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Business Model for Small-Scale Decentralized Wastewater Treatment and Sludge Management in Jordan

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Introduction: Importance of DWWTP

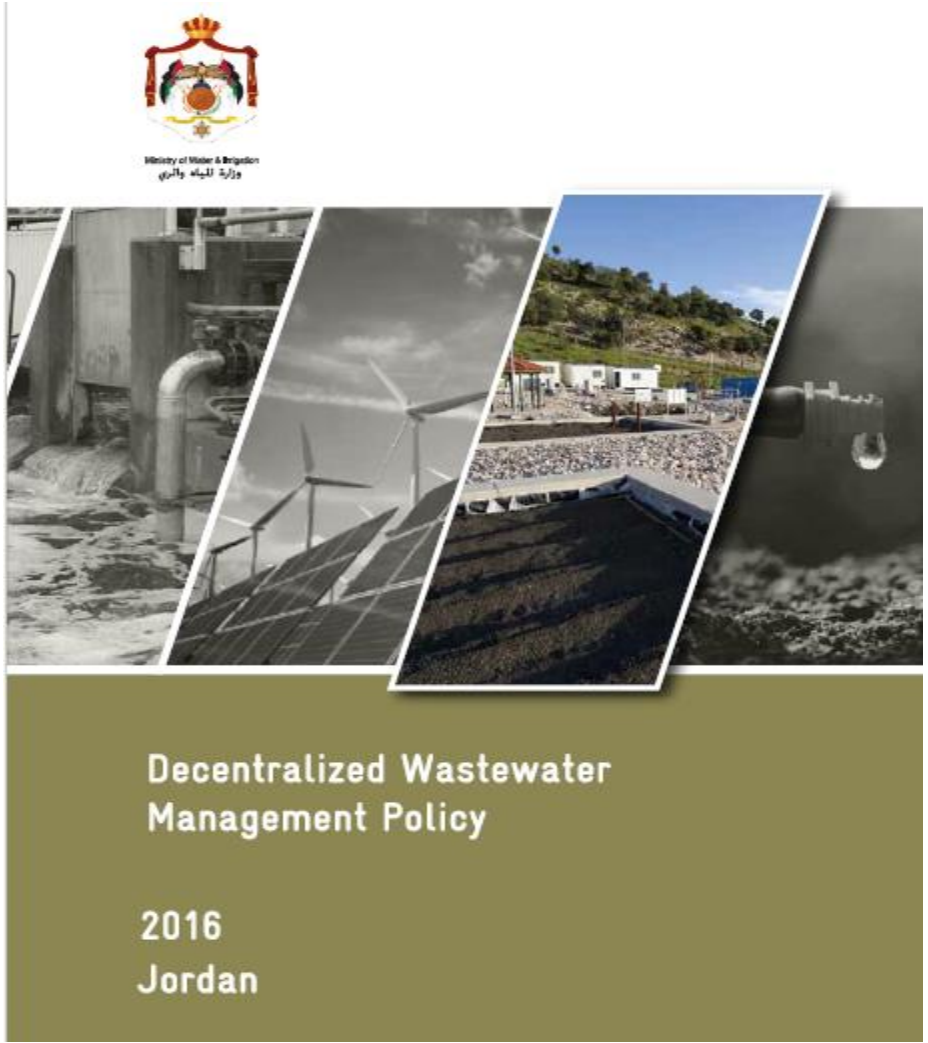
- **Environmental Protection:** They treat wastewater locally, preventing pollution of water bodies and preserving ecosystems.
- **Public Health:** Removing contaminants, they ensure safe water and reduce waterborne diseases.
- **Water Conservation:** DWTS treat water for non-potable uses, reducing freshwater demand.
- **Cost-Effectiveness:** They are often cheaper and more energy-efficient than centralized systems.
- **Community Engagement:** Implementing DWTS involves community participation and education on wastewater management.
- **Accessibility:** DWWTS provide wastewater treatment in areas without access to centralized plants, benefiting remote rural and semi-urban communities.
- **Flexibility:** They offer adaptable solutions for diverse settings, treating wastewater from individual homes to entire communities.
- **Sustainability:** Implementing private operations aligns with government policies on public-private partnerships (PPPs) and utility management

Introduction:

Institutional and Regulatory framework for DWWM

- **National Water Strategy 2023-2040:**
  - Aims to expand sanitation services and improve infrastructure using decentralized systems where suitable.
  - Focuses on efficient management considering health, hygiene, and environmental concerns.
- **Decentralized Systems Benefits:**
  - Provides wastewater treatment in remote areas, promoting water recycling for sustainability.
- **Reuse Guidelines and Clusters:**
  - Sets quality standards for treated wastewater reuse from smaller plants.

Institutional and Regulatory framework for DWWM



SDG - Goal 6 Targets ….. By 2030

6.1: Ensure everyone has access to safe and affordable drinking water by 2030.

6.2: Achieve access to adequate sanitation and hygiene for all, especially focusing on ending open defecation and addressing the needs of vulnerable groups by 2030.

6.3: Improve water quality by reducing pollution, minimizing hazardous, treating wastewater, and promoting recycling and safe reuse by 2030.

6.4: Increase water-use efficiency across all sectors,

6.5: Implement integrated water resources management

6.6: Protect and restore water-related ecosystems

6.A: Provide support and capacity building ……., including wastewater treatment technologies

6.B The participation of local communities in improving water and sanitation management

Five-Step-Technology Selection Procedure for wastewater treatment plants with a design capacity of up to 5,000 PE

Step One:

Data acquisition/quality assessment of basic data

Step Two:

Develop and confirm selection criteria

Step Three:

Develop and confirm weighting of selection criteria

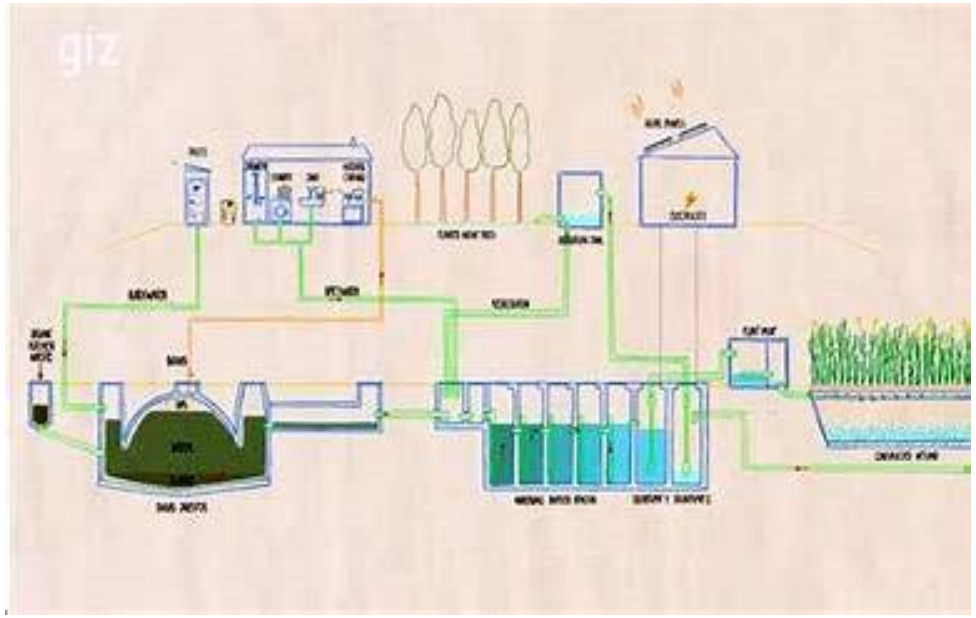
Step Four:

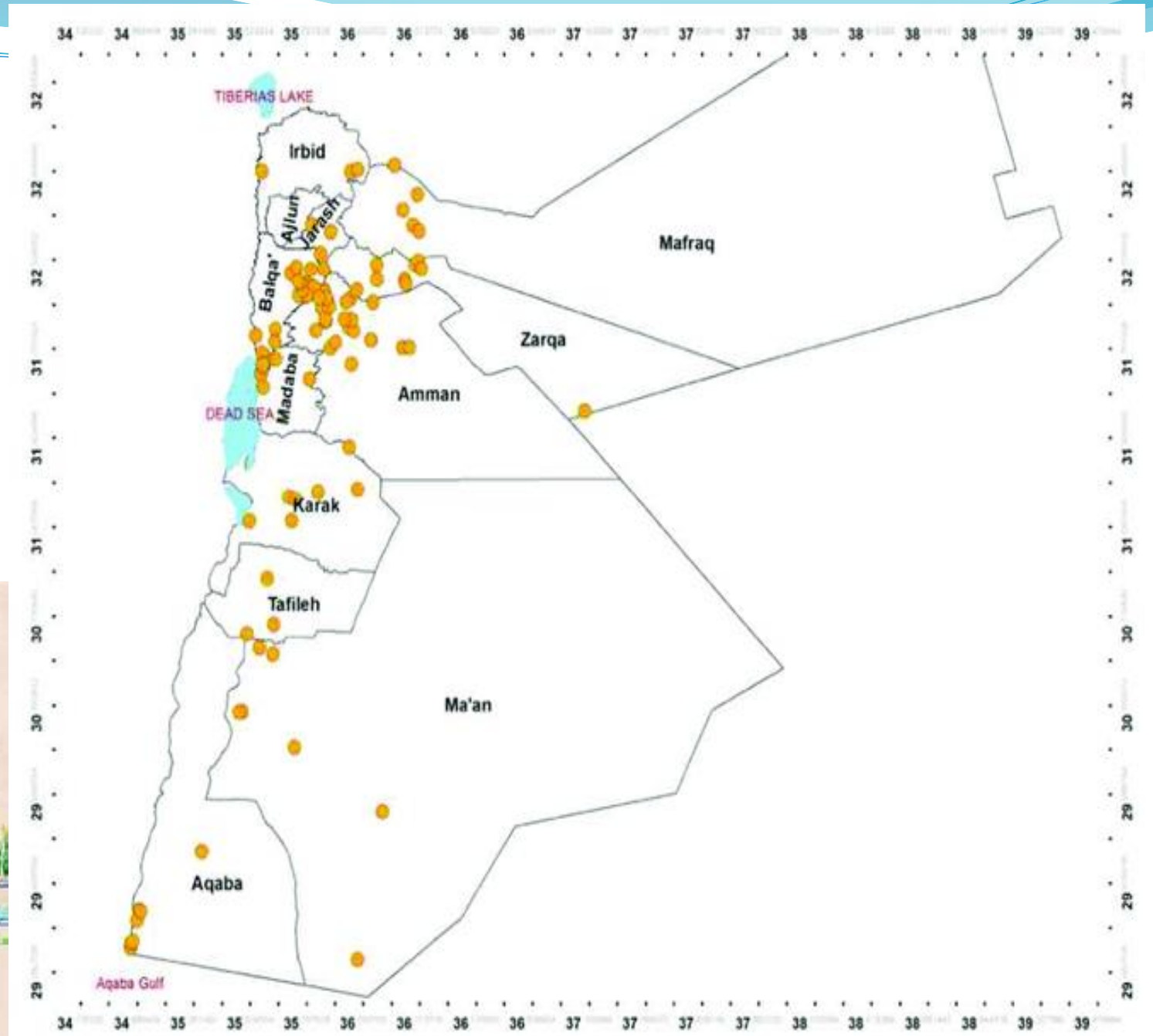
Analysis of the technology against each of the agreed and weighted criteria

Step Five:

Ranking of all technologies based on combined scoring and weighting results

Locations-of-the-85-identified-decentralized-wastewater-treatment-plants





Business Model Concept

- **Business models are defined by two categories "who do what" and "who pays for what".**
- **The first part** "who do what "concerned how to run the project, legal and administrative issues, ownership, choice of treatment technology, revenues collection.
- **The second parts** "who pays for what" the attention is to define the user groups who will contribute to the revenues of the WW services, degree of aggregation, and clustering service provision.

Objectives

- **Assessment of Current Status:** Evaluate existing DWWM framework, including institutions, laws, roles, and coordination.
- **Recommendations for Improvement:** Provide concise policy suggestions to enhance DWWM setup and coordination.
- **Exploring Business Models:** Discuss potential DWWM business models considering economic, environmental, technical, legal, managerial, regulatory, and social aspects.

Methodology

- **Business Model Development:** In-depth research to develop a business model for decentralized wastewater treatment systems (DWTS).
- **Case Study Selection:** Rasoon village in Ajloun was selected due to its relevance to Jordanian rural conditions and groundwater vulnerability, gathering crucial data for detailed investigations.
- **Stakeholder Engagement:** Involved key stakeholders through focus group discussions and interviews with local officials and private vendors related to DWTS implementation.
- **Challenges and Solutions:** Identified and analyzed challenges in legislation, financing, construction, operation, and maintenance for sustainable DWTS,.
- **Financial Modeling and Sustainability:** Conducted thorough financial modeling including infrastructure costs, operational expenses, revenue streams, ensuring the financial sustainability of the proposed DWTS business model.

Results : Population Pressure and Demand:

- **Sanitation Infrastructure and Financing**:

  Sewer system coverage is at 68% in 2022, funded by government sources, international aid, and household water bills.

- **WW Treatment Challenges and Reuse:**

  Inefficient wastewater treatment plants struggle to meet standards, with treated wastewater mainly reused for agriculture.

- **Sanitation Methods and Concerns:**

  Safe sanitation coverage is high but relies on septic tanks or less ideal cesspits, posing pollution risks and maintenance challenges.

- **Private Systems and Risks:**

  Areas without public systems use private disposal methods like cesspools, which can lead to pollution and maintenance issues.

The challenges to the business model in DWWM:

- **Institutional Challenges:**
  - Lack of clarity in institutional roles, ownership, and maintenance responsibilities.
  - Inadequate regulatory framework and certification for operations and maintenance (O&M) systems.
- **Private Sector Engagement Factors:**
  - Long-term financial viability requires stable regulatory and financial conditions, including tariff clarity and subsidy commitments.
  - Consumer support and willingness to pay for services are crucial for sustainability.
  - Commitment from stakeholders and collaborative support from institutions are needed for sustained revenue streams and broader societal benefits.
  - Meeting investor expectations for positive cash flow, returns, and margins is essential for private sector participation.

Ownership Models and Challenges:

- Ownership ranges from state/municipal bodies to commercial/private operators, each with advantages and disadvantages.
- Efficiency differences between public and private sectors are debated, with both facing inefficiencies.
- Municipal or community ownership is favored in Jordan due to land acquisition challenges, aligning with public interest laws.

- **Ownership Pros and Cons Summary:**
  - Public Utility: Secured funding, but higher costs.
  - Associations: Transparent, but limited rural coverage.
  - Municipal Enterprises: Funding options, but political influences.
  - Municipal Departments: Flexibility, but lacks technical capacity.
  - Commercial Companies: Private investments, but limited funding options.
  - Small Private Operators: Efficiency, but limited capacity.

Summary of the business model concept for DWWM:

- **Purpose:** Sanitation coverage and wastewater (WW) treatment, solid waste management.
- **Target Customers:** Institutions, industries, rural, and semi-urban populations.
- **Strategies:** Public service provision, private sector participation, or involvement.
- **Infrastructure:** Sewers System, DWWTPs, reuse systems.
- **Organizational Structures:** Public companies, subordinated water companies, municipalities, private sector (enterprises/companies), cooperatives.
- **Ownership:** Sole, public, shared, community ownership.
- **Capital Investment (CAPEX):** Private sector, public sector, municipalities.
- **Source of Finance:** Private sector, DBO (Design-Build-Operate), BOT (Build-Operate-Transfer), government, loans, donations, international cooperation.
- **WW Treatment Technologies:** Sophisticated or natural-based treatment.
- **Trading Practices:** Connection fees, emptying fees, tariffs, revenues from sales.
- **Operational Processes:** Collection, transport, treatment, reuse.
- **Culture and Social Factors:** Social acceptance, willingness to cooperate, religious aspects, affordability.

Summary of the economic and financial viability of the business model for DWWM:

- **Pilot Project in Rasoon Village:**
  - Utilized 2-stage vertical flow constructed wetland for effective wastewater treatment meeting quality criteria.
- **Business Model Options:**
  - Option (1): Relies on tariffs, state budgets, and effluent sales for funding.
  - Option (2): Focuses on selling treated wastewater for agricultural use, requiring maintenance and sales activities.
- **Financial Analysis:**
  - Capital investment estimated at JD 1.54 million, annual operational expenditure JD 45,800, with potential revenue from reused effluent.
  - Tariffs adjusted yearly to cover expenses, return on investment, and profit margin, but challenges remain in matching tariff levels and reducing consumer burdens.
- **Key Findings:**
  - Average incremental cost (AIC) per cubic meter ranges from JD 0.63 to JD 0.77, depending on project lifespan.
  - Operational costs higher in dispersed areas, requiring higher tariffs but within affordability constraints.
  - Limited opportunities for revenue generation, posing uncertainty and deterring operator interest.

Private-sector partnership options for wastewater treatment

- **Partnership Options:**
  - Acquisition, Divestiture: Public facility sold to private partner for private ownership and operation.
  - Joint Venture: Private and public partners co-own facility.
  - Concession or BOT (Build-Operate-Transfer): Private partner builds, owns, operates facility; transferred to public partner later.
  - Turnkey Facility: Private partner designs, constructs, operates facility; public partner retains ownership.
  - Full-Service Contract: Private partner operates and maintains facility, public retains ownership.
  - Contract Operations: Private partner operates public partner's facilities.
  - Contract Management: Private partner manages and supervises public partner's personnel.
  - Operations Assistance: Private partner aids in transition or program management for public partner.
- **Stakeholder Concerns:**
  - Resistance to full privatization due to profit-driven concerns, limited access, and unequal distribution.
  - Balanced approach needed for private efficiency with public oversight to ensure affordability, quality, and accountability.

Proposed management of DWWMs:

- **Service Contracts:**
  - Cover labor for repair and maintenance, with equipment purchase by the facility owner.
  - Includes preventive maintenance and some operations, but major equipment installation is the owner's responsibility.
  - Cost-effective initially but may pose challenges in budgeting for emergency repairs.
- **Management Contracts:**
  - Enhance services and reduce government risks.
  - Improve system efficiency and service quality, driving organizational reforms.
  - Doesn't require capital investment from the management firm, funded by public budget or external sources.
- **Comparison in Jordan:**
  - Service Contracts: Grant access to private expertise, lead to efficiency improvements, but limited impact on overall utility management.
  - Management Contracts: Enhance services, reduce risks, but require government financing for capital and some operational investments.

Regulation and control for sustainable DWWM in Jordan

- **Setting Standards for DWWM:**
  - Need for tailored standards for effluents from decentralized systems alongside a distinct monitoring framework.
- **Establishment of a Monitoring System:**
  - Use of reliable monitoring technology, including remote monitoring, to ensure efficient DWWM operations.
- **Update and Amendment of Legislations:**
  - Introduce penalties for non-compliance with effluent standards, following polluter-pay principles, and adjust treatment fees.
- **Certification Body for Technology and Operation:**
  - Establish a certification body (e.g., JSMO) for technology and operation to ensure compliance and reduce monitoring frequency.
- **Contract-Based Service Performance:**
  - Foster a competitive market for outsourcing O&M services for smaller DWWTPs to the private sector, overseen by a national regulator.
- **Institutional Coordination and Roles:**
  - Ensure skilled operators and staff for O&M, with clear roles and responsibilities, for successful and sustainable management of decentralized WW infrastructure.

Conclusions and Recommendations

- **Governance Challenges:**
  - Lack of clear institutional and legal arrangements for DWWM in Jordan leads to role confusion despite MWI assigning management to WAJ.
- **Prioritizing Rural DWWM:**
  - Small-scale DWWM in rural areas faces higher costs, leading to challenges in sustaining services without subsidies, despite tariffs within affordability estimates.
- **Revenue Avenues:**
  - Limited options like selling wastewater to agriculture or obtaining carbon credits are insufficient to reduce tariffs, requiring public budget support for capital investments to attract private investors.
- **Service Contracts and Regulations:**
  - Specific regulations and economic incentives are needed for service contracts in smaller areas to ensure high-quality services and financial viability.
- **PPP Viability:**
  - Privatization through PPPs like BOT, BOOT, DBO, DBFO, DCMF is applicable for large-scale WW projects and can be adapted for DWWM with guaranteed revenues and treated wastewater volumes.
- **Adapting to Arid Environments:**
  - In arid regions, adapting design paradigms, promoting water reuse, and considering environmental impacts are crucial for sustainable wastewater treatment solutions.
- **Comparative Analysis for Improvement:**
  - Aligning regulatory frameworks, enhancing private sector engagement, and involving communities are key areas for improving DWWM globally, requiring innovative and adaptable strategies.

Recommendations

- **Establish a Monitoring Body:** Create a dedicated monitoring unit within MWI for DWWMS, to streamline monitoring responsibilities.
- **Encourage PPPs:** Promote Public-Private Partnership schemes for infrastructure development and sanitation system management, reducing immediate cash spending and involving private expertise.
- **Consider Site-specific Solutions:** Opt for economically feasible and environmentally sustainable wastewater systems tailored to specific locations,
- **Introduce Certification Procedures:** Implement certification processes for technology and operations to ensure adherence to standards and enhance system reliability.
- **Implement Remote Monitoring:** Utilize advanced sensor technology for reliable remote monitoring systems, and reducing onsite monitoring needs.
- **Diverse Financing Models:** Explore financing models that incentivize private sector involvement through subsidies, service leasing, tax exemptions, and international assistance.
- **Adapt Regulations:** Develop regulations considering the effectiveness of small and decentralized treatment systems, promoting decentralized wastewater treatment and reuse at a local scale while meeting regulatory standards.