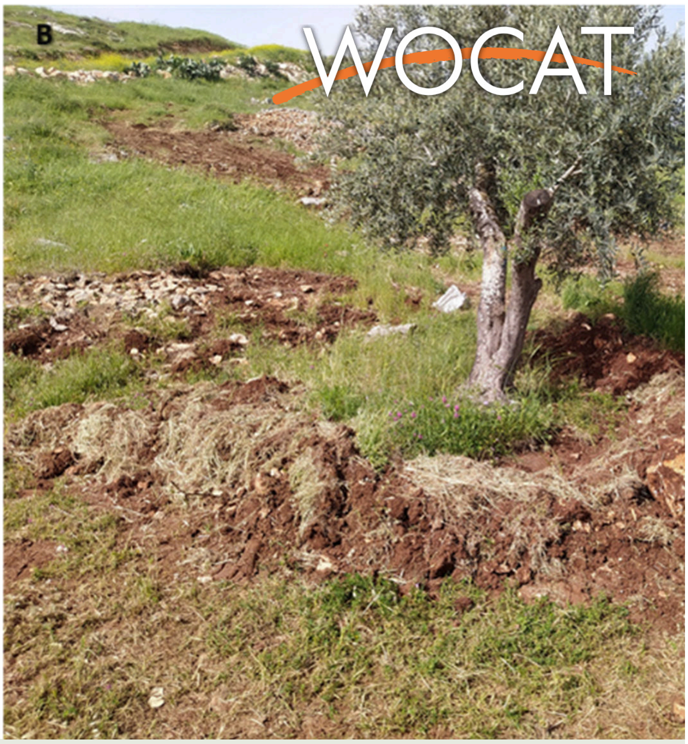


Water harvesting structures (semi-circular bunds) implemented at the Faqua’a site in Palestine using soil and stones (Left) and soil only (Right). (ARIJ)

Rainwater Harvesting for Olive Production (Palestine, State of)

DESCRIPTION

Microcatchment water harvesting captures, stores and allows safe overflow of excess surface runoff collected during heavy rainfall events. The intercepted and deep-infiltrated water enhances soil moisture at/around the microcatchment structure. This eventually boosts plant productivity in dry areas, mitigates land degradation, and benefits the local farming communities’ livelihoods

In Palestine, rainfed olives are traditionally cultivated within undulating landscapes with an average annual precipitation ranging between 400 and 700 mm. Olive trees are well known for their resilience to droughts. However, degraded and steeply sloping areas have limited water infiltration and storage capacity: a large proportion of rain forms surface runoff, further speeding up land degradation through erosion and the removal of fertile topsoil, leading to decreased soil health and productivity. The International Center of Agriculture Research in Dry Areas (ICARDA) among others, recognised these issues and superimposed microcatchment water harvesting structures on existing rainfed olive trees in marginal and degraded drylands of Palestine. This technique aims to improve yields by increasing soil moisture through capturing runoff and enhancing infiltration. Thereby, it also decreases the potential for land degradation through surface runoff. This has positive impacts on the local land users and land owners. These are often considered marginalised groups because they lack access to off-farm work and finance to invest in their farms. Additionally, these farmers are directly experiencing the negative impacts of climate change, such as more frequent droughts which can be linked to declining yields, and decreasing farm income. Depending on local climate, topographic and soil conditions, olive trees are usually spaced 5-10 meters apart to avoid competition for water.

The land is first surveyed and then the microcatchment water harvesting structures (technically termed “semi-circular bunds”) are designed with the tips of the structures on the contour. They are constructed around 0.5 meters downslope of each olive tree in a semi-circle of around 4 meters diameter. The structures are created through stone foundation and bunds topped with a compacted soil layer. The height of the structures varies between 0.3 meters and 1.2 meters. As a first step, stones are placed and fixed in a semi-circular shape. Secondly, the soil inside the structure is slightly levelled. Thirdly, more stones are placed to heighten the bunds. Lastly, excavated and surround soil is put over the stones and thoroughly compacted. The estimation of establishment cost is 7 USD per meter of bund, implying a total cost of approximately 7000 USD per hectare.

The life-duration of the water harvesting system implemented in highly sloping areas, is estimated at 15 years with yearly maintenance cost estimated at 3 USD per tree – 300 USD per hectare. Without maintenance, the life-cycle of the system will be less.

Land users appreciate the technology because it improves their olive yields and thus income. They state that the topsoil maintained in situ, and the improved soil moisture, have positive effects on their harvest. Land users also acknowledge that implementing and maintaining increases the workload. Nevertheless, due to the local material requirements, the costs are low and thus perceived as positive.

Data presented in this documentation are partly made available under the project 'Testing and Out-scaling in situ Water Harvesting Technologies in Palestine' led by ICARDA in collaboration with the Applied Research Institute Jerusalem, Palestinian Ministry of Agriculture, and National Agricultural Research Centre in Palestine. The project is under the Food and Agriculture Organization of the United Nations (FAO) – a regional project “Implementing the 2030 Agenda for water efficiency/productivity and water sustainability in NENA countries” directly under the Regional Water Scarcity Initiative. The Swedish International Development Cooperation Agency funded the project.

LOCATION

Location: Palestine, State of

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 35.23605, 31.95392

Spread of the Technology: evenly spread over an area (approx. 0.1-1 km2)

In a permanently protected area?: No

Date of implementation: 2021

Type of introduction
- [ ] through land users' innovation
- [ ] as part of a traditional system (> 50 years)
- [x] during experiments/ research
- [x] through projects/ external interventions


An older water harvesting structure (ARIJ)


Freshly implemented water harvesting structure (ARIJ)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose
- [x] improve production
- [x] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [ ] reduce risk of disasters
- [x] adapt to climate change/ extremes and its impacts
- [ ] mitigate climate change and its impacts
- [x] create beneficial economic impact
- [ ] create beneficial social impact

Land use
Land use mixed within the same land unit: No


Cropland
- Tree and shrub cropping: olive

Is intercropping practiced? No
Is crop rotation practiced? No

Water supply
- [x] rainfed
- [ ] mixed rainfed-irrigated
- [ ] full irrigation

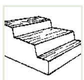
Purpose related to land degradation
- [x] prevent land degradation
- [x] reduce land degradation
- [ ] restore/ rehabilitate severely degraded land
- [ ] adapt to land degradation
- [ ] not applicable

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion, Wg: gully erosion/ gullying, Wm: mass movements/ landslides

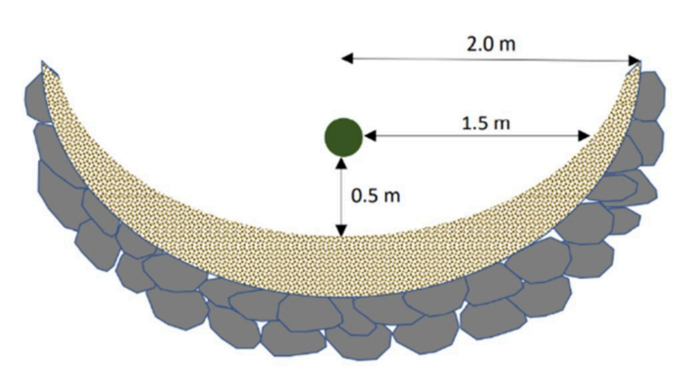

soil erosion by wind - Et: loss of topsoil

SLM group
- forest plantation management
- cross-slope measure
- water harvesting

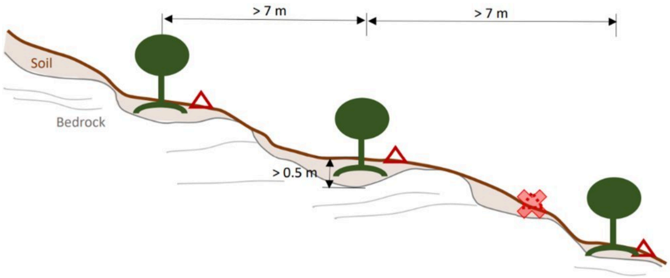
SLM measures

structural measures - S2: Bunds, banks, S7: Water harvesting/ supply/ irrigation equipment

TECHNICAL DRAWING

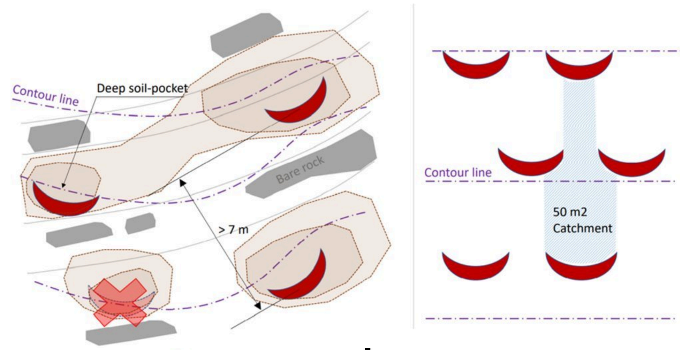
Technical specifications
Microcatchment rainwater harvesting design, with detailed cross-sectional (left) and top (right) views; definition of dimensions



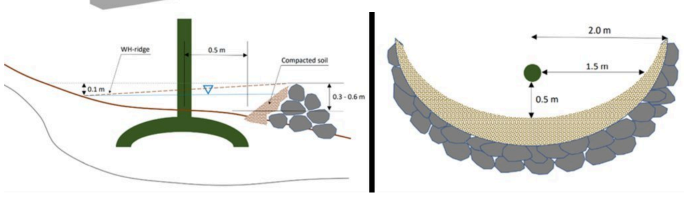
Microcatchment rainwater harvesting design in hillslope direction; definition of spacing constrained by the local 'soil pocket' hillslope pattern.



Microcatchment rainwater harvesting design from a top view; definition of minimum microcatchment areas contributing to the rainwater harvesting pits.



Microcatchment rainwater harvesting design, with detailed cross-sectional (left) and top (right) views; definition of dimensions.



ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **1 Hectare**)
- Currency used for cost calculation: **USD**
- Exchange rate (to USD): 1 USD = n.a
- Average wage cost of hired labour per day: n.a

Most important factors affecting the costs

n.a.

Establishment activities

1. Field survey for contours (Timing/ frequency: None)
2. Place Stones (Timing/ frequency: None)
3. Soil Removal (Timing/ frequency: None)
4. Stone bund around tree (Timing/ frequency: None)
5. Stone bund topped with excavated soil (Timing/ frequency: None)

Total establishment costs (estimation)

7000.0

Maintenance activities

1. Incidental repairs (Timing/ frequency: None)

Total maintenance costs (estimation)

300.0

NATURAL ENVIRONMENT

Average annual rainfall

- [ ] < 250 mm
- [x] 251-500 mm
- [x] 501-750 mm
- [ ] 751-1,000 mm
- [ ] 1,001-1,500 mm
- [ ] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

Agro-climatic zone

- [ ] humid
- [ ] sub-humid
- [x] semi-arid
- [ ] arid

Specifications on climate

n.a.

Slope

- [ ] flat (0-2%)
- [ ] gentle (3-5%)
- [x] moderate (6-10%)
- [x] rolling (11-15%)
- [ ] hilly (16-30%)
- [ ] steep (31-60%)
- [ ] very steep (>60%)

Landforms

- [ ] plateau/plains
- [ ] ridges
- [ ] mountain slopes
- [x] hill slopes
- [ ] footslopes
- [ ] valley floors

Altitude

- [ ] 0-100 m a.s.l.
- [x] 101-500 m a.s.l.
- [x] 501-1,000 m a.s.l.
- [ ] 1,001-1,500 m a.s.l.
- [ ] 1,501-2,000 m a.s.l.
- [ ] 2,001-2,500 m a.s.l.
- [ ] 2,501-3,000 m a.s.l.
- [ ] 3,001-4,000 m a.s.l.

Technology is applied in

- [ ] convex situations
- [ ] concave situations
- [x] not relevant

- [ ] > 4,000 m a.s.l.

Soil depth
- [ ] very shallow (0-20 cm)
- [x] shallow (21-50 cm)
- [ ] moderately deep (51-80 cm)
- [ ] deep (81-120 cm)
- [ ] very deep (> 120 cm)

Soil texture (topsoil)
- [ ] coarse/ light (sandy)
- [x] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Soil texture (> 20 cm below surface)
- [ ] coarse/ light (sandy)
- [x] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Topsoil organic matter content
- [ ] high (>3%)
- [x] medium (1-3%)
- [x] low (<1%)

Groundwater table
- [ ] on surface
- [ ] < 5 m
- [x] 5-50 m
- [ ] > 50 m

Availability of surface water
- [ ] excess
- [ ] good
- [ ] medium
- [x] poor/ none

Water quality (untreated)
- [ ] good drinking water
- [ ] poor drinking water (treatment required)
- [x] for agricultural use only (irrigation)
- [ ] unusable

Water quality refers to: surface water

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

Species diversity
- [ ] high
- [ ] medium
- [x] low

Habitat diversity
- [ ] high
- [ ] medium
- [x] low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [x] mixed (subsistence/ commercial)
- [ ] commercial/ market

Off-farm income
- [x] less than 10% of all income
- [ ] 10-50% of all income
- [ ] > 50% of all income

Relative level of wealth
- [x] very poor
- [x] poor
- [ ] average
- [ ] rich
- [ ] very rich

Level of mechanization
- [x] manual work
- [ ] animal traction
- [x] mechanized/ motorized

Sedentary or nomadic
- [x] Sedentary
- [ ] Semi-nomadic
- [ ] Nomadic

Individuals or groups
- [x] individual/ household
- [x] groups/ community
- [ ] cooperative
- [ ] employee (company, government)

Gender
- [ ] women
- [x] men

Age
- [ ] children
- [x] youth
- [x] middle-aged
- [x] elderly

Area used per household
- [ ] < 0.5 ha
- [x] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 2-5 ha
- [ ] 5-15 ha
- [ ] 15-50 ha
- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

Scale
- [x] small-scale
- [ ] medium-scale
- [ ] large-scale

Land ownership
- [ ] state
- [ ] company
- [ ] communal/ village
- [ ] group
- [x] individual, not titled
- [x] individual, titled

Land use rights
- [ ] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [x] individual

Water use rights
- [ ] open access (unorganized)
- [x] communal (organized)
- [ ] leased
- [ ] individual

Access to services and infrastructure

		1	2	3	
health	poor	✓			good
education	poor		✓		good
technical assistance	poor		✓		good
employment (e.g. off-farm)	poor		✓		good
markets	poor	✓			good
energy	poor	✓			good
roads and transport	poor	✓			good
drinking water and sanitation	poor	✓			good
financial services	poor	✓			good

IMPACTS

Socio-economic impacts

		1	2	3	4	5	6	7		
Crop production	decreased						✓		increased	
crop quality	decreased						✓		increased	
risk of production failure	increased						✓		decreased	Improved soil moisture provides resilience for droughts, reducing failure risk
land management	hindered			✓					simplified	Not damaging the bunds may hinder land management
expenses on agricultural inputs	increased			✓					decreased	Inputs for repair and implementation is required

farm income

decreased increased

Because soil moisture is increased, yield is as well and risk is decreased

workload

increased decreased

Building and repairing the bunds requires labour

Socio-cultural impacts

food security/ self-sufficiency

reduced improved

SLM/ land degradation knowledge

reduced improved

Local farmers were included in the process, improving their knowledge

situation of socially and economically disadvantaged groups (gender, age, status, ehtnicity etc.)

worsened improved

Ecological impacts

harvesting/ collection of water (runoff, dew, snow, etc)

reduced improved

surface runoff

increased decreased

soil moisture

decreased increased

soil cover

reduced improved

soil loss

increased decreased

soil accumulation

decreased increased

Off-site impacts

water availability (groundwater, springs)

decreased increased

downstream flooding (undesired)

increased reduced

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns

very negative very positive

Long-term returns

very negative very positive

Benefits compared with maintenance costs

Short-term returns

very negative very positive

Long-term returns

very negative very positive

CLIMATE CHANGE

Gradual climate change

annual rainfall decrease

not well at all very well

Climate-related extremes (disasters)

local rainstorm

not well at all very well

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology

- [x] single cases/ experimental
- [ ] 1-10%
- [ ] 11-50%
- [ ] > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?

- [ ] 0-10%
- [ ] 11-50%
- [ ] 51-90%
- [ ] 91-100%

Has the Technology been modified recently to adapt to changing conditions?

- [ ] Yes
- [x] No

To which changing conditions?

- [ ] climatic change/ extremes
- [ ] changing markets
- [ ] labour availability (e.g. due to migration)

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Increased yield
- Decreased land degradation

Strengths: compiler's or other key resource person's view

Weaknesses/ disadvantages/ risks: land user's viewhow to overcome

- Increases the workload In the current state this cannot be overcome. However, alternative structures may be considered e.g., pre -fixed.

- Reduced and reversed land degradation
- Increased yield

- Limited availability of suitable stones The purchase of stones or alternative materials such as wood or clay, or alternative structures such as pits.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome

REFERENCES

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Full description in the WOCAT database

https://qcat.wocat.net/en/wocat/technologies/view/technologies_6437/

Linked SLM data

n.a.

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Project
- ICARDA Institutional Knowledge Management Initiative

Key references

- Boubaker Dhehibi, Mira Haddad, Abdallah Alimari, Sameer Shadeed, Stefan Strohmeier, Issam Nofal, Anas Sayeh, Ibtisam I. O. AbuAlhaija, Mohammad Besharat, Imad Ghenma, Vinay Nangia. (6/3/2023). Potential Of Water Harvesting as a Strategic Tool for Resilience, Sustainable Livelihoods, and Drought Mitigation in the Olive Farming System in Palestine. Beirut, Lebanon: International Center for Agricultural Research in the Dry Areas (ICARDA).: https://hdl.handle.net/20.500.11766/68288

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