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PROSPECTS OF ROOFTOP RAINWATER HARVESTING: A CASE FROM NEPAL

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Abstract:

The overall objective of this study is to evaluate the possibility of promotion of rooftop rainwater harvesting in addressing even increasing water scarcity in Kathmandu, Lalitpur and Madhyapur Thimi municipalities. Fifty respondents were taken for questionnaire survey for each municipality. The questionnaire was distributed among friends, relatives, school teachers, publics in hospital and environment exhibitions.

They were requested to fill up the questionnaire. Cases of organizations, schools and residences were studied where the rainwater harvesting systems were installed. Interview schedule was carried out with the owner of the houses/schools/organizations where the system was installed. Out of fifty respondents in Kathmandu Metropolitan City, 90% respondents are willing to know about rainwater harvesting system. 52 % respondents already knew about modern rainwater harvesting system. Out of 50 respondents in Lalitpur Metropolitan City, 100% respondents are willing to know about rainwater harvesting system. 52% respondents already know about modern rainwater harvesting system. Out of 50 respondents in Madhyapur Thimi Municipality, 100% respondents are willing to know about rainwater harvesting system. 32% respondents already know about modern rainwater harvesting system. The overall domestic reduction in demand for Kathmandu valley is found to be 24.09% and the overall institutional reduction in demand for Kathmandu valley is found to be 23.99% which indicates that rainwater harvesting system plays an immense role to reduce water demand to some extent. So, there must be massive campaign to motivate people to install rainwater harvesting systems as we are suffering from maximum water scarcity nowadays. This system can replenish the demands of millions of people of Kathmandu valley. If people start using rainwater harvesting system, then the demand of the people will be fulfilled by rainwater. People will feel relief to some extent. They will be free from paying huge bills for tankers every month because rainwater harvesting system is one time investment. So, it proves to be economical in long run as well. So we must start using rainwater harvesting system for fulfilling our great water demand.

Key Words: Rainwater Harvesting, Rooftop, Water Demand, Water Management, People Awareness

Introduction:

Background:

Water is essential to human life and there is no alternative for it which forms a life line any society or civilization. The significance of water can be related to each and every aspect of living beings such as biological, environmental, social, cultural, financial and many others (Mishra, 2018).

Though, Nepal is rich in water resources, there is severe crisis of water and mismanagement of water resources. It can be verified through study of performance by Joshi et al (2020), Mishra 2018 and Mishra et. al (2018) where scarcity of water sustainability and performance of water supply has been expressed as challenge in Nepal. Hydro politics is emerging everywhere. Karnali water issue to Kathmandu water scarcity is highly discussed. With the rapid increase in population, the demand of water supply is increasing day by day for maintaining the standards of life in the urban areas (Mishra, 2019). The demand to supply ratio for Kathmandu valley is very high even in both dry and wet seasons. There is irregular and inequitable supply of water by leading water supply organizations within the valley.

Rainwater harvesting is the technology for collecting and storing rainwater for human use from rooftops or land surfaces or rock catchments using simple as well as sophisticated techniques. Rainwater harvesting provides a long-term answer to problem of water scarcity (Agrawal, A. et al. 2008).In Nepal, according to Department of Hydrology and Metrology, the average rainfall is 1500mm and on average 1610mm only in Kathmandu valley. As Kathmandu valley receives higher amount of rainfallthroughout the year, a simple technology could be enough address the scarcity issues in some extent. Thus a systematic and well managed water harvesting system could be an alternative for water scarcity issues within the valley.

Research Objectives:

The overall objective of the research was to evaluate the possibility of promotion of rooftop rainwater harvesting in addressing the water scarcity in Kathmandu Valley. Evaluation of, willingness of

users in adaptation of rooftop rainwater harvesting and its potential in domestic and institutional buildings were the specific objectives for obtaining the main objective.

Literature Review:

With the increased needs of water, new approaches in improving the water supply are desperately needed in many parts of developing countries. A wide variety of small-scale rainwater harvesting methods is being applied in some countries for irrigation of crops and sustains the life generally. In Nepal also this system of collecting rainwater and using it in washing clothes, utensils, feeding animals, irrigating the gardens and even recharging the ground water table can be seen mostly in rural areas.

Department of Water Supply and Sewerage of Nepal have envisaged promoting Rainwater Harvesting Systems in the country. Many initiations have been taken by the department in many districts to serve the communities facing the safe adequate water supply problems. In coordination with the department many other NGOs and INGOs have already constructed some systems in their working areas and many more are under research (Gould, 2000).

Components of Rainwater Harvesting System:

Regardless of the complexity of the system, the domestic rainwater harvesting system comprises following six basic components (water Aid Nepal, 2007; Michel et al 1992; Zhu et al, 2009):

- Catchment surface
- Gutters, downspouts and roof drains
- Leaf screens, first-flush diverters and roof washers
- Storage tanks
- Delivery system
- Treatment/purification systems.

Attempt for Rainwater Harvesting Promotion:

Many organizations have studied rainwater harvesting to mitigate the scarcity of the water. Water scarcity is a problem where ever there is an increasing population. With this in mind many activities and conferences have been conducted to talk about water scarcity and the potential permanent solution that is rainwater harvesting. In this way in Nepal, India, Sri Lanka, Bangladesh, Sweden, America, Singapore, Japan, Indonesia, Thailand, Philippines etc. are all talking and implementing it. In India even the president took participation in that conference on potential of water harvesting in October 3, 1998 organized by the Center for Science and Environment. This conference felt that the community based water harvesting paradigm still had great relevance in this modern day and age. "Making water everybody's business" is the collection of the output of the conference where different people practicing indigenous knowledge from many years in the field of water harvesting in the places where land is like desert.Rural water harvesting system traditions in the Central Highlands, Deccan Plateau, Eastern Ghats and Eastern Coastal Plains, Pakistan and Sri Lanka etc. have been extensively studied and researched (Center for Science and Environment).

Harvesting rainwater utilizes time tested ancient wisdom to avert the water crisis we are facing with. With the growing need to conserve the country's ground water needs, rainwater harvesting is the best option to meet our water needs. Rainwater is free so, why not make use of it? (Amatya, 2005).Tansen Hospital, located in the hilly area of Palpa District, has been successfully maintaining its rainwater harvesting system through storage tanks for last 25 years. Peace Corps Nepal has also initiated community based rainwater harvesting schemes for its health posts in the Ramechhap District and some similar schemes for schools in Kaski District.

Methodology:

Study Area:

The study area includes the three major cities/municipalities of Kathmandu valley. Respondents from Kathmandu Metropolitan City, Lalitpur Sub-metropolitan city and Madhyapur Thimi were selected for data collection as these cities have rapidly growing population, depleting groundwater table and high demand of water rather than its supply.

Research Design:

Exploratory as well as descriptive methods were used for research design. Exploratory research design was used to collect the information relating to the significance of rainwater as a sustainable source and the knowledge toward harvesting. Descriptive research design was used to describe the situation of water demand, its supply, consequences, relevant situation, willingness, awareness and components of rainwater harvesting etc.

Sampling Procedure:

Random Sampling:

For the targeted objective, different sampling procedures were used and 50 samples were collected from each city. For Kathmandu Metropolitan city, random sampling was done. While for other two cities 3 or 4 samples were collected from different wards.

Case Studies:

For obtaining some objectives like potential of and reduction in domestic and institutional demand with and without rooftop rainwater harvesting system, questionnaire survey was conducted. Six cases of

residences and institutions each were studied where rainwater harvesting system was installed. From each municipality, two houses and two institutions were selected and finally interviewed.

Data Collection:

The study was based on the primary data and the case studies of institutions and residences. Questionnaire survey, structured interview techniques and field observation technique were used to extract the data on the required objective. Open ended questions as well as closed ended questions were prepared for questionnaire survey.

Reliability and Validity of Data:

This study was based on the basis of structure questionnaire which helped to maintain the uniformity in information collected. The information was retested, which gave the same result. The application of theoretical framework of study helped to include essential variable, which ultimately completed the study smoothly.

Results and Discussion:

Kathmandu Metropolitan City:

Based on the questionnaire survey, interviews and field observation, it was found that 40% of the households in Kathmandu Metropolitan city used rainwater occasionally when it rains by storing it in big tanks. The water is only used for toilet flushing, washing clothes and other cleansing works. The water is used by none for drinking purpose. 80% of the respondents stated that there is commonly a down spout from the flat or sloped roofs but the collected rainwater drains into the sewage system which finally flushes into the nearby river basin.

52% of the respondents knew about modern rainwater harvesting technology whose knowledge was gained from different exhibitions, advertisements, radio programs, documentaries and friends. Having the knowledge on importance of rainwater harvesting in and during water scarcity, they have not taken any initiatives to install this system.

Almost all respondents who did not know about rainwater harvesting system were willing to learn about this modern technology as there is scarcity of water. Out of 50 respondents, 90% respondents wanted to adopt/know about rainwater harvesting system only with understanding in depth about the success of this system and its overall costs and benefits.

Lalitpur Sub-Metropolitan City:

Out of 50 households, 60% respondents 60% respondents used rainwater for other purposes rather than drinking. They collect it temporarily and for instant use through their roofs. They do not collect it thinking that this can supplement their water demand.

Out of total respondents, 52% of the respondents have heard about modern rainwater harvesting technology through exhibitions, radio programs and documentaries. Though they have heard about this technology, they have not shown any initiatives to install this system.

Although, lesser percentage of the respondents know about this system and have even suffered from the water scarcity problems, 100% of the people have willingness towards its implementation to supplement their demand.

Madhyapur Thimi Municipality:

Among the 50 respondents, 34% houses were found to use rainwater for toilet flushing and other cleansing purposes though they do not have any idea of rainwater harvesting system or they have heard about this system recently.

Only 32% respondents knew about rainwater harvesting system. This recently acquired knowledge has not however motivated them in action to install rainwater harvesting system but it seems that it will take time to change perspectives and attitudes.

The escalating problem of water scarcity encourages them giving 100% willingness towards the modern technology of rainwater harvesting system.

Table 1: Comparison between three cities

	Kathmandu	Lalitpur	M. Thimi
Rainwater Users	40%	60%	34%
Awareness about Modern RWH System	52%	52%	32%
Willingness to know/adopt RWH system	90%	100%	100%

Reduction in Domestic and Institutional Water Demand with and without RWH System:

Though RWH is not systematic, its use in domestic purposes has contributed in demand reduction to some extent.Also, from the study, it is seen that most of the educational institutions have been using rainwater for toilet flushing, cleansing the institution premise and even for drinking purposes by suitable filtration techniques.

Though, the rainwater users in Madhyapur Thimi are minimum, but the domestic demand reduction is highly contributed to the peoples of this city. The capability of institutions of Lalitpur sub-metropolitan city seems higher in comparison to other two cities of Kathmandu valley for institutional demand cutoff.

On average 22.72% of the domestic demand seems to becontributed by the rainwater collection system while 17.41% institutional demand is reduced by its use.

Table 2: Comparison between Three Cities

Domestic Demand and Supply Variation			
S.No	User/Respondent Location	% Reduction	Average%
1	Kathmandu	19.49	22.72
2	Lalitpur	17.96	
3	Madhyapur Thimi	30.71	
Institutional Demand and Supply Variation			
S.No	User/Respondent Location	% Reduction	Average%
1	Kathmandu	12.61	17.41
2	Lalitpur	27.40	
3	Madhyapur Thimi	12.21	

Conclusions:

- People have adopted RWH system knowingly or unknowingly for their benefits from rainwater.
- More formal advertisement and media involvement need to be made to spread out the benefits of RWH system.
- If proper technology and support could be provided people are willing to install RWH system again if it becomes affordable.
- People with existing RWH system are not willing to use the collected water for drinking purpose, so suitable technology of filtration need to be suggested.
- Higher area coverage of roofs could increase the water collection ultimately cutting off the water demand.
- One time investment could reduce the daily investment water tankers in Kathmandu valley.
- Direct contribution to the ground water could be made through ground water recharge.

Recommendations:

- Rainwater though fit for drinking, is commonly used for non-potable use such as toilet flushing, gardening, vehicle washing, laundry etc. These activities consume lots of water. We consume relatively little water for drinking and cooking purposes. It is recommended that housing complexes, big organizations, private companies, government offices, schools which have large water catchment areas should harvest rainwater so that huge amount of drinking water could be collected and processed for drinking purpose.
- Rainwater harvesting technology should use to provide water to areas on highlands / communal places where there is scarcity of water sources.

Limitations:

- Although these studies need to be done nationwide, due to constraints of time money and lack of past research in Nepal, the study is not examined in general.
- The sample size of the study population is small as compared to the total population. The number of respondents worked for organizations with an interest in rainwater harvesting and as such may not have been representative of the general population.
- The study felt difficult to calculate demand for rainwater harvesting due to unsystematic installation of rainwater harvesting.
- This study has been limited to the opinions and responses of small segment and selected population of Kathmandu, Madhyapur Thimi and Lalitpur Minicipality.

References:

1. Agrawal, A. et al. 2008. Making Water Everybody's Business Practice and Policy of Water harvesting, Centre for Science and Environment, India.
2. Amatya, P.C. 2005. Nepal: Rainwater: Wasted or Utilized, ENPHO Journal.
3. Joshi, G.D, Mishra, A.K., and Ghimire, J. 2020. Performance Assessment of Water Supply Scheme; ACase of Mangadh Water Supply Scheme, Nepal. TEST Engineering & Management. Volume 83Page Number: 30105 – 30116Publication Issue: May-June 2020
4. Mishra, A.K., & Acharya, S. R. (2018). Performance assessment of Salyankot water supply project in post-earthquake scenario of Nepal. Journal of Advanced Research in Geo Sciences & Remote Sensing, 5(3&4), 23-40.
5. Mishra, A.K. (2018). Sustainability and risk assessment of Salyankot water supply project in post earthquake scenario, Inter. Journal of Operations Management and Information Technology, 8(1), 1-30.
6. Mishra, A.k., 2019. Institutional Performance Assessment of Water Supply System. Saudi J Bus Manag Stud, DOI: 10.36348/sjbms.2019.v04i09.002
7. Rainwater Catchment Systems for deomestic Supply 2000, by John Gould and Erik Nissen-Petersen.
8. Runoff Rainwater Harvesting Practical Action Technical Brief.
9. Water Aid Nepal, 2007. The Water and Sanitation Millennium Development target in Nepal, Kathmandu: Water Aid Nepal.

10. Water Harvesting 1992. A Guide for Planners and Project Managers, Lee, Michael D. and Visscher, Jan Teun, IRC International Water and Sanitation Centre.
11. Zhu, C.L. and H. Wang 2009. Weak Water Becomes a Growing Point, Wang: China.