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RAINWATER HARVESTING IN ARID AND SEMI-ARID LANDS OF AFRICA: CHALLENGES AND OPPORTUNITIES

Etienne Umukiza[1], Romain Ntole[2], Sylvester R. Chikavumbwa[3], Erion Bwambale[4], Davis Sibale[5], Zechariah Jeremaih[6], Ciro Apollonio[7], Andrea Petroselli[8]✉

[1] West African Center for Water, Irrigation and Sustainable Agriculture (WACWISA), University for Development Studies P.O.BOX TL 1882, Tamale, Ghana. Civil and Environmental Engineering, Jomo Kenyatta University of Agriculture and Technology, P.O. Box 62000, Nairobi 00200, Kenya.
[2] West African Center for Water, Irrigation and Sustainable Agriculture (WACWISA), University for Development Studies P.O. BOX TL 1882, Tamale, Ghana.
[3] Department of Civil Engineering, University of Malawi-The Polytechnic, Blantyre, Malawi.
[4] West African Center for Water, Irrigation and Sustainable Agriculture (WACWISA), University for Development Studies P.O. BOX TL 1882, Tamale, Ghana. Department of Agricultural and Biosystems Engineering, Makerere University P.O.BOX 7062, Kampala, Uganda.
[5] West African Center for Water, Irrigation and Sustainable Agriculture (WACWISA), University for Development Studies P.O. BOX TL 1882, Tamale, Ghana. Department of Land and Water Resources, Lilongwe University of Agriculture and Natural Resources (LUANAR-NRC), P.O Box 143, Lilongwe, Malawi.
[6] West African Center for Water, Irrigation and Sustainable Agriculture (WACWISA), University for Development Studies P.O. BOX TL 1882, Tamale, Ghana. Department of Agricultural Engineering, Faculty of Agriculture, Upper Nile University, P.0.Box1660, Malakal, South Sudan.
[7] Department of Agriculture and Forest Sciences (DAFNE), Tuscia University, 01100 Viterbo (VT), Italy.
[8] Department of Economics, Engineering, Society and Business Organization (DEIM), Tuscia University, 01100 Viterbo, Italy.

ABSTRACT

Aim of the study
Arid and semi-arid lands often face a shortage of freshwater due to uncontrolled runoff. In arid and semi-arid regions of Africa, rainwater harvesting is a promising solution that can be implemented for multiple purposes such as agriculture, recreation, flood control, and availability of drinking water. The present review aims to highlight the benefits, opportunities and challenges associated with rainwater harvesting in arid and semi-arid lands of Africa.

Material and methods
Analysis of scientific and professional contributions reveals that, although water scarcity remains a major constraint to life and economic development, arid and semi-arid regions of Africa are slowly adopting effective rainwater harvesting measures.

Results and conclusions
Based on the findings on benefits and challenges of water harvesting in arid and semi-arid lands of Africa, the present study recommends that policymakers should invest in mass education to adopt rainwater harvesting as complement to traditional water sources, and engage experts to comprehensively design infrastructure for rainwater harvesting using necessary techniques that will optimise collection and storage. To make progress, further research is needed to identify potential zones for runoff harvesting, and rainwater harvesting should be integrated with the much-needed green revolution and climate change adaptations for land reclamation.

Keywords: ASAL, rainwater harvesting, benefits, operations, challenges

✉e-mail: petro@unitus.it

INTRODUCTION

Water is an essential element for sustaining life, driving sustainable economic growth, and maintaining the balance of ecosystems and biodiversity (Akuffobea-Essilfie et al., 2020). It is the most valuable natural resource with countless uses and tremendous significance that cannot be overstated (N Ka Patel et al., 2020). However, water scarcity has become a worldwide challenge due to urbanization (Umukiza et al., 2021; De Luca et al., 2022), population growth, and climate change (Hassan et al., 2021), and this is particularly felt in Africa. The practice of rainwater harvesting in arid and semi-arid lands of Africa is of crucial importance due to the variety of challenges and opportunities that exist in these regions. Climate change, lack of infrastructure and water scarcity have exacerbated water crises in these regions, leading to unpredictable rainfall patterns and prolonged draughts (Biazin et al., 2012; Awuah et al., 2014; Owusu and Asante, 2020). These conditions cause seawater intrusion and other water quality problems (Apollonio et al., 2018) such as the over-exploitation of groundwater in coastal aquifers mainly due to the increasing water demand in the agricultural sector over the last decades, in particular in most semi-arid or arid countries of the world (Giordano et al., 2010). For these reasons, in Arid and Semi-Arid Lands (ASAL), integrating a rainwater harvesting (RWH) system, i.e. a system intercepting and concentrating the runoff, followed by storage either in soil for direct use by plants or in reservoirs for later use to mitigate dry spells (Mzirai and Tumbo, 2010) with water management practices can enhance agriculture.

RWH measures can be implemented for various purposes, such as domestic use, irrigation, and groundwater recharge. For instance, in irrigation, Li et al. (2000) identified three primary components of this system: the rainwater harvesting system, the water-saving irrigation system, and the highly efficient crop production system. In urban areas, RWH measures are designed mainly to capture and utilise rainwater for domestic use for non-drinkable purposes such as toilet flushing, laundry, and outdoor uses; these measures include rooftop rainwater collection, storage systems, and distribution systems. RWH measures for groundwater recharge focus on optimizing water use in agriculture and replenishing underground water sources. The measures commonly employed are contour farming, rainwater storage, and percolation pits in recharge wells.

Even though RWH techniques have been used for a long time, going back more than 4000 years (Barry et al., 2008; Linderhof et al., 2022), renewed interest has emerged due to the increase in available water resources and the effects of climate change, in particular in African ASAL.

Indeed African ASAL have suffered from insufficient resource planning due to an inadequate understanding of the impact of hydrological processes. Despite the unreliable rainfall, the majority of the population in such ASAL rely on rainfed agriculture and pastoralism for subsistence. In African ASAL, conventional water sources are expensive and often impermanent, making rainwater harvesting a practical alternative to water supply (Kahinda and Taigbenu, 2011). Rainwater harvesting has great potential in both rural and developing urban areas of African ASAL, where rapid population growth has led to the need for simple, effective, reliable, low-cost, and environmentally sustainable water sources.

Water scarcity affects one-third of Africa's population, leading to significant loss of rainwater through runoff and flooding in some areas (Khan et al., 2017; Mwamila et al., 2022; Otmani et al., 2022). However, implementing small on-farm earthen dams can help reduce peak flows and flooding in affected areas (Umukiza et al., 2022). Meanwhile, water shortages and conflicting demands create a dilemma for policymakers and communities, emphasizing the need for efficient use of available rainfall, so rainwater harvesting can provide a solution.

In African ASAL, people have traditionally used various RWH techniques to increase water availability for their domestic needs, crop production, and livestock grazing (Furumai, 2021). Although the implementation of RWH systems can reduce reliance on traditional water sources and contribute to water conservation efforts, there is a lack of quantitative methods to determine the efficiency of RWH and replacement strategies (Goyal et al., 2016). The promotion of awareness and education about the benefits of RWH is crucial to encouraging widespread adoption measures end ensuring responsible usage and maintenance of the systems. Therefore, implementing RWH technology requires a comprehensive approach that includes financial support, awareness programs, and measures to ensure cost-effectiveness and wider adoption of the system.

Furthermore, extensive research is needed to determine whether current rainwater harvesting structures and techniques are capable of functioning effectively under changing climatic conditions, and whether they will require redesigning to adapt to future situations. Currently, some Sub-Saharan African countries, particularly those in ASAL, experience a scarcity of clean and sufficient drinking water, with fifty per cent of the population using unimproved sources of drinking water (Barnes, 2009). This is 10% higher than the African continent's average, where 40% lack access to improved drinking water sources (Lee and Visscher, 1990).

Based on the aforementioned, this work aims to provide a simple review of the technology, components, benefits, and challenges of RWH adaptation in African ASAL, with a specific focus on enhancing the role of rainfed agriculture and water conservation. The main on-line databases (such as Scopus) were used to retrieve the existing literature, coupled with the publications provided by the main local Agencies. We should note that this work does not claim to be exhaustive in terms of research, but only to constitute a starting point in perspective in order to provide valuable insights and contribute to the sustainable development of water resources in arid and semi-arid regions of Africa. Hence, this paper is focused on presenting a range of valuable information on the importance, benefits, and challenges of RWH systems in ASAL, where water scarcity has severe consequences.

COMPONENTS AND STORAGE STRUCTURES OF RAINWATER HARVESTING

Every RWH system comprises the following components (Oweis et al., 2012), see Figure 1:

- A catchment: this refers to the area where rainwater is collected, also known as a runoff area. The size of the catchment area can range from a few square meters to several square kilometres, and it can be a paved road, rocky area, agricultural land, or rooftop.
- A storage facility: this component is responsible for storing the harvested runoff water until it is utilized for domestic, agricultural, or livestock purposes. The water can be stored in aboveground facilities such as ponds or reservoirs, underground storage containers such as cisterns, or in the soil profile.
- A target: this is the ultimate destination of the harvested rainwater. It is where the stored water is used for domestic purposes or crop production.

Depending on the type of water to be collected, different scenarios can be seen as shown in Figure 2. The challenge is to identify suitable locations for constructing RWH storage structures that can be used for various purposes in urban and rural areas to address environmental, agronomic, and socio-economic issues such as urban floods, crop irrigation, and human consumption (see Figure 3).

RWH implementation is vital to improving the performance of rainfed farming systems and drinking water and to addressing environmental issues such as erosion (Mzirai and Tumbo, 2010), since RWH techniques are applicable in all climatic zones. However, the success of RWH requires comprehensive considerations of demand size, agricultural technologies, and management practices.

RWH techniques, such as ponds, check dams, terracing, and percolation tanks, are commonly used in ASAL particularly in developing countries, including those in Africa (Kahinda and Taigbenu, 2011; Oberascher et al., 2021).

Ponds are considered one of the most economical and reliable sources of water in ASAL. However, implementing RWH over large areas requires the consideration of various aspects, including geohydrological, ecological, social, cultural, and political factors (Li et al., 2000; Md Lani et al., 2018).

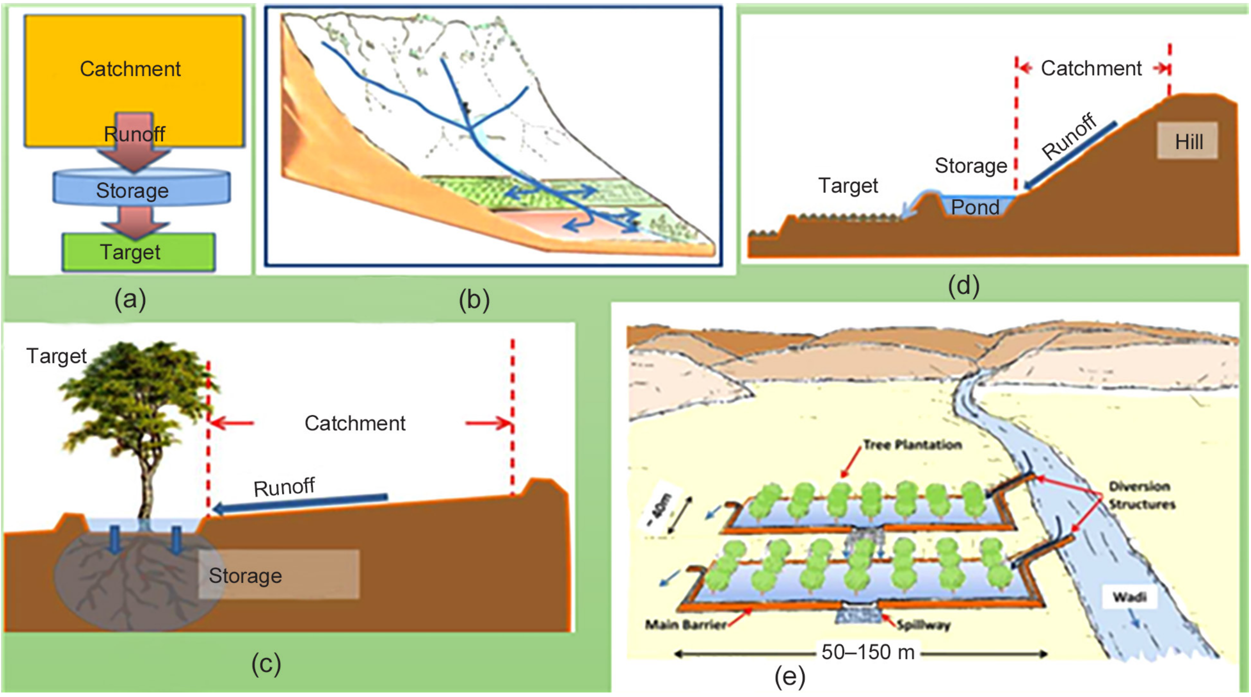

Fig. 1. (a) The operation steps of rainwater harvesting; (b) Schematic diagram of macro catchment system; (c) Micro catchment system; (d) Schematic diagram of a macro catchment system with a pond for intermediate storage of runoff; (e) Floodwater diversion under climate change (source: Prinz, 2013)

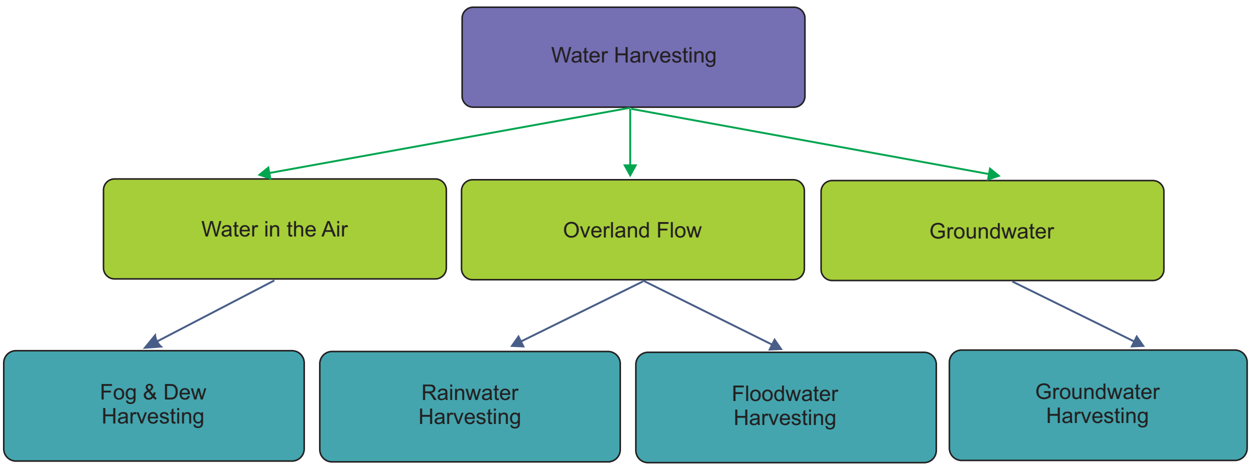

Fig. 2. Subdivision of Water Harvesting (source: Kahinda and Taigbenu, 2011)

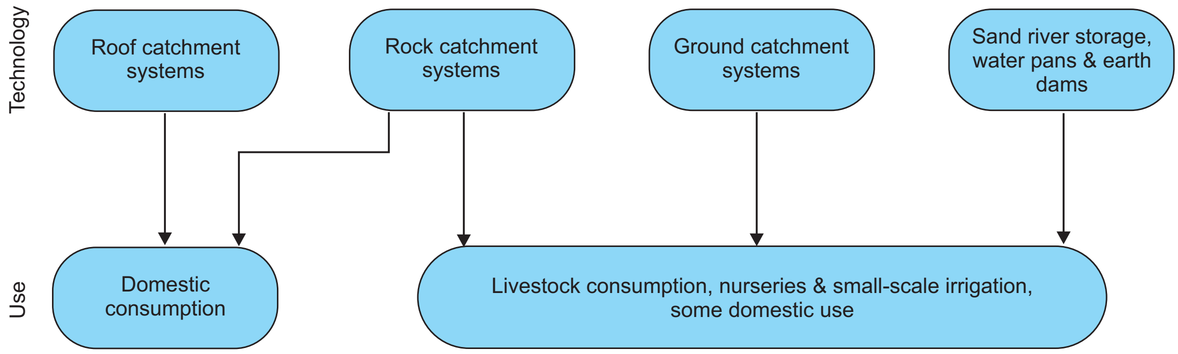

Fig. 3. Implementation system of rainwater harvesting systems and uses (source: Kimani et al., 2015)

RAINWATER HARVESTING IN ASAL

Various techniques can be combined to assess the range of uncertainties associated with RWH systems in ASAL. According to Prinz (2013), rainwater harvesting is divided into three methods used in agriculture: micro-catchment water harvesting, macro-catchment water harvesting, and floodwater harvesting. Micro-catchment harvesting is characterized not only by small size but also by sheet or rill flow, as the catchment and run-on area (or „target") are adjacent to each other. Conversely, macro-catchment harvesting collects water from a large natural catchment, such as the slope of a mountain or a hill. Floodwater harvesting systems are characterized by large distance catchments, turbulent water flow in channels, and the storage or spreading of water within the same stream bed.

Improving agricultural production in drier regions of Africa requires adequate water harvesting, which involves directing and concentrating rainwater through runoff to benefit crops and other uses (Akuffobea-Essilfie et al., 2020).

As water is often the most limiting factor in these regions, recovering over 50% of lost water at a low cost can have significant benefits for both the natural environment and local communities (Leidl et al., 2010). In Ghana, water harvesting has been practised for decades for various purposes, including domestic use, whereas in South Africa, conservation practices and water harvesting have contributed to successful agricultural production for more than a century (Denison and Wotshela, 2012).

Research conducted in South Africa by Denison and Wotshela (2012) found that water harvesting can meet the criteria for sustainable intensification by improving water availability during dry spells and droughts, increasing agricultural yield for food security, rehabilitating degraded lands to restore biodiversity, minimizing external inputs that negatively affect the environment, sequestering carbon to mitigate climate change, and reducing downstream riverine pollution.

The work by Barry et al. (2008) in West African countries including Niger, Mali, Burkina Faso, and Senegal also concluded that integrated water harvesting can rehabilitate degraded land, retain moisture, re-establish vegetation cover, and improve crop growth, ultimately alleviating poverty and enhancing food security.

Currently, RWH practice in Africa is gaining importance in the context of addressing water scarcity issues. In addressing water availability challenges, a number of practical applications of rainwater harvesting have been implemented in several African countries (Critchley and Gowing, 2013). Here are some examples of rainwater harvesting that have been implemented in Africa that contributed to better access to clean water, improved food security, and sustainable development.

(i) Kenya: Wangi Wangari Maathai initiated RWH under the Green Belt Movement (GBM) to combat deforestation and improve water availability. This action was implemented through the construction of sand dams that trap and store rainwater in underground sand reservoirs (Aroka, 2010). It is more than necessary to implement modest, small-scale, low-cost rainwater collection schemes as one of the methods to minimize the detrimental consequences of drought. In addressing the issue of water shortage, water supply system for a school project was implemented also in different locations in Kenya, through the installation of tanks to collect roof water for multiple purposes including drinking after treatments.

(ii) Ghana: Ghana's water challenges forced the Ministry of Water Resources, Works, and Housing (MWRWH) to develop a National Rainwater Harvesting Strategy with the primary goal of guiding the water sector and water-related actors in the promotion of the RWH as a supplement to water service delivery in both urban and rural areas (Amoah et al., 2019). Despite the numerous benefits of RWH in terms of accessing alternative water sources, in Ghana – like in most African countries – implementation strategy remains a challenge to harnessing rainwater potential as an alternative source of water.

(iii) South Africa: The program implemented in Cape Town through rooftop rainwater harvesting encourages residents to collect rainwater for domestic use. The water stored in tanks can be used for non-potable purposes such as irrigation, toilet flushing, and laundry.

(iv) Ethiopia: The Tigray region implemented an innovative rainwater harvesting technique known as "Tassa tank". These tanks are constructed underground to collect and store rainwater during the rainy season, providing reliable water supply for communities during dry periods. Moreover, stone bunds are common rainwater harvesting practices used to manage runoff and soil erosion. Stone bunds are constructed across contours of sloping land to slow down rainwater flow allowing it to infiltrate the soil. This method helps in recharging groundwater and improving soil moisture levels, supporting agricultural productivity even during dry periods (Vema et al., 2018).

(v) Nigeria: The Ogun State Rainwater Harvesting and Utilization program aims to improve water availability in schools by installing rainwater harvesting systems. The collection provided water for drinking, handwashing, and sanitation purposes in schools.

(vi) Senegal: due to climate change, exacerbating the duration and severity of droughts that threaten agricultural livelihood and food security (Kabo-Bah et al., 2021), rainwater harvesting was implemented through the "Gardens of Senegal" initiative for agricultural purposes. The program involves small-scale reservoirs and pans to collect rainwater, which is used to irrigate vegetable gardens and improve food security in rural areas.

(vii) Morocco: since the region is characterised by ASAL and erratic spatiotemporal rainfall distribution, various water harvesting practices have been implemented. They include the construction of small dams, cisterns, and underground reservoirs known as khettaras (Ouali et al., 2022). These techniques help to capture and store water from rainfall and mountain runoff, providing irrigation for agriculture and water for communities.

(viii) Burkina Faso: where arid and semi-arid conditions prevail, communities adopted a technique that involved the digging of small planting pits to capture and retain water during the rainy season, promoting vegetation growth. Across these African countries, RWH demonstrated the potential to alleviate water stress and enhance water security (Nijhof et al., 2010; Biazin et al., 2012). These examples highlight diverse approaches for some African countries that have implemented RWH techniques, trying to overcome water scarcity and ensure sustainable water management.

(ix) Somalia: Particularly in the rural regions, barkads are common rainwater harvesting structures (Oduor and Gadain, 2007). Berkards are underground reservoirs built to capture and store rainwater. They are mostly constructed to settle and ensure a reliable water supply for domestic use and livestock. Also, the caag system was used to harvest runoff water in sloping and flat lands (Oweis et al., 2012).

(x) Mauritania: Jassour is a traditional rainwater harvesting technique practised in Mauritania's desert areas. Jessour is a small stone embankment built across wadis (dry riverbeds) to capture and store rainwater runoff during occasional heavy rains, where the stored water can then serve for irrigation and livestock watering during prolonged dry spells. This practice plays a central role in combating desertification and settling the people in these areas (Ahmed et al., 2007).

(xi) Chad: In Chad, a traditional rainwater harvesting system called Zarai is practised in the Guera region. The system consists of constructing small, shallow basins in the soil, which collect and retain rainwater for agricultural use. The basins are designed to promote water infiltration and reduce evaporation, making it an effective method for small-scale farmers in arid regions (Nijhof et al., 2010; Prinz, 2013).

(xii) Mali: In Mali's arid and semi-arid regions, farmers practice a technique called Zai, which involves digging small pits or basins in the soil during the early stages of the rainy season. The pits catch rainwater and allow it to infiltrate the soil, promoting plant growth and better water retention in the root zone.

BENEFITS OF RAINWATER HARVESTING SYSTEMS IN ASAL

The aforementioned initiatives play a crucial role in improving agricultural productivity, enhancing food security, and supporting communities' livelihood. Overall, RWH is an important practice in many African countries and the system can play a crucial role in helping communities to cope with water scarcity and build resilience in the face of climate change. However, water harvesting measures should technically be applicable under physical circumstances in the field.

It is also important to consider that cultural acceptance of the method and the requirement for comprehensive post-implementation governance are equally crucial. Effective governance becomes indispensable when multiple individuals within a village or several villages need to share the available water resources. Several instances of water harvesting projects failing to achieve their objectives stem from governance intricacies or their lack of acceptance by the community, influenced by cultural, environmental, or economic factors (Lasage and Verburg, 2015).

The benefits of RWH are numerous and encompass economic, environmental, technological, and social advantages (Mutiso, 2019). Implementing an RWH system can lead to annual domestic cost savings of up to $240 per household, while also providing potable water savings, mitigating flooding in urban areas, and reducing nutrient loads in waterways (Lani et al., 2018; Yusop and Syafiuddin, 2018). Rainwater harvesting plays a vital role in mitigating water scarcity in ASAL regions, and these practices demonstrate the ingenuity and adaptability of communities facing challenging environmental conditions.

Furthermore, RWH systems can be more economically feasible in areas with higher water tariffs (Barry et al., 2008; Owusu and Asante, 2020). The environmental benefits of RWH include reduced flooding, with studies showing a reduction of up to 10% in flood occurrence in South Korea (Amoako and Boamah, 2015).

In ASAL regions, RWH offers a variety of benefits such as providing water for irrigation when no other source is available, supplementing rainfall to increase and stabilize crop production, combating desertification by improving pasture land and permitting tree growth, and contributing to groundwater recharge and cultivation (Furumai, 2021; Mwamila et al., 2022).

By decreasing runoff rates, RWH can also reduce soil erosion, increase soil water storage, and alleviate moisture stress on crops and vegetation (Vieira et al., 2014).

Despite the many benefits of RWH, adoption by communities in drought-prone areas is still low (Campisano et al., 2017). However, RWH remains a low-cost method that can enable resource-poor farming communities to adapt to climate change, and reduce water-related stress in agriculture.

CHALLENGES OF RAINWATER HARVESTING SYSTEMS IN ASAL

In Africa, rainwater harvesting faces various challenges due to the region's unique environmental conditions and socio-economic factors (Awuah et al., 2014). Md Lani et al. (2018) identified several challenges that need to be addressed in order to promote the wider adoption of RWH systems. These challenges include achieving competitive costs, extending the application of RWH to commercial buildings, developing cost-effective treatment systems, effective policy implementation, using green materials, improving public perception, and implementing reliable first flush technology.

Similarly, a study by Wanyonyi (2002) examined the possibilities and challenges of RWH in both rural and urban areas of Kenya, and found that water scarcity is a significant problem in urban areas, whereas the high costs of developing new surface water resources, coupled with the scarcity of groundwater supplies in ASAL, constitute major challenges. The study exhaustively identified several challenges associated with this process, which are listed as follows:

- Unpredictability: The supply of rainwater can be limited by the unpredictability of rainfall, and in areas with limited rainfall, it is not advisable to rely solely on rainwater for all water needs.
- Initial high cost: The cost of the RWH system may vary, depending on various factors such as its size, the material used, the specific requirement from the location, and the level of technology. However, the benefits of the system cannot be realized until it is fully operational. Similar to solar panels, the cost of the system can be recouped over a period of 10–15 years, depending on the amount of rainfall and the level of sophistication of the system.
- Regular maintenance: RWH systems need regular upkeep to prevent infestation by rodents, mosquitoes, algae, insects, and lizards, which may use the stored water as their breeding grounds. Improper maintenance may also lead to roofs leaking chemicals, animal droppings, or other debris that can harm plants if used for irrigation.
- Storage limits: The capacity of collection and storage facilities may limit the amount of rainwater that can be stored. In cases of heavy rainfall, the collection systems may not be able to store all the rainwater, which can result in overflow into rivers.
- Policy issues: Many African countries have limited policies in place for the collection and use of rainwater for various purposes. The policies implemented by government ministries, departments, agencies, non-governmental organizations, and donors are often inadequate and inefficient in meeting the needs of local communities. Additionally, policies have largely overlooked the potential for urban rainwater harvesting, with most projects focused on rural areas and neglecting options such as retention ponds that are feasible for urban environments. Limited coordination and networking among organizations further hinder the development of localized rainwater harvesting projects. The policies also lack guidance on mobilizing, training, and enhancing the capacity of communities for rainwater harvesting.
- Technical issues: RWH in Africa has the potential to provide abundant water for various purposes, but it has been limited by a lack of technical expertise. Technical challenges include inadequate knowledge of RWH structure design, limited training on resilient technologies, insufficient understanding of hydrological and hydraulic conditions, insufficient design manuals for sizing storage reservoirs, and poor selection of RWH locations.
- Management issues: The challenges facing the successful implementation of rainwater harvesting in Africa include issues related to both community management and skilled professionals in the water sector. These issues include inadequate understanding of the importance of RWH structures and lack of political will from communities, frequent misdirection and political interference, limited knowledge and skills in project management, lack of community involvement during project implementation resulting in poor ownership of projects, and poor coordination among organizations and communities. Additionally, although rainwater collected during the first rainy season can be used for household purposes and controlling runoff, it is generally not needed by plants until the dry season. However, once the catchment is full, it cannot take advantage of further rainfall.

Also, insufficient rainfall: In some ASAL regions the total annual rainfall may be very low, making it challenging to collect significant amounts of water through rainwater harvesting system (Oberascher et al., 2021). In addition to insufficient rainfall, high evaporation rates and arid conditions result in rapid evaporation of rainwater collected in storage tanks or reservoirs.

Finally, maintenance and operation is a recurrent problem in some ASAL communities due to the lack of technical skills and resources that may hinder proper upkeep, whereas rainwater harvesting systems require regular maintenance and operation to ensure they function optimally. This issue should be kept appropriately in account when designing the RWH systems that of course should be subject of regular maintenance.

CONCLUSIONS

To summarize, this study highlights the significance of rainwater harvesting as crucial for water management in ASAL regions of Africa. Given the scarcity of water resources in these regions, improved techniques of RWH systems can present significant potential for rainwater use efficiency. It was also noted that Africa has great potential for utilizing rainwater harvesting (RWH) for various projects provided that local communities are trained, involved, and equipped with the skills to develop affordable and sustainable RWH technologies. This is supported by the study conducted by Biazin et al. (2012), who concluded that appropriate development of RWH techniques is vital as a practical and sustainable solution to the challenges of climate change and environmental degradation in fragile regions of South Saharan Africa (SSA). Therefore, governments should develop manuals and guidelines for RWH implementation and policies. The advocacy for increased attention and support from governments, non-governmental organizations (NGOs), and relevant stakeholders to promote rainwater harvesting as a viable solution to address water scarcity in arid and semi-arid regions of Africa should be considered. This will promote the efficient supply of rainwater for different purposes.

This paper presents a range of useful information on the importance, benefits, and challenges of RWH systems in ASAL, where water scarcity has severe consequences. To overcome this issue, an integrated approach is necessary to ensure water availability for human well-being and food security, particularly in areas with limited rainfall. In order to improve the performance of RWH systems, proper implementation could include area selection and design.

Further research is needed to identify suitable RWH systems based on local conditions, downstream impacts, and socio-economic factors. Moreover, the employment of new techniques and the introduction of scientific approach would be more advantageous. Additionally, potential areas for locating runoff water harvesting and their design must be identified to mitigate water shortage and support multiple-purpose applications, including irrigation.

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RETENCJA WODY DESZCZOWEJ NA SUCHYCH I PÓŁSUCHYCH TERENACH AFRYKI: SZANSE I WYZWANIA

ABSTRAKT

Cel pracy

Tereny suche i półsuche często borykają się z niedoborem słodkiej wody z powodu niekontrolowanego spływu. W suchych i półsuchych regionach Afryki retencja wody deszczowej (magazynowanie deszczówki) stanowi obiecujące rozwiązanie, którego wdrożenie może posłużyć do wielu celów, takich jak: rolnictwo, rekreacja, ochrona przeciwpowodziowa i dostępność wody pitnej. Niniejszy artykuł ma charakter przeglądowy, a jego celem jest wyszczególnienie korzyści, możliwości i wyzwań związanych z retencją wody deszczowej na suchych i półsuchych terenach Afryki.

Materiały i metody
Analiza publikacji naukowych i branżowych pokazuje, że chociaż niedobór wody nadal pozostaje główną przeszkodą dla życia i rozwoju gospodarczego, to suche i półsuche regiony Afryki stopniowo wdrażają skuteczne sposoby odzyskiwania deszczówki.

Wyniki i wnioski
Na podstawie ustaleń dotyczących korzyści i wyzwań związanych ze pozyskiwaniem wody na suchych i półsuchych terenach Afryki zaleca się, aby decydenci inwestowali w masową edukację w zakresie wykorzystania retencji deszczówki jako uzupełnienia tradycyjnych źródeł wody oraz angażowali ekspertów do kompleksowego projektowania infrastruktury służącej pozyskiwaniu wody opadowej z wykorzystaniem niezbędnych technik, które zoptymalizują gromadzenie i magazynowanie deszczówki. Aby osiągnąć postęp w tej dziedzinie, potrzebne są dalsze badania w celu zidentyfikowania potencjalnych stref zbierania wody ze spływu, a gromadzenie deszczówki należy zintegrować z tak bardzo potrzebną zieloną rewolucją oraz przystosowaniem się do zmian klimatu w celu rekultywacji gruntów.

Słowa kluczowe: ASAL (tereny suche i półsuche), retencja wody deszczowej, korzyści, działania, wyzwania