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Unleashing Effective Models of Collaboration for Rainwater Harvesting: Experiences from Nepal

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Abstract

Background: Rainwater harvesting (RWH) is an age-old practice of a localized renewable and alternate source of water supply to meet the growing demand of people in developing countries like Nepal. Thus, the effective models of collaboration for providing water services through RWH is a pathway to the sustainable water management of the nation leading to achieving SDGs. **Purpose:** The paper aims at unleashing effective models of collaboration for RWH in the context of the rural areas of Nepal. **Methodology:** The study comprises a descriptive cum analytical research design based on both primary and secondary data. The necessary primary data were collected by conducting a field survey using a semi-structured questionnaire on a sample of 38 communities/projects having RWH systems while the secondary data were collected through relevant publications. The csollected data were analyzed using statistical tools through SPSS to derive results leading to major findings of the study. **Analysis/Results:** The study concluded that a collaborative plan provides a ground to get contributions from different stakeholders and increase their sense of ownership. The collaboration with the local government ensures co-financing and involvement in planning and monitoring and increases prospects for support to required rehabilitation in the future. Community engagement from planning to implementation to managing the systems ensures the system's functionality and sustainability, leading to caretakers' management and promoting income-generating activities using waste/overflow water from the system. The multiple uses of water services (MUS) provide a basis for livelihood enhancement leading to regular payment of tariffs. The caretakers' management ensures to fix minor repairs promptly as needed. A combination of monitoring and evaluation with different stakeholders during implementation and afterward ensures efficient and effective implementation and sustainability of the RWH system. **Originality/Value:** No such study uses recent data related to effective models of collaboration for RWH in the context of the rural areas of developing countries like Nepal is accessible. The paper, therefore, is valuable for users' committees, development actors, academia, and policymakers to create effective models of collaboration for RWH. This work may potentially be useful to academia for future studies. **Future avenue:** The extension of this study can be made by incorporating an analysis of diverse applications of artificial intelligence (AI) in the water management sector in future studies.

Keywords: Caretakers' management, Collaborative plan, Community engagement, Monitoring and evaluation, Multiple uses of water services (MUS)

INTRODUCTION

Access to water services is the foundation of a healthy and dignified life for people. Despite this, 2.2 billion people worldwide are still deprived of safe drinking water and only 16 percent of the populatiosn has access to safely managed water supply in Nepal (WHO and UNICEF, 2023) [1]. In addition, growing sources dried up and/or depletion of sources is due to deforestation, unmanaged extracting of materials such as sand, stones, gravel, etc. from rivers, threatened biological diversity, climate change, and natural disasters leading to scarcity of water in the country. To overcome these situations, identification, management, and utilization of water resources have become indispensable.

In this connection, there are different sources of water such as groundwater, surface water, recycled water, and rainwater that have been used to meet the water demand of the people in the country. The availability of groundwater and surface water resources continues to decrease leading to the availability of water sources decreasing day by day and rainwater is one of the most prominent sources where it falls.

In addition, the consequences of the global climate crisis are somehow linked to water. Climate change is increasing variability in the water cycle, reducing the predictability of water availability, affecting water quality, and threatening sustainable development. The increasing water demand simultaneously increases the need for energy-intensive activities such as water pumping, transportation, and treatment. Climate change is affecting the sustainability of drinking water services. Meeting increasing water stress and future water demands means making difficult decisions about how to allocate water resources amid competing water uses. In this connection, rainwater harvesting (RWH) would be an important source of water for climate adaptation across the country.

RWH is an age-old practice of collecting and storing water for domestic and agricultural purposes. RWH is a localized renewable water supply alternative that minimizes the necessary resources for beneficial use (Gilliom, 2020) [2]. It has proved to be a viable alternative water source in challenging environments where other means of water supply have no or very little potential. In the last two decades, interest in RWH has grown. In this connection, several governments of Southern countries have taken the initiative to scale up community RWH approaches and networks have been established between Southern and Northern civil society organizations, governments, the private sector, and research institutes to support and promote the upscaling of RWH (Nijhof et al., 2010) [3].

The typical scheme of a domestic RWH system is based on the collection of rainwater coming from the building roof (and/or other surfaces) and on their temporary storage within a rainwater tank (Campisano, Nie, & Li, 2013) [4]. RWH is not something new. Its' history can be traced as far back as ancient times, some 3,000 years ago to 850 BC, if not even father (NEWAH, 2012) [5]. Along with more conventional water supply technologies, RWH has become a valuable and viable alternative or supplementary source of water.

RWH is a process of catching water from rainfall. It is the collection, purification, and storage of rainwater from paved and unpaved rooftops before it is runoff. As this technique is cost-effective, more people are harvesting rainwater to meet their needs. The cost associated with catchments, transportation pipes, a first flush system, filtration, and storage tank involved in setting up an RWH system. The cost per system varies from place to place based on the size of the RWH system designed as per the number of people who would be using the respective system.

The primary purpose of the RWH system is to provide water to drink. During downpours, rain seeps into the ground to become a part of the rivers and lakes which is called groundwater. Without rainwater constantly replenishing our groundwater sources, water would be scarcer than it is right now. In addition, RWH has more advantages to the environment than we may think. Apart from aiding in nature's cycle, it will reduce flooding by runoff water, saving energy, protecting the environment by reducing carbon emissions as well and growing healthy plants.

Fig. 1: Photo of pumpkin-shaped RWH Tank

RWH systems comprise various components- catchment, transporting rainwater through pipes or drains, a first flush, filtration, and storage in tanks for reuse or recharge (Yadav, 2023a) [6]. The catchment is the area on which rain falls directly. It is the area that contributes water to the RWH system such as rooftops, sloppy roofs, courtyards, and paved and unpaved areas are catchment areas. Transportation pipes transport rainwater from the catchment to the storage system. They include down water pipes and drains. The first flush is a device to flush off the first shower of rain. It is important to flush off this water as it contains all contaminants and bacteria from the catchment and atmosphere. Filtering rainwater is important before its storage and usage to make the water fit for potable use. The tank that stores rainwater after its purification is called a storage tank.

The proper operation and maintenance (O&M) of the RWH system protects water quality in several ways. Regular inspection and cleaning of catchments, gutters, filters, and tanks reduce the likelihood of contamination. It would ensure that water from other sources should not be mixed with that in the tank. Rainwater is one of the purest forms of water. It is a high-quality soft water, so it requires less amount of detergent and soap for washing clothes and body. It can be used for multiple purposes such as drinking, watering plants, toilets, and laundry. However, while collecting and storing, rainwater gets contaminated. So, to ensure the quality of rainwater, a properly designed and operated RWH system is required. Moreover, the filtration system uses gutter screens, in-tank filters, sand filters, and cartridge filters to make the water fit for drinking purposes.

RWH is an important source of drinking water everywhere from urban areas to very remote areas in the country [6]. The water scarcity in city areas can be solved by installing RWH systems and constructing recharge pits at the household level. It will increase the availability of drinking water as well as increase the groundwater level leading to an increase of water in the well. In addition, RWH can also be an important source of water in the Tarai/Madhesh, the plain areas of Nepal for recharging groundwater by construction of ponds and/or recharge pits. That's why it will be used to a larger extent in the future to meet the growing water demand.

Despite the number of benefits of RWH, there are a few challenges faced during the implementation of the system as the water from the RWH system may not be sufficient for all domestic uses throughout the year. In some cases, people may not use it for drinking purposes assuming it is not pure as needed. An awareness program having a practical session would increase their confidence to use it in the rural areas of Nepal. It may be a limited supply due to the uncertainty of rainfall. It is not suitable for regions where rainfall is scarce throughout the year. The rainfall pattern has been changing over the years due to climate change leading to challenges to meet the water demand of the people. To cope with these challenges, a combination of RWH with other sources would be a way to meet the water demand of the people of the respective community. Thus, providing water services through RWH is a pathway to the sustainable water management of the nation leading to achieving SDGs.

Moreover, the development of adaptation and mitigation strategies to tackle anthropic and climate change impacts is becoming a priority in drought-prone areas and Indigenous RWH techniques are to be used as a viable solution for flood mitigation (Tamagnone, Comino, & Rosso, 2020) [7]. Likewise, building and/or strengthening an institutional setting focusing on RWH plays a crucial role in ensuring successful and sustainable RWH implementation (Neke et al., 2009) [8]. In this connection, the involvement of communities in the selection of appropriate technologies and participation in managing O&M costs as well as users' committee capabilities have positively influenced sustainability (Adaka & Mugambi, 2018) [9]. Likewise, the formation of a water committee and the tariff collection for O&M funds are crucial for sustainable water supply systems (Tadesse et al., 2013) [10].

The insights gained from the implementation of water supply systems in the context of developing countries reveal that even the best-implementing agencies cannot successfully implement, operate, and maintain the water systems without the full cooperation and commitment of the community people (Lammerink, 1998) [11]. The factors contributing to the sustainability of water supply systems are the participation of community people in decision-making on O&M, the existence of O&M funds, readiness to contribute cash, and the active user's committee in place (Peter & Nkambule, 2012) [12] (Yadav, 2023b) [13].

There are the above-mentioned findings in the context of other countries and Nepal. The enduring question arises of how models of collaboration have impacted RWH in the rural setting. Thus, the study on effective models of collaboration for RWH in the context of the rural areas of Nepal is of greater significance.

REVIEW OF LITERATURE

Several studies have been reviewed on effective models of collaboration for RWH. The review of the literature in this study is presented in Table 1.

Table 1: Summary of the review of recent literature

Study	Major findings
Wani et al. (2003) [14]	The key elements of efficient management of RWH are community participation, capacity building at the local level through technical guidance by a consortium of organizations, and the use of high-science tools to manage the watershed efficiently.

Samaddar & Okada (2008) [15]	The hearing generated or informal social networks significantly influence the trend and pattern of implementation of RWH tanks- the adaptation rate is steady and balanced in the community which has developed a prominent social network.
Neke et al. (2009) [8]	NGOs, governmental organizations, universities, private sectors, consultancies, and research institutes are important players, being able to manage and coordinate implementation activities, promote knowledge exchange, optimize technologies and practices, and ensure integration of RWH into policies and plans.
Nijhof et al. (2010) [3]	The multi-layer institutional model requires substantial initial investment and effective communication between organizations, water users, and governments as well as women's involvement in community management of RWH systems is still weak.
Nichols (2015) [16]	Capacity building of local technicians in rural villages in Nepal can initiate involvement from the private sector in RWH system construction and increase the opportunities for Nepali people to access a safe drinking water supply.
Kativhu et al. (2017) [17]	Active participation by communities at the planning stage of water projects is found to be critical for sustainability although field results showed passive participation by communities at this critical project stage. Financial factors of adequacy of financial contributions and establishment of O&M funds are also found to be of great importance in sustaining water supply systems.
Adaka & Mugambi (2018) [9]	Due to the low level of communities' unawareness of its contents and applicability, water regulatory policy had a low but significant positive relationship with sustainability, but its influence greatly diminished in multivariate analysis of sustainability.
Adhikari (2019) [18]	Users' committees and local government will be more responsible for governing the service quality rather than managing the scheme.
Budhathoki (2019) [19]	There is a disparity in using improved sources of water supply service between rich and poor people. The government should make consolidated and integrated efforts to reduce existing inequity in the sector to provide WASH services.
Yadav (2022) [20]	A combination of two or more innovative monitoring mechanisms will make more sense for effective and efficient monitoring mechanisms to keep the projects functional and sustainable.
Shaikh & Birajdar (2024) [21]	The pivotal role of community engagement, the diverse applications of artificial intelligence (AI) in water management, and the significance of Information Education and Communication (IEC) in shaping sustainable behaviors.
Ulibarri (2024) [22]	By evaluating conflict dynamics that occur at the scale of an individual interaction and the positive and negative roles they play in shaping collaborative outcomes, this study moves conflict from being a static barrier or contextual factor to a dynamic ingredient that can be managed to shape policy outcomes.

The above-mentioned literature shows the diverse perspective of RWH in the context of Nepal and beyond. However, the controversy is which effective models of collaboration for RWH in developing countries like Nepal.

MATERIALS AND METHODS

To conduct this study, a descriptive cum analytical research design was adopted. Descriptive research design was utilized mainly for a conceptualization of the problem while analytical research design was followed mainly to analyze the results. This study has been based on both primary and secondary data. The necessary primary data were collected by conducting a field evaluation survey using a semi-structured questionnaire on a sample of 38 communities/projects having RWH systems while the secondary data were collected through different relevant publications. The number of communities/projects having RWH systems selected for the study is given in Table 2.

Table 2: Number of communities/projects having RWH systems selected for the study

Province	Number of communities/projects
Bagmati	1
Gandaki	20
Karnali	1
Koshi	15
Sudurpaschim	1
Total number of projects	**38**

Source: NEWAH 2024

Altogether, 20 communities were from Gandaki province, 15 communities were from Koshi province, and one community was from each of the Bagamati, Karnali, and Sudurpaschim provinces of Nepal selected from the study. The collected data were cleaned, tabulated, and analyzed using different statistical tools through SPSS to derive results leading to major findings of the study.

RESULTS AND DISCUSSION

In this section, an attempt is made to explore effective models of collaboration for RWH in the context of the rural areas of Nepal. The models of collaboration have been explored by analyzing collaborative planning, involvement of local government and community contribution, collaboration for MUS and caretakers' management, and collaboration for monitoring and evaluation of the RWH system in the context of the rural areas of Nepal.

Collaborative plan

A collaborative plan is prepared based on a feasibility study in consultation with the stakeholders and carried out accordingly. In the very beginning, the least coverage of rural/municipalities is identified by analyzing the secondary data and coordination with the District Coordination Committee (DCC). Accordingly, the projects are to be identified and implemented.

From the initial stage, a pre-feasibility study of the project is conducted to ensure the appropriateness of water sources, source location, the possibility of source pollution, and sanitary surveillance by conducting detailed technical and social surveys.

A collative plan provides a ground to get contributions from diverse stakeholders leading to ensure the sustainability of the RWH system. The collaborative plan is formalized through tripartite agreements among local governments, implementing agencies, and users' committees.

The number of project beneficiaries and women participating in the users' committees shows the collaborative efforts of the selected RWH projects as given in Table 3.

Table 3: Number of beneficiaries and women participating in users' committees of selected RWH projects

Province	Number of projects	Number of households	Number of water points	Number of total beneficiaries	Number of people in users' committees	Women in users' committees	
						Number	Percent
Bagmati	1	47	47	313	7	2	29%
Gandaki	20	737	496	4,867	139	60	43%
Karnali	1	96	96	570	11	4	36%
Koshi	15	400	421	3,515	98	40	41%
Sudurpaschim	1	54	55	369	7	3	43%
Grand Total	38	1,334	1,115	9,634	262	109	42%

Source: Author's calculation.

Altogether, 38 RWH projects having 1,115 water points, 1,334 households, and 9,634 beneficiaries were implemented in coordination and collaboration with users' committees and local governments. In addition, over 42 percent of women have participated in the users' committees. Thus, the collaborative approach is one of the important models for RWH which is consistent with the findings of Neke et al. (2009) [8] and Kativhu et al. (2017) [17].

Collaboration with local government

The collaboration with the local government is not only for co-financing but also for joint monitoring and post-implementation support as needed in the respective system. The rural/municipalities prepare and endorse their annual plan and budget for the entire municipality. In this connection, the local government allocates funds for the water structure as the matching fund as shown in Table 4.

Table 4: Local government's contribution to the selected RWH projects of this study

Province	Number of projects	Total project cost (NPR)	Local government's contribution	
			Amounts (NPR)	Percent
Bagmati	1	4,441,151	-	0.00%
Gandaki	20	41,525,491	185,000	0.45%
Karnali	1	9,994,478	50,000	0.50%
Koshi	15	23,865,660	169,500	0.71%
Sudurpaschim	1	4,220,466	-	0.00%
Total	38	84,047,246	404,500	0.48%

Source: Author's calculation.

Note: - indicates not applicable.

Table 4 shows the local government's contribution to the selected RWH projects of the different provinces of Nepal. The co-financing for the RWH systems was received from the local governments in Gadaki, Karnali, and Koshi provinces in Nepal, however, it is quite low which is less than one percent of the total project cost of the respective provinces. Besides, there are no contributions received from the local governments in Bagmati and Sudurpaschim provinces for RWH systems. It is necessary to increase co-financing from the local governments for RWH systems to achieve national and international goals related to water supply services. In this connection, the local government is one of the key players in implementing RWH projects which is consistent with the findings of Neke et al. (2009) [8], Nijhof et al. (2010) [3], and Adhikari (2019) [18].

Collaboration for community engagement

Community engagement is one of the important aspects of collaboration for RWH systems. The activeness of the users' committee led to the functionality of the RWH systems not only for engaging community people for the implementation of the project but also for contributing to the project and self-monitoring the implementation of the project. The community contribution to the selected RWH projects of this study is given in Table 5.

The community contribution to the RWH projects is encouraging as shown in Table 5. There is the highest contribution by the community people in Gandaki province (23.94 percent) followed by Koshi province (22.90 percent), Sudurpaschim province (9.86 percent), Bagmati province (8.69 percent), and Karnali province (6.91 percent) for the RWH projects. Moreover, the overall contribution is over 20 percent of the total project cost which is quite impressive leading to an increased sense of ownership of the projects.

Table 5: Community contribution to the selected RWH projects of this study

Province	**Number of projects**	**Total project cost (NPR)**	**Community contribution**	
			Amounts (NPR)	Percent
Bagmati	1	4,441,151	385,766	8.69%
Gandaki	20	41,525,491	9,939,546	23.94%
Karnali	1	9,994,478	690,144	6.91%
Koshi	15	23,865,660	5,464,074	22.90%
Sudurpaschim	1	4,220,466	416,090	9.86%
Total	38	84,047,246	16,895,620	20.10%

Source: Author's calculation.

The informal social networks of the community people significantly influence the trend and pattern of implementation of the RWH tank which is consistent with the findings of Samaddar & Okada (2008) [15]. Community participation is a key element of efficient management of RWH that is consistent with the findings of Wani et al. (2003) [14] and Nijhof et al. (2010) [3].

Collaboration for multiple uses of water services (MUS):

The multiple use of water services (MUS) is one of the effective ways to utilize water for diverse purposes such as domestic uses and irrigation for kitchen gardening in the respective community. The MUS through 3R (recharge, retention, and reuse) approach provides ground to work more efficiently for income-generating activities in the respective RWH project.

A catchment-based 3R approach to water supply delivery decreases the variability of supply and provides inherent mechanisms to improve water quality and quantity, agricultural productivity, and adaptation to climate change. A 3R approach maps opportunities to increase natural or anthropogenic water storage and utilizes this storage as a buffer for periods of low rainfall. This approach occurs at the catchment scale to provide a holistic and integrated approach to water supply delivery in the respective community. In this connection, the MUS in the selected RWH projects of this study are given in Table 6.

Table 6: Multiple uses of water services (MUS) in the selected RWH projects of this study

Province	Number of projects	Number of households	Kitchen garden		Dish drying rack		Garbage pit	
			Number	% of HHs	Number	% of HHs	Number	% of HHs
Bagmati	1	47	0	0%	0	0%	0	0%
Gandaki	20	737	121	16%	335	45%	47	6%
Karnali	1	96	15	16%	96	100%	96	100%
Koshi	15	400	0	0%	153	38%	25	6%
Sudurpaschim	1	54	33	61%	49	91%	26	48%
Total	38	1334	169	13%	633	47%	194	15%

Source: Author's calculation.

The multiple uses of water for drinking, bathing, dishes washing, cattle rearing, and kitchen gardening as far as available. Furthermore, the highest number of households in Sudurpaschim province (61 percent) started their kitchen gardening followed by Gandaki province (16 percent) and Karnali province (16 percent) of the total number of households having RWH projects. However, there are no households with kitchen gardening in the selected RWH projects in Bagmati and Koshi provinces of Nepal. Altogether, 13 percent of households started kitchen gardening just after the completion of the implementation of the project using waste/overflow water from the RWH systems.

Overall, there are 47 percent of households have separate dish-drying racks in the selected RWH projects. Likewise, 15 percent of households have garbage pits out of the total households in the selected RWH projects. The garbage pit has been utilized for decaying materials leading to the production of compost fertilizers. Besides, micro-entrepreneurship training was also given to the community people to develop their skills in business planning to start up micro-enterprises using water in the respective community. Capacity development is paramount for stimulating local management and encouraging the financial self-sufficiency of users (Neke et al. 2009) [8].

Collaboration for caretakers' management:

The sustainability of water supply facilities is one of the major issues in the WASH sector of Nepal as most drinking water supply schemes cannot function for the expected life span of 20 years (White, Badu, & Shrestha, 2015) [23]. Thus, the caretaker is a key player in the RWH system for its smooth operation and to keep it functional. The caretakers were trained during the implementation of the RWH projects and assigned to the operation and maintenance of the systems.

The users' committee pays a minimum remuneration for the repair and maintenance of the RWH systems. In this connection, the caretakers' management has been assessed by analyzing the number of households per caretaker and the number of water points per caretaker as mentioned in Table 7.

Table 7: Caretakers' management in the selected RWH projects of this study

Province	Number of projects	Number of households	Number of water points	Number of caretakers	Number of HHs/care taker	Number of water points/car etaker
Bagmati	1	47	47	-	-	-
Gandaki	20	737	496	16	46	31
Karnali	1	96	96	2	48	48
Koshi	15	400	421	-	-	-
Sudurpas chim	1	54	55	-	-	-
Total	38	1334	1115	18	74	62

Source: Author's calculation.

Note: - indicates not applicable.

The caretakers were trained in the RWH systems of Gandaki and Karnali provinces while no caretakers were trained in other provinces as given in Table 7. One caretaker has served 46 households in Gandaki province and 48 households in Karnali province of Nepal. Likewise, one caretaker has served 31 water points in Gandaki province and 48 water points in Karnali province of Nepal.

Caretaker management is one of the crucial factors influencing the systems' functionality which is consistent with the findings of NEWAH (2014) [24], Nichols (2015) [16], and Yadav (2023b) [13].

Collaboration for monitoring and evaluation

Monitoring provides information needed to make effective informed decisions by governments, development partners, civil society, and other stakeholders to ensure the quality and sustainability of RWH systems. Therefore, monitoring and evaluation cover the process of collecting, managing, and disseminating information required to manage and provide RWH services effectively.

The multi-stakeholder monitoring mechanisms comprised of different monitoring by different agencies throughout the implementation and afterward. The self-monitoring by the community people/users' committee has been conducted throughout implementation and after implementation. The technical issues of the RWH systems were monitored by the caretakers' management. Regular supervision by assigned field staff of the implementing agencies has been conducted throughout the implementation to ensure quality implementation of the RWH systems. The monitoring by implementing agencies regularly throughout the implementation by different layers of the organization. Furthermore, joint monitoring with local governments, funding partners, and the Social Welfare Council (SWC) has been conducted once every year for each agency. Likewise, an evaluation of the projects was conducted after the completion of the RWH projects to evaluate it.

Finally, post-implementation monitoring of the RWH systems was conducted after the completion of the projects regularly to ensure their functionality. It has been conducted through Hello monitoring. Under hello monitoring, the assigned technicians call the caretakers and users' committees to know its functionality and issues if any. Based on the issues identified in the RWH projects through hello monitoring, the dedicated technicians coach caretakers over the phone to fix the issues. If the solution is beyond their capacity, the technicians will provide technical assistance by visiting the project site to fix the issues.

If there has been major damage and rehabilitation is required, the technicians will conduct a technical survey and prepare a project list for the project's rehabilitation.

A multi-stakeholder monitoring mechanism with a combination of two or more innovative monitoring methods is crucial for the functionality and sustainability of the projects which is consistent with the findings of Yadav (2022) [20].

CONCLUSION

The results of this study led to important conclusions. The study concluded that a collaborative approach to project design and development ensures contributions from different stakeholders and increases their ownership leading to increased co-financing by local government and post-implementation support to the respective project in the future. Community involvement in the planning phase has increased community ownership and its contribution to the respective project while its involvement in implementation provides a ground to complete the project within the stipulated timeframe efficiently. The community engagement ensures caretakers' management and promotes income-generating activities using waste/overflow water from the system. The caretakers manage and fix minor damages promptly leading to increased functionality of the water supply system. The multiple uses of water services (MUS) such as drinking, domestic uses, and irrigation for kitchen gardening enhance the livelihood of the community people. The multi-stakeholder monitoring mechanism ensures efficient and effective implementation through timely improvement as needed, timely completion of the RWH projects, and functionality and sustainability of the RWH system through post-implementation monitoring and follow-up support.

This study is useful for users' committees, development actors, academia, and policymakers. The study is valuable particularly for users' committees to keep their water supply system functional by collaborating with the relevant stakeholders as discussed in this study. It is also useful for the development actors in the sector and policymakers as reference material for promoting the RWH system by formulating entrepreneur-friendly policies and implementing projects effectively. This work may potentially be useful to academia for future studies by generating at least some new knowledge in the literature on entrepreneurship.

The extension of this study can be made by incorporating an analysis of diverse applications of artificial intelligence (AI) in the water management sector in future studies. The study can be extended by conducting a detailed analysis of the projects having other kinds of water sources such as groundwater, surface water, and recycled water in the context of developing countries like Nepal.

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