

Groundwater conservation

Republic of Yemen

water scarcity impact

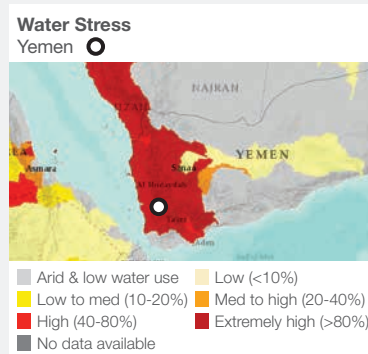


Reduced withdrawal	●
Reduced consumption	
Improved water quality	
Increased productivity	●
Net basin benefit	●

volumetric impact
83 000 000 m³/yr

programme cost
\$56 000 000

estimated unit cost of water
5¢/m³



Water Stress Map:
Gassert, F., M. Landis, M. Luck, P. Reig, and T. Shiao. 2013. "Aqueduct Global Maps 2.0."

Confidence level
● Low ● Medium ● High

Water Scarcity Impact Key
● Main ● Minor

Credits
We wish to acknowledge the input of Yoshiharu Kobayashi (The World Bank) in the preparation of this case study.

Project Overview

Yemen is a water scarce country and is reliant on groundwater as its primary source of its water supply, 90% of which is used for agriculture using water intensive irrigation practices. Abstraction from deep aquifers has resulted in rapid decline in its groundwater resources, not only increasing the cost of abstraction but also reducing the country's ability to meet its current and future needs.

The Government of Yemen, in collaboration with The World Bank, implemented the ground water conservation project in 10 of the 13 catchments in the country, with focus on sub-catchments where aquifer depletion rate was most critical. An integrated approach using a combination of supply side and demand side interventions was implemented to increase the available supply as well as to reduce the demand on groundwater. Water User Associations were created to help educate the farmers about water efficient irrigation practices, improve communications between government officers and farmers, and to help monitor and regulate abstraction of groundwater.

The project not only surpassed its objectives of improving the sustainability of the groundwater resources, it also achieved a 6% to 15% increase in crop yield per unit of irrigation water and strengthened key institutions that work and assist the agricultural sector.

Key Elements

- Integrated approach focussing on technical, social and institutional measures.
- A tripartite agreement to prevent increases in irrigated areas and thus increased demand for water.
- Improved conveyance and distribution systems reducing evaporative losses.
- Use of water efficient agricultural practices requiring less water.
- Increased on site water retention and ground water recharge.
- Increased use of spate irrigation to reduce reliance on groundwater.

Key Outcomes

- 83 000 000m³ of water saved per year.
- A 6% to 15% increase in the crop yield per unit of irrigation water.
- Reduction in depletion rate of deep aquifers.
- Improved monitoring and governance of water resources.
- Creation of 2 582 water user associations, representing over 39 000 farmers, to monitor and manage local water resources and irrigation abstraction in coordination with the government officials.



Republic of Yemen

Intervention Features

- Sprinkler irrigation systems
- Bubbler irrigation systems
- Drip irrigation systems
- Replacement of channels with pipes
- Groundwater recharge
- Rainwater harvesting
- Institutional reform
- Education, technical training and capacity building
- Stakeholder engagement

Project Levers

The project was financed with a mixture of loans (\$40m), grants (\$15m) and from a trust fund (\$1m) and focussed on a combination of supply side and demand side interventions.

(1) Improvements to water distribution system:

Above ground galvanised iron pipes and below ground PVC pipes replaced open channels to reduce losses due to evaporation and leakage, and improved the water distribution in 27 000 ha of irrigated land.

(2) Installation of water efficient irrigation system:

Drip, bubbler and sprinkler irrigation systems were installed in some of the fields to reduce the volume of water that was previously lost through water intensive irrigation practices.

(3) Improvement of spate irrigation schemes:

A large area is irrigated through seasonal floodwaters (spate irrigation). New embankments were constructed and existing embankments structurally improved to help retain the water on the fields.

(4) Rainwater harvesting schemes:

The provision of water supplies for use by people and animals was improved by construction of on-farm storage ponds and underground cisterns for rainwater harvesting.

(5) Groundwater recharge schemes:

Existing upland terrace walls and water harvesting dams and ponds were rehabilitated and new ones constructed to improve ground water recharge through increased retention and infiltration of overland flows.

(6) Monitoring of groundwater levels and abstractions:

Ground water monitoring levels and borehole flow meters were installed to monitor and regulate abstraction of groundwater. This helped farmers understand the relationship between abstraction and ground water levels and improved enforcement capabilities.

(7) Institutional strengthening of water institutions:

Training of the field officers helped to strengthen the irrigation policy formulation units in the Ministry of Agriculture and Irrigation and the Central Water Monitoring Unit. An Irrigation Advisory Service was created within the Ministry to assist field officers with the on-farm monitoring and liaison with Water User Associations.

(8) Creation of Water User Associations:

Water User Associations were created to educate farmers and to provide a forum for open communication about local water issues. They were also provided with data from the local groundwater monitors and borehole flowmeters to assist the field officers to monitor and regulate the abstraction.

(9) Tripartite agreement to prevent extension of irrigated area:

To ensure the farmers did not increase the extent of their irrigated area with the saved water, a tripartite agreement was made between beneficiary farmers, project field offices and the local Water User Association.

Outcomes and Challenges

The project achieved between 6% to 15% increase in crop yields with reduced water use. It also achieved annual savings of 83 000 000m³ surpassing its initial objective of 47 000 000m³. These savings were achieved through a combination of supply side and demand side measures.

The improvements in groundwater levels and lack of increase in irrigated land, as validated by satellite imagery, have confirmed the effectiveness of the Water User Association in helping to regulate local water abstraction and expansion of irrigated land.



Above: Agricultural terraces near At Tawilah, Yemen
(© Bernard Gagnon, Wikipedia - creative commons)