WATER RECLAMATION, TREATMENT AND REUSE IN LESOTHO

TECHNOLOGY DESCRIPTION

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Water reclamation, treatment, and reuse technologies are essential in addressing global water scarcity by transforming wastewater into a valuable resource. These technologies involve a series of processes designed to remove contaminants and produce water suitable for various applications, including potable and non-potable uses. The treatment process typically includes primary, secondary, and tertiary stages, each targeting different types of pollutants to achieve the desired water quality. The selection of appropriate technologies depends on factors such as energy consumption, cost, and the specific reuse purpose.

Three stages are critical in the treatment process. These are: a) **Primary Treatment**: This initial stage involves the removal of large solids and sediments from wastewater through physical processes such as screening and sedimentation; b) **Secondary Treatment**: Biological processes are employed to degrade organic matter and reduce biochemical oxygen demand; c) **Tertiary Treatment**: Advanced processes, including membrane filtration, reverse osmosis, and advanced oxidation, are used to remove remaining contaminants, including persistent chemical pollutants.

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

In Lesotho, the TRL for water reclamation and treatment is still in the early to mid-stages of development (TRL 3-4. Current efforts are focused on understanding the feasibility and effectiveness of various treatment methods. The reuse phase is at TRL 4- 5 with ongoing initiatives to integrate water reuse into the national water management strategy. This includes pilot projects seeking to demonstrate the benefits and practicalities of water reuse in both urban and rural settings. The CRI for the technology is relatively low (CRI 1-3), reflecting the early stages of commercial deployment and market adoption. The development of policies and regulatory frameworks to support water reuse is still in progress. The Water and Sewage Company (WASCO) is the primary institution involved in wastewater management.

CLIMATE RATIONALE OF THE TECHNOLOGY

Water reclamation, treatment, and reuse technologies are increasingly recognized as vital strategies to address the challenges posed by climate change, particularly in the context of water scarcity. These technologies offer a sustainable solution by transforming wastewater into a valuable resource, thereby enhancing water security and reducing environmental impact. The climate rationale for adopting these technologies is multifaceted, encompassing economic, environmental, and social dimensions.

Firstly, economic benefits derive from the inherent reduction on the reliance on freshwater resources, leading to cost savings in water procurement and the use of mineral fertilizers, as reclaimed waste water often contains beneficial nutrients for agriculture (Penserini et al., 2024). Furthermore, the reuse of treated water can mitigate water stress in regions facing water scarcity, potentially stabilizing food prices and supporting agricultural productivity. Secondly, the technology provides a direct environmental impact in the water reclamation helps in reducing the depletion of natural water bodies and prevents the discharge of untreated wastewater into the environment, thus minimizing pollution. This can also integrate nature-based solutions, such as using water fleas for tertiary treatment, offer a low-cost and environmentally friendly method to remove persistent pollutants, enhancing the quality of reclaimed water for reuse (Abdullahi et al., 2023).

AMBITION OF THE TECHNOLOGY

SCALE FOR IMPLEMENTATION AND TIME-LINE

The scope of this technology covers 11 urbans plus the municipal council of Maseru (≈ 330,760 people). The target is to reclaim, treat and reuse a minimum of 50 percent of treated wastewater (effluent) for industrial use and agriculture. The timeline for implementing water reclamation, treatment and reuse is 10 years (2025-2035) in line with national and development policies. These are also aligned to Sustainable Development Goal 6.

The project will roll out in three staggered or concurrent phases: a) **Planning and feasibility phase (1-3 years) -** Public consultations, conducting economic valuation of water reuse, capacity needs assessment and trainings; **Construction and Installation phase (2-4 years)-** Building necessary infrastructure and installation of technology for monitoring and enforcing water quality standards; and **Operation and maintenance phase (Continuous) -** Regular monitoring of water quality and technology performance. Perform scheduled maintenance to ensure efficient operation of the technology.

AMBITION FOR TECHNOLOGY READINESS LEVEL OR COMMERCIAL READINESS INDEX

The ambition is to advance TRL to 9 by developing and implementing supportive policies and regulatory frameworks and enhancing technical skills and knowledge among local professionals and communities involved in water management. In addition, by advancing the water reuse part to the highest TRL by raising awareness about the benefits and safety of water reuse among the public. Similarly, the ambition is to move towards higher CRI stages (5) by expanding successful pilot projects to larger scales, developing supportive policies, and increasing public awareness and acceptance.

EXPECTED IMPACTS OF THE TECHNOLOGY

Environmental and Water Quality Benefits

- Water reclamation can significantly improve water security by providing a reliable source of water for various uses, such as groundwater recharge, agriculture, and industrial processes.
- Reuse of treated wastewater can reduce the concentration of contaminants of emerging concern in effluent-dominated rivers, although the effectiveness varies by contaminant type.
- Tailored treatment schemes can target specific pollutants, enhancing the quality of reclaimed water for its intended use.

Agricultural and Economic Impacts

- Reclaimed water can be used for irrigation, reducing the demand on freshwater resources and supporting agricultural productivity, especially in drought-prone areas.

Public Health and Safety Concerns

Despite the benefits, there are health risks associated with the use of partially treated wastewater, including the presence of pathogens and antibiotic resistance genes, which can lead to infections and other health issues. However, the use of green wall-treated greywater for irrigation has shown potential in reducing pathogen presence in crops, aligning with sustainable urban agriculture practices. Thus, adhering to guidelines from organizations like the World Health Organization is crucial to mitigate these risks and ensure safe reuse practices.

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 read together with **Water Resources Management Policy (2017)** 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.

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.

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.

PROPOSED POLICIES TO ENHANCE TECHNOLOGY IMPLEMENTATION

- Regulatory instruments; permits, licenses, enforcement mechanisms.
- Financial mechanisms that offer low water fees or tariffs for water reuse; Water trading systems or markets.
- Revised technical guidelines for measuring and monitoring water quality and standards.

COSTS RELATED TO THE IMPLEMENTATION OF POLICIES

Research on the Economic Valuation Associated with Water Reuse: Estimated cost is USD 1.5 million.

Institutional Capacity Building: Estimated cost is USD 3.0 million.

Awareness Raising and Behaviour Change Campaigns: Estimated cost is USD 4.0 million

Water Reuse Subsidies and Incentives: Estimated cost of about USD 4.5 million.

Water Quality Monitoring: Estimated cost is USD 6.0 million

Total estimated costs of project implementation are **USD 19 million**

USEFUL INFORMATION

CONTACT DETAILS

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LINKS TO TNA REPORTS

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