UN environment programme | CTCN UN Climate Technology Centre & Network

Funded by the European Union

RAINWATER HARVESTING

Capturing rain for water security and community resilience

Objective: Climate adaptation and mitigation

Approach: Community based | Disaster risk reduction | Ecosystems and biodiversity | Gender

Benefits

- Health and hygiene benefits
- Time savings, economic opportunities
- Flood mitigation and prevention of soil erosion
- Flexible, multiple uses
- Water conservation and security
- Reduces pressure on central water infrastructure

1. Problem articulation
2. Invention and design
3. Prototyping and training
4. Monitoring, regulation and standards
5. Commercialization
6. Diffusion and scaling

Step-by-step implementation

Rainwater harvesting systems

Globally, rainfed agriculture is practised on 80% of cultivated land, supplying more than 60% of the world's food.[1] Amid increasing variability of global rainfall patterns and more frequent droughts driven by climate change, rainwater harvesting can serve as a valuable climate adaptation and mitigation strategy, providing a sustainable alternative water source.

Rainwater harvesting refers to a range of methods for collecting and storing rainfall using water pans, tanks, reservoirs and dams to help sustain water supply during dry spells and droughts. The catchment area is the area where the rainfall or water runoff is initially captured and is in most cases either the roof-top of a house or building, ground surface or rock surface.

Rainwater harvesting systems are commonly constructed from one of three methods:[2]

- **Rooftop:** rainwater is collected in vessels at the edge of the roof or channeled to a storage system via gutters and pipes.
- **Ground surface:** water flowing along the ground during rainfall is diverted toward a tank below the surface.
- **Rock surface:** Bedrock surfaces found within rocky top slopes or exposed rock outcrops in lowlands often have natural hollows or valleys which can be turned into water reservoirs by building a dam.

Sudan

Rainwater harvesting in practice

Location
Sudan

Duration
December 2024–December 2025 (12 months)

Implementing partner
AidEnvironment and RICOS Engineering

National designated entity
Higher Council for Environment and Natural Resources

Project proponent
Water Research Center, University of Khartoum

Funder
European Union, through UN CTCN

Other key stakeholders
Ministry of Irrigation and Water Resources, Agricultural Research Corporation

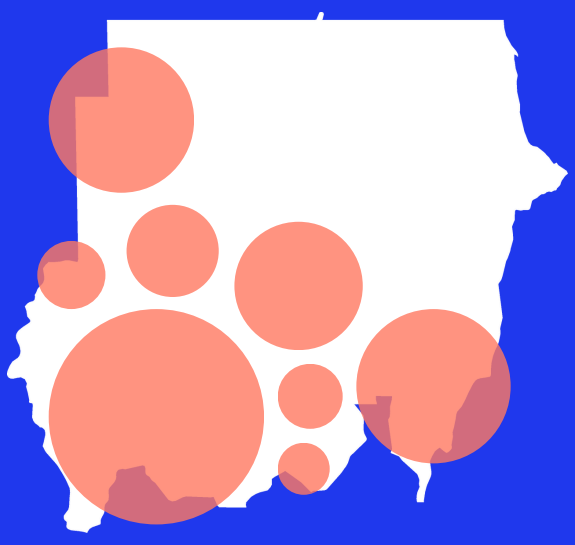
Rainwater harvesting for agriculture, Sudan

Sudan faces severe climate change impacts including higher temperatures, prolonged droughts, floods, and unpredictable rainfall, which undermine crop yields and rural livelihoods. **This drives competition and conflict over scarce water, especially between farmers and pastoralists. Half of Sudan's population lives on 15% of the land, mostly near the River Nile.** However, about two-thirds of the population depend on rain-fed agriculture, which is highly vulnerable to changing climate conditions.[3] Civil war since 2023 has compounded these challenges by disrupting agriculture, limiting access to inputs and water, and deepening food insecurity.

Sudan's adaptation strategies – outlined in its National Adaptation Plan, National Communications, and National Adaptation Programme of Action – prioritize water and agriculture. Key measures include water harvesting, efficient irrigation, integrated watershed management, and improved water governance. Technology Needs Assessments and subsequent plans highlight the importance of adopting appropriate water harvesting methods, renewable energy integration, and revolving funds to support small projects.

Two-thirds of the population depend on rain-fed agriculture, which is highly vulnerable to changing climate conditions.

With frequent droughts and high evaporation rates – conditions that are expected to worsen with climate change – water harvesting technologies are increasingly viewed as essential to sustain rural livelihoods in Sudan. Sudan possesses a diverse portfolio of traditional and modern water harvesting technologies, from ancient hafirs and half-moon terraces to sand dams and recharge basins, each with distinct ecological, hydrological and socio-economic functions. The pilot project *Improving the Efficiency and Sustainability of Water Harvesting Technologies through Capacity Building, Technology Transfer, and Research* set out to assess current rainwater harvesting technologies in Sudan, evaluate their effectiveness, propose alternative technologies, pilot a selected technology (where feasible), and train relevant stakeholders.



Achievements

1 Gender analysis

An analysis of gender roles and the involvement of women (and youth) in water harvesting technologies across 15 sites in Red Sea and Kassala states. The report provides recommendations for addressing gender disparities in water interventions, crucial for designing effective and meaningful water interventions.

2 Technology analysis

An evaluation of 12 existing water harvesting technologies and practices in Sudan. The assessment serves as a technical reference and strategic planning tool for practitioners, policymakers, and development partners working in water resource management, climate resilience, and sustainable land use. In addition, four in-depth case studies and a catalogue of new fitting technologies were identified, along with the onset of a spatial tool for practitioners.

3 Financial, capacity and market analysis

An assessment of the financial, market and capacity dimensions of nine different water harvesting technologies in Sudan, offering practical guidance for future water inventions.

4 Capacity and knowledge analysis

Practical insights to develop a more decentralized, learning-oriented model of water harvesting support, one that values local knowledge, enables adaptive practices, and builds durable institutions around water infrastructure.

Local officials at drinking water source commissioning, Liwa, Chad

© Jean Bataka

Looking ahead

Since the outbreak of armed conflict in April 2023, water harvesting operations across Sudan have been severely affected. The supply of essential construction materials has been disrupted, governance structures collapsed or ceased to function in many areas, leading to the absence of institutional continuity and oversight. In addition, with many skilled professionals leaving the country, this has left a shortage of human resources and skills, hampering research and development. As a result, both public and donor-supported investments in water infrastructure have come to a near standstill, with the responsibility falling to informal or community-managed systems.

The project found that gender dynamics significantly influence how water interventions impact community members in Sudan.

Women and girls in Sudan bear primary responsibility for household water, sanitation, and hygiene, yet are often excluded from water management decisions, leading to inefficiencies and neglect of their needs. The gender analysis recommends improving women's direct and safe access to water points, involving women in planning processes and water management committees, and providing training for women in water governance and livelihood activities.

Future water harvesting in Sudan must use realistic financial models, conflict- and gender-sensitive approaches, and technologies matched to specific needs. Despite the challenging context, scalable solutions remain possible by leveraging existing infrastructure, local capacity, and designs built for resilience. Community-led systems represent a particularly resilient approach under current conditions.

"By aligning technology selection with specific water needs, understanding true lifecycle costs, and designing for resilience in fragile environments, water harvesting in Sudan can play a critical role in strengthening both livelihoods and water security."

– AidEnvironment and RICOS Engineering

Key considerations and recommendations

Drawing from UN CTCN pilot projects, the following lessons can guide National Designated Entities and other stakeholders in the development and implementation of rainwater harvesting technologies:

1 Advance gender integration →

Advance gender integration across all stages of water interventions by ensuring safe and accessible water points, promoting inclusive decision making, and providing targeted training to strengthen women's capacity in water governance and related livelihoods.

Using technology selection tools, closely evaluate the best solution for the context, since the effectiveness of a water harvesting technology depends on a complex interplay of factors, including local rainfall patterns, soil and geological conditions, land use, and community capacity.

← **2 Closely evaluate the best solution for the context**

3 Use adaptive, confict-sensitive approaches →

Implement rainwater harvesting technologies using adaptive, conflict-sensitive approaches in fragile settings, matching technologies to specific needs.

To ensure that benefits endure over time, strengthening community ownership and institutional capacity is key. In contexts of conflict, as public and private investment gets diverted, community-led innovation becomes increasingly important.

← **4 Strengthen community ownership and improve institutional capacity**

5 Embed capacity building in practice →

Embed capacity building in practice, with an emphasis on field-based learning over classroom instruction. Establishing practical demonstration sites can create training hubs where local implementers, engineers, and community members learn by doing. At the community level, training key individuals, such as young people or respected local figures, and offering follow-up support and mentoring can strengthen skills, promote ownership, and ensure continuity despite institutional gaps.

To support planning and avoid duplication of efforts, share local knowledge and experience by creating adaptive learning environments and collecting, curating and distributing local knowledge. For example, developing a centralized platform that consolidates technical manuals, pilot experiences, environmental data, and contextual insights, and through regular consultations and knowledge exchanges between stakeholders.

← **6 Share local knowledge and experience**

7 Develop financial sustainability models →

To ensure the long-term viability of rainwater harvesting systems, employ financial sustainability models such as through affordable user-fee structures, public–private partnerships, and innovative financing options. Embedding financial planning from the outset can help to encourage local investment and strengthen community ownership.

Encourage greater engagement with international good practices to introduce and adopt new climate technologies and approaches and upgrade design standards, combined with lessons from existing projects and local knowledge.

← **8 Engage with international good practices**

9 Implement integrated planning →

Implement integrated catchment-level planning to enhance the sustainability and equity of water access.

References

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