RAINWATER COLLECTION FROM GROUNDWATER SURFACES IN LESOTHO

TECHNOLOGY DESCRIPTION

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Rainwater collection from ground surfaces involves techniques and systems designed to capture, filter, and store rainwater for later use. These systems include two key components and methods that optimize the collection and utilization of rainwater. Firstly, components of rainwater collection systems composed of the following: a) Catchments and Storage - Systems typically include catchment areas such as permeable pavements or urban surfaces that direct water into storage tanks or wells designed to maximize water capture and minimize loss through runoff (Walia et al., 2024); b) Filtering and Conveyance: Filters and conduits are used to remove debris and contaminants from the collected water. Systems like permeable concrete pavements incorporate grooves and cavities to facilitate water filtration and conveyance; c) Communicating Vessels: Some systems use communicating vessels to transport water from higher to lower elevations, utilizing gravity to avoid the need for mechanical pumps, thus conserving energy and reducing environmental impact. Secondly, techniques for Rainwater Harvesting typically composed of the following subsystems: a) In Situ Water Harvesting: Techniques such as contour farming and terracing are employed to capture rainwater directly on agricultural land, enhancing soil moisture and reducing erosion (Walia et al., 2024); b) Runoff Harvesting: In urban areas, systems like elevated pavements with precipitation tanks and funnel-shaped outlets are used to collect and direct rainwater into storage wells or for immediate use in irrigation.

CURRENT TECHNOLOGY READINESS LEVEL (TRL) OR COMMERCIAL READINESS INDEX (CRI)

The TRL of rainwater harvesting systems in Lesotho is generally considered to be around TRL 6 to 7. The technology has been demonstrated in a relevant environment and is close to being fully operational. Rainwater harvesting technology, including the collection of rainwater from groundwater surfaces, is being implemented in various parts of Lesotho. Most rural communities rely on rainwater from ground water surfaces for water supply, often from springs, boreholes or hand dug wells. The CRI for rainwater harvesting from groundwater surfaces in Lesotho is in the early to mid-stages (CRI 3-4). The technology has shown potential and some level of technical validation, it however still faces challenges in terms of market penetration, regulatory support, and financial viability.

CLIMATE RATIONALE OF THE TECHNOLOGY

The technology is a strategic response to Lesotho's unique climatic and hydrological challenges. Lesotho's high altitude and rugged topography contribute to spatial variability in precipitation from rain shadow areas in the Senqu River Valley (< 450 mm), the southwestern lowlands (± 550 mm) peaking in the northeastern highlands (1200 mm) in terms of average annual precipitation which affects water availability and security. This variability, coupled with climate change impacts such as

delayed rainfall and drying rivers, necessitates innovative water management solutions to support agriculture and livelihoods. Rainwater collection systems can mitigate these challenges by capturing and storing water for use during dry periods, thus enhancing water security and supporting sustainable agricultural practices.

Two factors elaborate on the climate rationale for this approach. Firstly, it addresses climate variability and water security because Lesotho experiences significant spatial variability in precipitation due to its topography, impacting water availability and security (Fitchett et al., 2024). In particular, climate change has led to drying rivers and delayed rainfall, affecting agricultural yields and increasing vulnerability to food insecurity. Secondly, rainwater harvesting is a practical adaptation strategy employed by farmers to combat climate change impacts, providing a reliable water source during dry seasons.

AMBITION OF THE TECHNOLOGY

SCALE FOR IMPLEMENTATION AND TIME-LINE

The scope of the project is regional with a focus on the southern lowlands districts (Mafeteng, Mohale's Hoek) and Senqu River Valley (Quthing district). The target is to supply water and sanitation services to at least 50 percent of the population (229, 640 people) in these rural and drought-stricken districts using rainwater collected from surface waters. The vision is to target a) household Level with small-scale systems for individual homes, typically involving rooftop collection and storage tanks; b) Community Level with medium-scale systems serving multiple households or a community, often including larger storage facilities and distribution networks; and c) national level with large-scale systems designed to serve entire districts, incorporating catchment areas, storage, and distribution infrastructure.

The time for fully implementing rainwater from groundwater surfaces spans 10 years (2025 -2035) to align with national policies aiming to achieve Lesotho's water sector priorities in line with SDG 6. The project will roll out in three staggered or concurrent phases: Planning, assessment, and design (1 – 3 years), procurement, construction, and installation (1-4 years) and training, testing, and initial monitoring (1 – 6 years).

AMBITION FOR TECHNOLOGY READINESS LEVEL (TRL) OR COMMERCIAL READINESS INDEX (CRI)

The ambition is reach TRL 9 by 2030 i.e. the technology would be fully mature, with widespread adoption and proven performance in real-world conditions. Achieving this level would involve demonstrating a wide range of customization options for different contexts and accelerating manufacturing and deployment. The ambition for the CRI is to reach CRI 7-8 by 2030 i.e. the technology would not only be commercially viable but also widely adopted and supported by robust policies and market opportunities. Achieving this level would involve: a) Enhancing regulatory support and creating favourable policies; b) Increasing stakeholder acceptance and community engagement; c) Improving technical performance and reliability of the systems; d) Ensuring financial viability and exploring revenue-generating models; e) Expanding market opportunities and scaling up the technology.

EXPECTED IMPACTS OF THE TECHNOLOGY

Economic benefits

- The implementation of the technology entails job creation at both skilled and unskilled levels in support of construction activities.
- There is a high return for investment because of the potential to enhance irrigation and aquaculture.
- The improvement in water supply will potentially reduce public expenditure in health due to consumption of clean water and improvements in nutrition and food security because of improve agricultural productivity.

Social benefits

- Increased options for income generation from employment and agriculture activities.
- The health co-benefits of improved water supply and agriculture productivity are high.

Environmental benefits

- Rainwater collection on ground surfaces reduce surface runoff, which can help mitigate flooding in urban areas.
- Implementing rainwater collection systems can significantly lower carbon emissions compared to traditional water supply methods.

POLICY ACTIONS FOR TECHNOLOGY IMPLEMENTATION

EXISTING POLICIES IN RELATION TO THE TECHNOLOGY

Water and Sanitation Policy (2007) promotes proper management and sustainable use of water resources, including provision of sanitation services, so as to maximize socioeconomic benefits while not compromising the integrity of the natural ecosystem. This is read together with **Water Resources Management Policy (2017)** which seeks to ensure sustainable development of water as a resource, adequate supply of potable water even in times of drought, and proper assessment and protection of available water resources.

National Climate Change Policy 2017 – 2027 (2017) ensures that all stakeholders address climate change impacts and their causes through the identification, mainstreaming and implementation of appropriate adaptation and mitigation measures, while promoting sustainable development.

Soil and Water Conservation Policy (2021) protects land and water resources by conserving the natural resource base, while maximizing the potential for sustainable land management, using appropriate land management techniques.

National Drought Contingency Plan 2018/2019 is aimed at minimizing the negative impact of drought on all vulnerable groups, especially people with disability, women and children.

Draft Irrigation Policy (2021) promotes social and economic well-being of people through irrigated agriculture development on maximum arable land while ensuring equity, sustainability, technical and economic feasibility, and social acceptability without causing any negative impact on the environment.

PROPOSED POLICIES TO ENHANCE TECHNOLOGY IMPLEMENTATION

- Revised land use regulations policies
- Revised water pricing policies
- Capacity building on development funding

COSTS RELATED TO THE IMPLEMENTATION OF POLICIES

Establishment of low interest financial mechanisms and loans: Estimated cost is USD1.2 million

Development and introduction of water pricing policies: Estimated cost is USD 0.6 million

Capacity building, training and research: Estimated cost is USD 5 million

Promulgation of land use regulations policies: Estimated cost is USD 2.6 million

The total estimated costs of the project are **USD 9.4 million**

USEFUL INFORMATION

CONTACT DETAILS

Mr. Maqhanolle Tsekoa - TNA Coordinator
Climate Change Unit, Lesotho Meteorological Services
Ministry of Environment and Forestry
Maseru, LESOTHO, Tel: + (266) 2231 7250
Email: relebohile@gmail.com

LINKS TO TNA REPORTS

https://tech-action.unepccc.org/country/lesotho/