs are not sufficient for water supply. Though there are few public taps, well, and Tube-well due to improper care and attention they are not in a useable condition. Local inhabitants travel a long distance to fetch water. They also suffer from a lack of adequate nutrition in their diet due to low agricultural production, lack of proper food, and water-borne diseases. They use simple household utensils to carry water from the source. The existing water source is not available throughout the year. The sources become drier during the winter season than in the summer season. The natural water is pure, colourless, and almost contaminant free. The study will explore the viability of rainwater harvesting as an alternative clean water source for consumption in this community.

Keywords: water scarcity, rainwater harvesting, SajekValley, clean drinking water

Paper 2- Rainwater Harvesting is a Means of Achieving Safe Water and Sanitation at the Household Level.

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Abstract

Rainwater harvesting is a technology used for collecting and storing rainwater from rooftops, the land surface, or rock catchments using simple techniques. A rainwater harvesting system also called a rainwater collection system or rainwater catchment system, is the technology that collects and stores rainwater for human use. Rainwater harvesting systems range from simple rain barrels to more elaborate structures with pumps, tanks, and purification systems.

Rainwater harvesting is defined as a method for inducing, collecting, storing, and conserving local surface runoff (rain or surface water flow that occurs when soil is infiltrated to full capacity) for agriculture in arid and semi-arid regions (Boers and Ben-Asher, 1982).

Usually, there are two basic ways of rainwater harvesting surface runoff harvesting and rooftop rainwater harvesting. The first method collects rainwater flowing along the surface into an underground tank. In the second method, rainwater is collected from the roof catchment and stored in a tank. Planting pits are also an innovative rainfall harvesting method. It holds rainwater in its pits and stops rainwater from runoff. A better understanding of the hydrological cycle is mandatory to improve rainwater harvesting. Clouds are a major component of the hydrological cycle; therefore, cloud distribution is the keystone of better rainwater harvesting.

Keywords: rainwater harvesting, surface runoff harvesting, rooftop rainwater harvesting, hydrological cycle

Paper 3- Techno-Economic Evaluation of a Multi-Media Vertical Flow Filter for Roof Water Harvesting

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Abstract

A vertical flow multimedia roof water filter was developed and tested for hydraulic efficiency and pollutant removal efficiency to meet drinking water standards. Along withsand and gravel, three types of adsorbents, viz, (coconut) shell charcoal, wood charcoal, and anthracite were tested as filter media. Apart from these, three types of circular-shaped screenssuch as nylon, aluminum, and non-woven coir-sisal fabric screens were also tested. As a pre-treatment quality study of inlet water, the direct rainwater, roof water, and runoff/ stormwater samples were collected and analyzed for various physicochemical parameters. The roof water vertical filters were found to be highly effective in removing TS, K, and PO $^{2-}$, normalizing pH, and reducing EC. It had fairly good efficiency in removing $NO3^{-}$. Theremoval percentage of Fe^{2+}, $Na^{+,}$ and Ca^{2+} was low, while that of Mg^{2+} showed a –ve value. A new terminology, UPI (Universal Performance Index), which represents the weighted averageof hydraulic efficiency and quality-improving efficiencies, giving extra weight to the latter, has been introduced. Based on the estimated annual costs and returns, all the financial viability criteria (IRR, NPV, and BCR) were found favourable and affordable for investment in a developed filtration system.

Keywords: Roof water filter, drinking water, standards, financial viability

Paper 4- Pumpkin Tank Story

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Abstract

Development of the Pumpkin Tank in 1995 has many aspects that can be useful for initiating rain water harvesting in rural third world setting. The Author and Presenter of this paper worked very closely in this process and considers this presentation will benefit the third world rural sector anywhere in the world, especially South Asia to promote Rain Water Harvesting.

This presentation will look at the social, technical, and financial aspects of the Pumpkin tank development process with real-life events included. economic, environmental, and gender aspects too will be touched.

World Bank Funded the first rural Community Water Supply Project was piloted in Badulla, Rathnapura, and Matara Districts of Sri Lanka. The funding limit was set at U$100 per house, The Project Steering Committee was ready to Pilot Rain Water Harvesting as an option. The original Pumpkin tank was developed in response to meet this option. The tank cost needed to be around U$ 100, and the volume of the tank needed to be able to supply a minimum of 100 liters per day from a well-managed rainwater harvesting system consisting of a minimum 60-meter square catchment. The tank also needs to be durable.

Keywords: pumpkin tank, social, technical, and financial aspects, rainwater harvesting, rural third world.

Session II

Rainwater Harvesting in Urban areas, Operational Policies and Institutions

Paper 5- Promoting Rain fed Pond for Town's Water Supply System: A Case Study of Southwest Coastal Region in Bangladesh

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Abstract

Bangladesh's coastal area is vulnerable to the changing climatic condition because of its geographic location and low-lying topography, and this vulnerability has been acute due to reducing upland flow during dry periods and sea level rise contributing to saline intrusion to coastal freshwater resources both surface and ground. Over the past 25 years, salinity intrusion in Bangladesh has increased by about 26 percent with the affected areas expanding each year. According to a 2014 study by World Bank, climate change is likely to further increase river and groundwater salinity dramatically by 2050 and exacerbate shortages of drinking water in the southwest coastal areas.

Because of the salinity of both groundwater and surface water in the Mongla port municipality, together rainfed pond water and river water became the main sources of drinking water as rain for around seven months is available and four months of river water is suitable for drinking in this area.

From physical observation, focus group discussion with water users, and interaction with key information providers, the study team assessed the quantity of water against the demand and also analyzed the quality of water. By using secondary data, the study team also analyzed the Mongla River's water salinity and rainfall intensity for overseeing the long-run feasibility. The result of the study regarding Mongla Port municipality's water supply approaching mixing rainfed pond and river water could be replicated for another coastal place as it is sustained in the coastal area in Bangladesh.

Keywords: Rainfed pond, water supply, salinity in the coastal area, climate change

Paper 6- Water Security – Rainwater Harvesting an Urban Case Study.

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Abstract

The increase in population and the emerging pattern of urbanization have led to an increase in demand for safe drinking water. This leads to over-exploitation of groundwater. The number of dug well or bore well is increased but also people are digging well more than 450 -600 ft below ground. As per a review by Maharashtra State's "Groundwater Survey Department (GSD)," there is an increase in exploited and over-exploited areas of groundwater level in Maharashtra.

The efficiency of utilization in all the diverse uses of water should be optimized and an awareness of water as a scarce resource should be fostered. Conservation consciousness should be promoted through education, regulation, incentives, and disincentives.

According to a study by the Water Resources Group, India will have a 50% gap in demand and supply of water (754 billion m^3) by 2030. 80% of this demand is projected to be for agriculture considering the fact that India has poor agricultural water productivity, produces water-intensive crops, has an aging and inadequate water supply infrastructure, and increases domestic food requirements. Due to rapid urbanization, India will see a rapid increase in municipal and domestic water demand also (108 billion m^3) by 2030. India has poor water storage capacity (200 m^3 per person) compared to China's 2200 m^3 per person and 6000 m^3 per person in the US. India's major river basins (Ganga, Cauvery) are projected to face shortages.

So, to ensure a 24X7 water supply and as well the quality of water, there is a need to conserve water and replenish it through rainwater harvesting technique that assumes even greater significance in the present-day context where the groundwater consumption far exceeds the replenishment of aquifers.

India is the home of 1.3 billion people, approximately 1/6th of the world's population. This increase in population and the emerging pattern of urbanization has led to an increase in demand for basic amenities i.e., safe drinking water and sanitation system. This leads to inadequate sanitation and water supply system. This turned rivers into sewers and contaminated/exploited groundwater supplies. While epidemics of cholera and typhoid occur infrequently, it is the recurring endemic diseases such as gastroenteritis, dysentery, diarrhea, and malaria. The per capita freshwater availability

in India is on the decline, from 3450 m3 /cap in 1951 to 1967m3 today, and it is estimated that it will fall drastically to between 1500 to 1800 m3 by 2025, even though annual precipitation is around 4000 billion cubic meters. It is the contamination of freshwater that is increasing the stress on the availability of water.

The efficiency of utilization in all the diverse uses of water should be optimized and an awareness of ‘Water’ as a scarce resource should be fostered. Conservation consciousness should be promoted through education, regulation, incentives, and disincentives. It is also observed heavy extraction of groundwater in the urban pocket as well as in rural pocket for diverse use leads to depletion of groundwater reserves as withdrawal of water is more than recharge. Though the rainfall is not reduced. We get a lot of rain but due to the paved area, it is wasted.

The need is to implement measures to ensure the harvesting of rainwater as much possible as we can either through groundwater recharge or direct use.

Keywords: Groundwater Survey Department (GSD), over-exploited areas of groundwater, Water Resources Group, India, groundwater

Paper 7- Common Man-Centric Innovation to Harvest Rainwater in Borewells or Tank.

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Abstract

This article is about innovation in the field of rooftop rainwater harvesting. A simple device by the name of NeeRain is innovated to bring our common man in the movement of rainwater harvesting. This is "no water loss" rooftop rainwater filter with two stages of filtration, with live monitoring facility. It works on reverse Y filtration and has separate clean water outlet and impurity outlet. Human intervention free rainwater recharge in borewell is the sole objective of this device. Modular, ready to use devices can be fixed by any semi-skilled plumber using four screws within two hours' time.

Keywords: innovation, NeeRain, rooftop rainwater filter, recharge, borewell

Paper 8- Utilizing the Potential of Rainwater Harvesting (RWH) for the Purpose of Lawn Irrigation at NUST.

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Abstract

Pakistan is one of the water-stressed countries, which is in dire need of effective water management. Underground water resources of the country are depleting due to a very high rate of abstraction (65000 MCM annually) in which 69%, 23%, and 8% are used for irrigation, industrial, and domestic purposes. Viewing the future scenarios (PCRWR) by 2025, there will be very little clean water available in the country.

The National University of Science & Technology (NUST) located in Islamabad faces a 1.7 meter/year depletion of the groundwater table. Current methods of utilizing water are resulting in both, water scarcity and high-energy consumption. Rainwater is one of the least used sustainable water resources that can reduce pressure on water demand, mitigating the utilization of fresh water for irrigation and domestic purposes. The aim of this study was to determine the suitability and estimate the quantity of rainwater at NUST Business School (NBS) that can be used for landscape irrigation through efficient technology (Drip & Sprinkler Irrigation). The novelty of the study is the economic analysis that helps us save 0.22M PKR/Year. To achieve these goals, a model of the Rainwater Harvesting Pressurized Irrigation (RWHPI) system was installed at NBS Lawn. Two reinforced cement concrete (RCC) Tanks each of 20,000 gallons were constructed to store rainwater coming from the NBS rooftop (4343.22 m^2). Meteorological data and a land use map of NBS were collected from the Pakistan Meteorological Department (PMD) and Procurement Management Office (PMO-NUST). Rainwater quality and soil tests were conducted at the Institute of Environmental Science Engineering (IESE). The total required irrigation water for 231 planted orchard trees at NBS Lawn through drips and sprinklers equals 97,020 L/year. We can collect 6.01×10^6 liters of rainwater per year from the NBS rooftop. The Cost-Benefit Analysis (CBA) of the RWHPI depicts that beyond environmental and social benefits, economically we can save 0.22M PKR/Year.

Keywords: National University of Science & Technology, cost-benefit analysis, Rainwater Harvesting Pressurized Irrigation, drip and sprinkler irrigation

Paper 9- Indigenous Knowledge of Floodwater Agriculture in Dry Regions of Iran

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Abstract

Except for a narrow strip along the Caspian Sea, most part of Iran has an arid and semi-arid climate with a 220 mm average rainfall and 2000 mm potential evaporation per year (Fig1). This has caused over exploitation of groundwater by digging numerous deep wells and damming major rivers by constructing large dams. This scenario has been mainly quickened during the last 4 to 5 decades leading to dramatic consequences such as land subsidence in main plains and drying downstream wetlands. More destructive consequences of such mismanagement have been that most of the rangeland became extremely poor and agricultural yields diminished extensively. Losing cropland and range cover led to the occurrence of repeated flooding and very high soil erosion. It is also understood (and documented in most of the country's official reports) that 70% of rain falling over the country area, evaporates in the vicinity of where it falls and neither joins to the deep groundwater nor reaches behind the existing dams. Looking back on the country's indigenous water harvesting knowledge, one can realize great wisdom in groundwater (i.e. Qanat) as well as surface water utilization (i.e. floodwater harvesting). Although the Qanat system (gravitational drainage of subsurface water) is well known to the world's water sectors, however, floodwater harvesting and utilization (diversion of seasonal runoff for crop production) are not clearly introduced.

Keywords: floodwater harvesting, over-exploitation of groundwater, evaporation, surface water utilization

Paper 10- Spring Recharge: Hope for Midhill's Water of Nepal

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Abstract

Approximately 240 million people in Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan rely on water security for their well-being and livelihoods. These communities currently use around 1597.8 km3 (20.62%) of the total 7745.5m3 of renewable water available (Scott et al., 2019). Climate change, population growth, water scarcity, and unequal access to water are expected to worsen the already limited water supply and make these communities more vulnerable to water insecurity (Wester et al., 2019). While small-scale efforts to protect springs, which are a vital source of water in the mountainous Hindu-Kush Himalayas (HKH) region, are underway to address water scarcity, these efforts are limited and insufficient to fully solve the problem (Scott et al., 2019; Singh et al., 2020). However, these efforts are still important for conserving and revitalizing springs in the HKH region.
However, local communities living in the hills often struggle to obtain enough water for basic needs such as drinking and sanitation due to difficulties in accessing water from rivers. For these communities, springs are the only readily available source of water. Springs, the primary source of water for hill communities in Nepal, are in danger of drying up or have already disappeared in some areas (Poudel et al., 2020; Singh et al., 2020). The drying up of springs is a major contributor to water scarcity in Nepal (Gyawali et al., 2019).

There are several factors that may be causing the disappearance of springs, including earthquakes, poorly executed development projects such as local road construction using bulldozers, encroachment and vegetation removal in spring source areas, and variability in weather patterns and rainfall (Adhikari et al., 2022). A survey of 300 local governments in Nepal, done by Nepal Water Conservation Foundation (NWCF) found that more than 74% reported incidents of dried-up springs within their areas, affecting regions from the Chure hills in the south to the mid-hills and high mountains. As a result, villages in various parts of Nepal have been displaced due to water shortages caused by dried-up springs, including Ram Prasad Rai Rural Municipality in Bhojpur, Shahid Bhumi Rural Municipality and Mahalaxmi Municipality in Dhankuta, Dalome Rural Municipality in Mustang, Manungkot in Vyas Municipality, Tanahu and Chhatreshwori Rural Municipality in Salyan (Thapa et al., 2020b).

So far, spring management efforts have mainly focused on either protecting individual or multiple springs at the village or ward level. While some initiatives to protect watersheds have been launched, more comprehensive action is needed, and adopting a spring shed management approach is the next step in conserving and revitalizing springs (Mahamuni & Kulkarni, 2012). Springs are the main source of water for mountain communities in Nepal and are used for basic needs such as domestic use, livestock care, agriculture, the environment, and cultural purposes (Molden, 2020).

The goal of the study is to review and explore the practical knowledge of springs in Nepal, focusing on the spring management challenges, threats and reviving approach as an adaptation option. A desks review is a primary source of information. Literatures includes peer-reviewed articles, working papers, and grey literature on springs are reviewed including the NWCF's past research and interventions.

Keywords: Springs in Nepal, spring management challenges, spring shed management, Nepal Water Conservation Foundation

Paper 11- Highlights of Rainwater Harvesting for Livelihood, Community, and Ecosystem Resilience in Nepal.

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Abstract

Nepal is a country with an abundance of water resources, rainfalls, and precipitation. But it also seems to be a country in dire need of clean drinking water and irrigation for its people. Many households in Nepal's mid-hills suffer from water shortages during the pronounced dry season. The water demand in rural areas of Nepal with people living in scattered settlements, generally in small populations, is difficult to be fulfilled. Rainwater Harvesting (RWH) has provided to be a viable alternative water source in challenging environments where other means of water supply have no or little potential. The problem of scarcity of water has steadily increased due to the increase in population and depletion of water sources for a variety of reasons including impact of the climate change. This has made it necessary for individuals, communities, and governments to do whatever can be and should be done in the area of RWH. Rainwater collection has been significantly more important as a source of domestic water supply since 1990. The technology became famous among the settlement, especially in those areas where people are facing water shortages, and more than 89% of the household relied on it in 2010. In Nepal, domestic RWH has traditionally been an important method of water supply systems, especially in the mountains, where source of water generally lies far away. Also, small ponds were constructed wherever feasible to catch rainwater to be used by animals, for irrigation, and also for religious purposes. In the Terai, large ponds used to be built to store rainwater for household, religious as well as irrigation purposes. A good portion of water needs in these areas is fulfilled by this age-old method. A similar practice has existed in other parts of the world since ancient times. However, they were limited to traditional know-how, limited community investment, and mostly contributed as a resource and local materials.

Rainwater Harvesting is in fact not a new technology. It was developed in ancient civilizations and is followed today, especially in Asia and Africa. It is a technology for the collection and storage of rainwater from rooftops, the land surface, or rock catchments using simple techniques such as jars or more complex underground check-dams. This collected water can be used for various purposes.

Keeping in view the importance of Rainwater Harvesting for supplementing water demand as well as ensuring water security National Conference on "Rainwater Harvesting for Livelihoods, Community and Ecosystem Resilience" was organized by Smart WASH Solutions on 27-28th July 2019 in Kathmandu, to bring together professionals, academicians, researchers, entrepreneurs, government and non-governmental organizations to share the experiences and learning of technological developments gathered through experience, research, and application of mutual benefit. This presentation mainly focuses on a summary of conference recommendations.

Keywords: National conference, Smart WASH solutions, rainwater harvesting for livelihoods, rainwater harvesting for eco system resilience

Paper 12- Rain Water Harvesting for Modern Urban Project: Case Studies of Ground Water Recharge and Alternate Water Supply Source

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Abstract

Pakistan is among the top ten countries affected by climate change. Recently, in the monsoon season of 2022, Pakistan faced heavy rains and flooding affecting about 30 M people. Since Pakistan is an agricultural country, a very productive use of rainwater could be to store it and use it in crop irrigation. Overground storage in the form of dams has become a political issue between the provinces and the only option that remains is underground storage in present aquifers. Lahore is the second most populated city in Pakistan, with a population above 11 M (Finance department,2017). It is also the provincial capital of the Punjab province. That is why several mega projects are under construction in Lahore. The water supply of Lahore is based mainly on groundwater, and that is why its water table is lowered by 1 meter every passing year (The news, 2021). The government of Punjab is putting serious efforts into making its current projects environmentally friendly. Rainwater harvesting for groundwater recharge is, therefore, a pivotal part of several mega projects. It can resolve several issues like underground water table depression as well as flash floods originating from heavy rainfall. Lahore receives significant rain (24.8 in/year) for 49 days/year. Therefore, there is an immense potential to harvest that water for groundwater recharge. Also, the same rainwater can be stored above ground in the form of an artificial lake in individual projects. That can serve as an alternate water supply source for that site and also as a recreational lake for birds, fish and water sports.

The aim of this abstract is to present two case studies where the rainwater collection system for the project sites is designed to collect water from all paved surfaces and roofs. The engineered design system of pipes and gravity based open channels brings the water to the central location. Here, in one project these channels terminate into a well-type of deep soakage pit for groundwater recharge. Whereas in the other project, the channels terminate in a very big artificial lake. Interestingly the primary source of freshwater supply in both projects is groundwater. Hence, a recharge of groundwater via soakage pits or infiltration through the artificial unpaved lake is a sustainable option.

Session III

Socio-economic Benefits and Disaster Risks Reduction through RWH

Paper 13- Promotion of Rain Water Harvesting in Earthquakes (2005) Affected Areas of Pakistan

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Abstract

The devastating earthquake in Asia on 8th October 2005 which took more than 73000 lives, caused 125000 injured, left 3.5 million people homeless, more than 5800 school buildings were damaged, 350 health facilities also badly affected, over 4000 existing water supply schemes along with disruption of almost all water sources in the Earth Quake Affected Areas (EQAAs) of Azad Jammu and Kashmir (AJK) State and Khyber Pakhtunkhwa (former NWFP) of Pakistan. The government of Pakistan established Earthquake Reconstruction & RehabilitationAuthority (ERRA) to take up the gigantic task of reconstruction/rehabilitation work in 12 different sectors.

About a 40% decrease in the yield of water, sources were also reported. Furthermore, the demand for water increased exponentially because of additional water requirements for brick-and-mortar construction activities. As more than 90% population of EQAAs lives in a scatteredmanner in mountainous rural hamlets, hence lifting water from main water-bodies (if available at the foothills) or tapping to any spring source situated at far-flung heights was not a financially viable solution in many areas.

To address this potential severe water shortage, ERRA in addition to rehabilitation and reconstruction of damaged water supply schemes, did launch the 1st ever project of its nature in the public sector to promote “Rain Water Harvesting” in the EQAAs, as one of the best possible alternatives, supplementary, sustainable and affordable solution, which is being practiced in many parts of the region as well as at global level.

Keywords: earthquake 2005, Earthquake Reconstruction & Rehabilitation Authority, reconstruction of damaged water supply schemes, Earth Quake Affected Areas

Paper 14- Mitigating the Climate Impacts of Water Scarcity through 'The Green Project' in Central Indian Region, Nagpur District Council of Maharashtra, India

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Abstract

Characterized by extreme cold and heat waves, Nagpur the Winter capital of the State of Maharashtra in the central region of India, is known as the orange city. With an annual assured rainfall of a little above 1000 mm, some sub-district regions of Nagpur are facing issues around supply and demand side management due to recent frequent changes in the rainfall pattern, and over-extraction of the groundwater in the recent past. All this leads to water scarcity in the key government institutions such as primary health centers, schools, and pre-schools as well as many places impacting the water needs for all purposes for the population both in the tribal and non-tribal belt of the district. Adding to the issues of supply versus demand side management, urbanization, and intensive water-fed agriculture are competing with the needs of the population. And hence, due the to uncontrolled utilization of water resources and the imaginable depletion of water resources, there is a need for water conservation.

'The Green Project' under discussion here in this abstract is an effort to address a set of issues rising due to extreme climate-induced conditions like water scarcity, increased temperatures, impact on services and availability of water, and an alternative to artificial energy. The project perfectly aligns with the mitigation expectations under the SDGs agenda including building a resilient community across service seekers and providers as well as meeting the basic rights.

Keywords: Paint, Energy, Dual-Pump, Green Project, Self-reliant, SDGs

Paper 15- Reduction of Poverty in Rural Villages in Sri Lanka by Introducing Groundwater Harvesting

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Abstract

Many parts of the dry zone of Sri Lanka reported declining groundwater water levels. In recent decades groundwater is also threatened by over-exploitation and contamination. The exploitation of groundwater resources more than its annual replenishment has caused a continuous decline in water level, well yields, dryness of shallow wells, deterioration of groundwater quality, and an increase in the energy required to lift water from greater depths. Therefore, adopting rainwater harvesting and recharging is one of the simplest and best measures.

Several rainwater harvesting methods for groundwater recharge include recharge pits, recharge trenches, contour bunds, percolation tanks, recharge shafts, gully plugs, and check dams. However, prevailing knowledge gaps, such as a lack of awareness of climate change and its impacts and a lack of understanding of groundwater recharging as a climate change adaptation measure, should be addressed through awareness programs. To address this issue, a groundwater recharge model unit was established in NWS&DB Groundwater (NW) section in Wariyapola. Demonstration models of different recharging methods are used to educate groundwater recharge to school children/teachers, selected farmers, villagers, Government, and the private sector in the North-Western province and the whole island. Three hundred and sixty-nine families were given awareness training of rainwater harvesting-based groundwater recharge (RWHBGWR) from December 2019 to December 2022.

Most trainees implemented RWHBGWR units on their premises. A social survey conducted in those areas proves that they get benefits from groundwater recharge. Some of the benefits of RWHBGWR are groundwater quality improvement through dilution, enhanced yield in areas where the aquifer has depleted, prevention of saline-water intrusion and land subsidence, the longevity of river flow, and increased soil moisture content. This will positively affect farmers on their cultivation, and water quality improvement will positively affect the health of society. Therefore, RWHBGWR will help to upgrade the living standards (economy and health) of the villagers and farmers in the dry zone of Sri Lanka. Virtually, it will control the detrimental erosion effects due to climate change.

Keywords: Rainwater harvesting, Groundwater recharge, Climate change, awareness of groundwater recharge, Living standards.

Paper 16- Experience Sharing of Government Programme Implementation on Nature Based Solutions for Climate Change Adaptation: A Case of Kerala State, India

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Abstract

The aim of the present paper is a narration of success case and author's own working experience in promoting and implementing shallow Well Recharging through roof rainwater harvesting from the Kerala State of India, South Asian Region from 2002 to 2022.This highlights the experiences of exploring financial opportunities for rainwater harvesting from the state governments, Central governments, Local governments (Rural and Urban) and funds from CSR and private sector. It concludes with the challenges faced during the mission and learning for replicating this experience in other developing countries where there are shallow wells and tube wells.

Keywords: shallow well recharging, Kerala, financial opportunities, tube wells

Paper 17- Groundwater Recharge Using Rainwater in the Badulla District of Sri Lanka

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Abstract

Sri Lanka is demarcated into three zones based on the annual rainfall such as Dry zone, Intermediate zone, and Wet zone. Two thirds of the country is belonging to the dry and intermediate zone, where there is scarcity for safe drinking water. According to the 2008 national census, pipe-borne water coverage in Sri Lanka is around 34%, with the rest of the population depending on local sources such as wells, hand pump tube wells, small scale rural water supply schemes, rainwater harvesting tanks and surface water bodies: irrigation tanks, canals, streams, and springs. It is believed that contamination of groundwater by industry and agricultural waste and fertilizers, are the main causes of the growing water-related health problems in the country. Most of the Schools in Badulla District are mainly dependent on groundwater wells for its uses. Major problems in using the groundwater wells are the decreasing well water levels during dry season and deterioration of water quality. Therefore, this study was designed to use the overflow of the rainwater harvesting tank for recharging groundwater. In total seven wells were selected in seven schools and overflow of the rainwater harvesting tank was diverted to these wells. Water levels in the well and the rainwater harvesting tanks were monitored at weekly intervals. In addition, pH, electrical conductivity and total soluble salts were measured in weekly interval. Results showed that the groundwater level increased due to recharging by rainwater during the year 2018 even though the annual average rainfall of year 2018 (1827.9 mm) was less than that of year 2017 (1924.5 mm). Further the pH, electrical conductivity and total soluble salts in harvested rainwater were within the safe limits of 6.5-8.5, 1500 µS/cm and 500 mg/L respectively. The EC and TDS values of rainwater harvested water is much less than those in the well water, therefore recharging by rainwater do not post any threat to the groundwater.

Key words: Rainwater, groundwater, artificial recharge, quality

Paper 18- Identification of Suitable Sites for Traditional Pokhari Water Harvesting in Mountain Rural Communities of the Himalayas.

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Abstract

For centuries, farmers have adapted to climate variability by implementing various practices including soil and water conservation techniques and water harvesting (WH) (Al-Adamat et al., 2012;Adhikari, 2018).

WH has proven to considerably increase crop yields (consequently improving food security and farmers' income), soil moisture, and groundwater recharge, and to reduce soil erosion and flood risk in various mountainous zones of the world, among which the Himalayan region, including Nepal (Adhikari, 2018; Adhikari et al., 2018; Bastakoti et al., 2016; Subedi et al., 2020).

Despite being perceived as a water-rich country (mean annual rainfall 1,344 mm), some areas of Nepal become water-stressed especially from March to June (Adhikari, 2018) due to the unbalanced rainfall distribution; with about 80% of total precipitation limited to the monsoon season between June and September (Adhikari et al., 2018). Moreover, climate change is altering rainfall patterns and decreasing total precipitation (Adhikari, 2018; Subedi et al., 2020). This can have severe consequences in Nepal, where around 80% of the population depends on subsistence agriculture and more than 50% of agricultural land is rainfed (Subedi et al., 2020). Nepalese farmers report an increased frequency of droughts, late monsoon onset, rising temperatures, reduction of water availability, and flooding during monsoons as major impacts on their livelihoods (Bastakoti et al., 2016). If monsoon onset is delayed, farmers need to irrigate their crops to avoid severe crop losses (Bastakoti et al., 2016; Pandey, 2019). Traditional Nepalese ponds called pokharis (Bastakoti et al., 2016) are used, especially in rural areas, to harvest and store rainwater for supplemental irrigation, cattle rearing, fishfarming, fire control, and recreational uses (Chen et al., 2017; Lal and Verma, 2008; Subedi et al., 2020). Very similar structures can be found also in India and China (Chen et al., 2017; Lal and Verma, 2008). Recently, pokharis are being abandoned due to irrigation facilities development in some areas, while many others are degrading because of farmlands abandonment (Chen et al. 2017). Underutilization and poor management of these ponds reduce not only water availability but also the ecosystem services they provide like downhill flood risk reduction and sediment control (Lal & Verma 2008; Bastakoti et al.2016). Various authors (Adhikari, 2018; Bastakoti et al., 2016; Chen et al., 2017; Lal and

Verma, 2008), also reporting farmers' opinions, point out that restoring existing *Pokharis* and building new ones could foster resilience to climate change through increased water availability. Usually, the construction sites of new *Pokharis*, and ponds in general, are selected 'arbitrarily', considering only the proximity to the point where water is needed (Chen et al., 2017).

However, a more comprehensive and systematic site selection can lead to more efficient WH structures, which in turn improve water availability and agricultural productivity (Adham et al., 2016). Nevertheless, site selection is a challenging task especially at large spatial scales, owing to the lack of detailed hydrological and soil data (Singhai et al., 2019). Many studies attempted to identify the most suitable sites for different WH structures, often using geographical information systems (GIS) and multi-criteria decision-making (MCDM). GIS is widely used because it allows us to analyze large areas by integrating spatial, physical, and socio-economic information in a timely and cost-effective way (Adham et al., 2016). On the other hand, MCDM allows us to relate different kinds of data producing a single final output displaying various options (Krois and Schulte, 2014). The literature reports the need to select some criteria for WH structures' best sitting, such as environmental, physical, and socio-economic characteristics of the area of interest, (Adham et al., 2016; Grum et al., 2016).

Participatory activities to assess socio-economic criteria are often neglected despite being necessary to ensure the proper implementation of site-specific effective measures (Adham et al., 2016; Grum et al., 2016). In this work, we use MCDM and GIS to produce, to our knowledge, the first large-scale best-siting analysis for *pokharis*, as a water management supporting tool. While considering similar MCDM criteria as other best-siting studies, we include innovative parameters, such as flow accumulation and elevation. Finally, we complement the geophysical analysis with community-driven criteria, including indigenous knowledge, to integrate and validate our analysis.

Keywords: Pokhari water systems, soil and water conservation techniques, climate variability, soil, and water conservation techniques

Paper 19- Rainwater Harvesting for Man-Centricity of Jal Jeevan Mission (JJM) Project Borewells Case Study in Selected States of India

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Abstract

For the first time in the history of drinking water in India, on August 15, 2019, from the ramparts of Red Fort of New Delhi, the Prime Minister of India announced that every rural household would receive regular water supply through tap water connection/piped water supply under the Jal Jeevan Mission (JJM). A provision of INR. 3.60 lakh Crore has been earmarked for the programme, and in partnership with the State Governments, it is to be completed by 2024. The rural India comprises 19,36,25,283 Households. The data indicated that before 15th August, 2019, it was only 16.71 % (3,23,62,838) rural households with tap water connections. At present, the programme implementation is in galloping stage and as on date, 56.09% rural households had been provided tap water connections.

The guidelines of JJM emphasised that conservation and use of rainwater is in practice since ancient times. Considering the scarcity of water, every villager should store rainwater in each household. This stored water can be used for different domestic uses. Gram Panchayat (village Government) should have an arrangement for rainwater harvesting and storage and use in all the public buildings in the villages viz. schools, Panchayat Offices etc. Apart from this, rainwater should be stored in village ponds also.

Further, the guidelines stressed on rainwater recharge. Nowadays, in most of the villages, extraction of water from numerous installed bore wells has resulted in depletion of the ground water table and at some places, many bore wells have been defunct due to depletion of water table. In such circumstances, people residing in rural areas will have to adopt water conservation. Each area has more or less rain every year. The available rainwater can be stored. In rainwater harvesting, water is stored as much as possible, at different locations, like in wells and ponds. Due to storage at different locations, the ground water table rises, and the problem of water scarcity gets reduced. Recharge water should be clean and pure so that ground water is not polluted. Considering the above, a quick assessment has been done with the aim to find out whether the rainwater harvesting is implemented in the JJM project areas or not. Also, studied the availability and accessibility of drinking water to the households.

Keywords: Jal Jeevan Mission project, rainwater recharge, water conservation, rural India

Paper 20- Rainwater Harvesting as an Effective Solution for the Safe Water Needs at the Household Level in Sri Lanka

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Abstract

People are undergoing misery because of water scarcity, both physically and economically. (Manungufala, 2021). “Every day, 2.1 billion people still wake up each morning without access to clean water” (wholives, 2022). Here, "rainwater harvesting" is defined as any water that households collect from building rooftops after rainfall events and store for later use. (Chirhakarhula E. Chubaka, 2017) .Rainwater is not a solution only for the water scarcity but also a solution for people who have to use contaminated ground water due to industrial and domestic pollution. The countries like Australia use rainwater for their domestic purposes even if they have municipal water supply ((Chirhakarhula E. Chubaka, 2017). In Sri Lanka domestic rain water Harvesting Systems were reintroduced to rural households since 1995. Since then, around 49,000 system have been installed by various organisations including the government in all 25 districts. The objective of the study is to examine the effectiveness of rainwater harvesting system as a safe water need at the household level. A household survey was conducted in 15 districts collects information on usage of the rainwater, consumer perception for rainwater and socio-economic benefits from using rainwater harvesting system. The study covers 60% of the total district in Sri Lanka. Information was collected from both rainwater and non-rainwater users to understand the situation comprehensively. The study results will give a good upstanding of the status of rainwater harvesting user and identify what are the constraints for promoting rainwater harvesting as a safe drinking water source for rural households.

Keywords: Rainwater Harvesting, Usage of Rainwater, Domestic Rainwater Harvesting

Case Study: Rainwater Harvesting as a mitigation measure for CKDu- (chronic kidney disease of an unknown etiology)- Case Study from Sri Lanka

Ms. Wasantha Padmini, Sri Lanka

Rain drops project - This project was started on 2014 in Gannoruwa is the brainchild of Mr. Ranjith Mulleriyawa. He started the research to explore the possibility of addressing the CKDu problem by promoting consumption of rainwater. Wasantha Padmini has worked with Mr. Mulleriyawa from the initiation of the project. Initially project installed 25 rain water harvesting system in Gannoruwa with the technical support of Lanka Rain Water Harvesting Forum and financial support from Commercial Bank. The project concept is extended to other areas and currently Kandy Rotaract Club is supported in providing 5000 L rainwater tank for 225 families effected by CKDu (Chronic Kidney Disease of unknow etiologic in 18 villages.

The roof run off rain water system consists of a flush, a filtering system which consists of burned coconut shells and pebble (Thirivana stone) and after filtration the water is diverted to the rain water tank.

This water is used only for cooking and drinking needs of a family of 4 for 8 months of the year. There were consultations of the patients arrange with the medical team to assess their condition after consuming rainwater. Patients had reported a reduction in symptoms side, such as burning sensation experienced during urination and joint pain which is attributed to CKDu. They also reported that drinking rainwater had increased their drinking water intake. Medical practitioners are of the opinion that consuming rainwater has control the disease. Follow up after providing rainwater harvesting tanks are essential until the beneficiaries are familiarised in the use and maintenance of rainwater consumption.

Poster Presentation, Infographic

Poster Presentation

01. Mr. Nilesh Mankar- Poster on the Green Project
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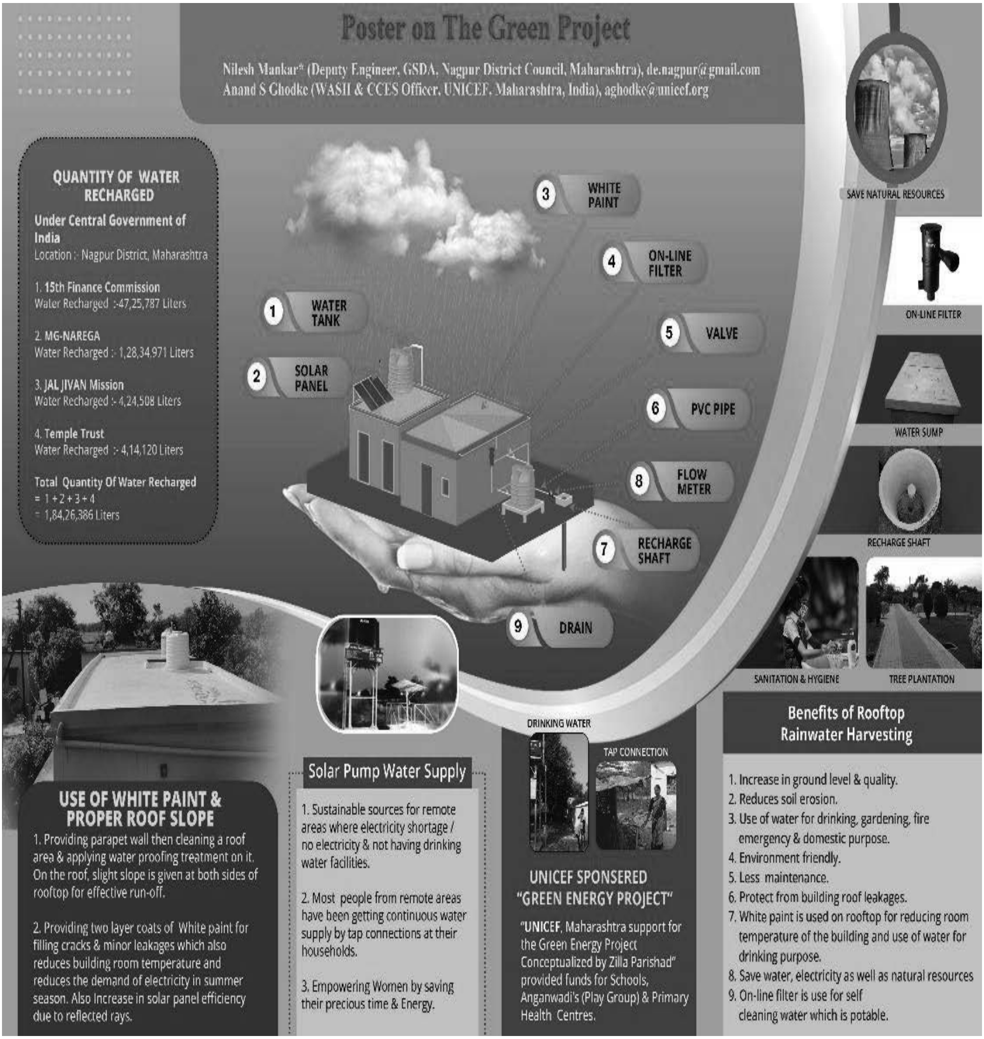
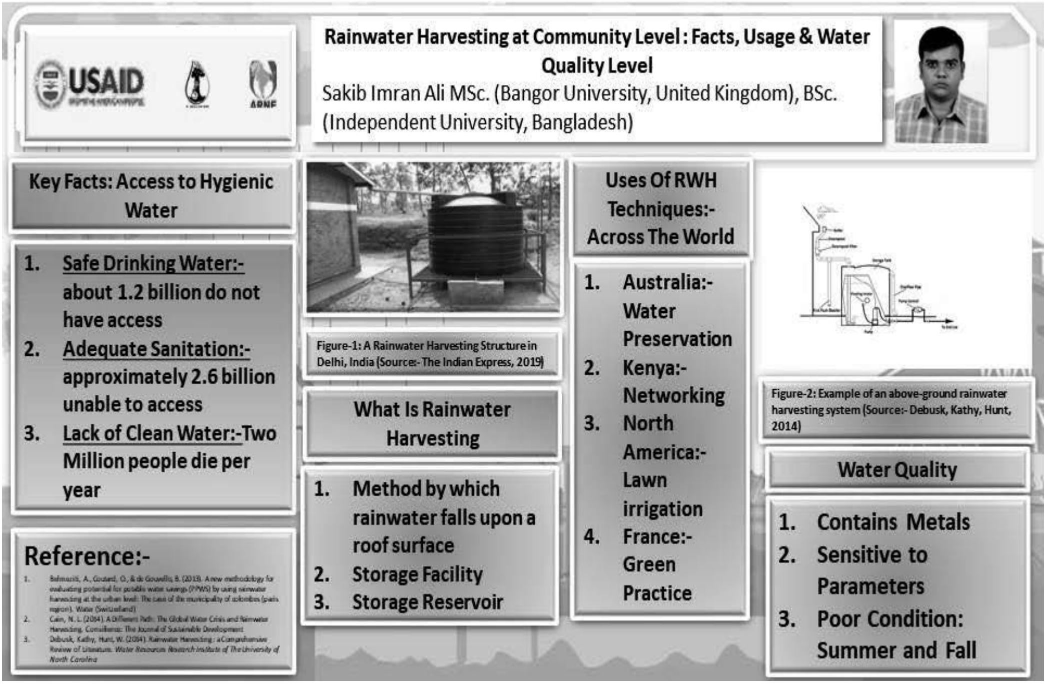


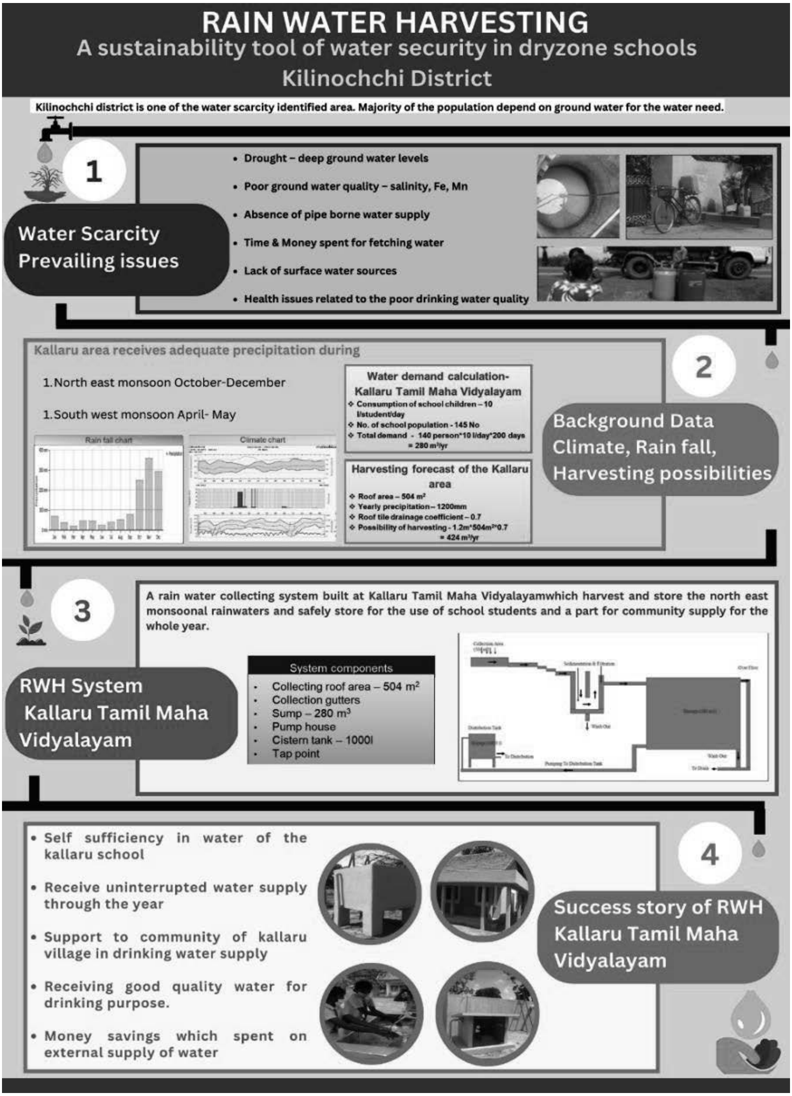
02. Mr. Sakib Imran Ali- Rainwater Harvesting Community Level: facts, Usage and Water Quality Level

MSc. Bangor University, United Kingdom) (BSc. Independent University, Bangladesh

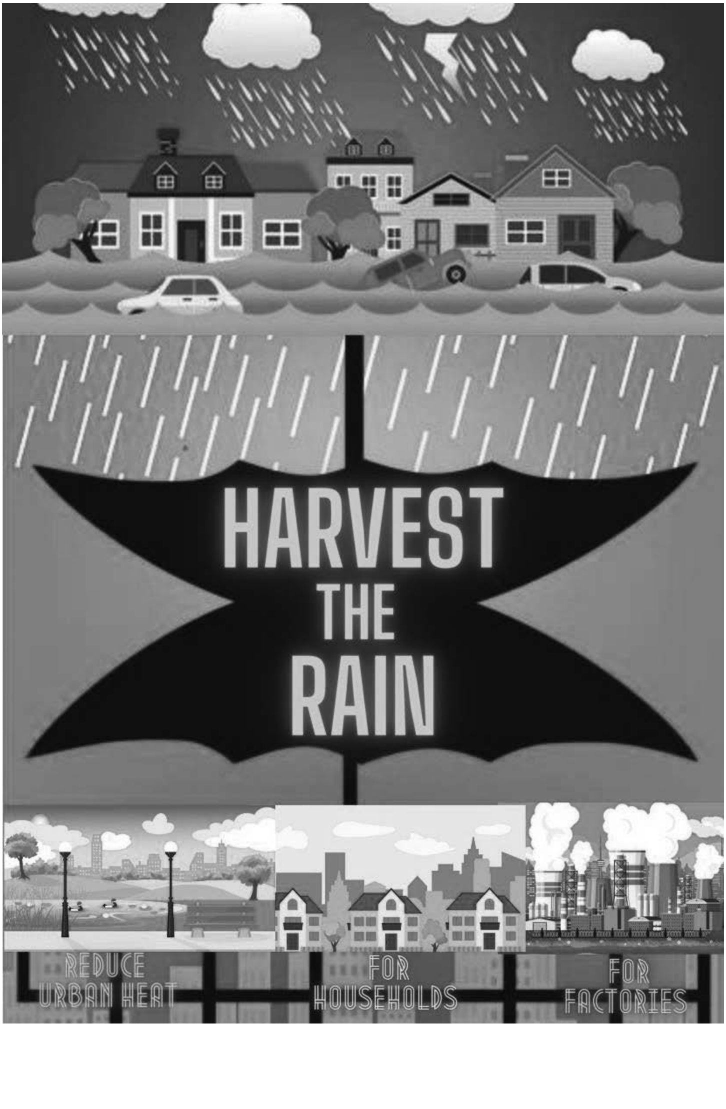


03. Eng. Y. Thayaparan A Sustainability Tool of Water Security in Dry Zone Schools- Kilinochchi District

Water Supply and Sanitation Improvement Project (WASSIP)



04 Praveen Kavinda- Urban Development Authority (Town Planner), praveenkavinda91@yahoo.com



Inforgrapic

Vijayraj Shisodya- Rain Water Harvetsing Consultant, Implementor