The three-storey Oasis of Gabes agroforestry system, where shallow tillage is practiced. Here there are palm trees (highest level), pomegranate and other fruit trees (middle level), and vegetables below. (Wiem Haouari)

Shallow tillage (15-20cm) (Tunisia)

In arabic (حراثة خفيفة (بعمق 15-20 سم،

DESCRIPTION

Shallow tillage involves disturbing the upper layer of soil without deep ploughing. It aims to provide a good seedbed, incorporate manure, control weeds, and enhance water infiltration while minimizing soil erosion and compaction. A machine tiller has recently replaced animal traction for this purpose.

Shallow tillage (15-20cm deep) involves disturbing the upper layer of soil and avoids deep ploughing. It aims to provide a good seedbed, while incorporating manure, controlling weeds, and enhancing water infiltration. Soil erosion is minimised, compaction is reduced and because deeper layers are not disturbed, less soil organic matter is oxidised.

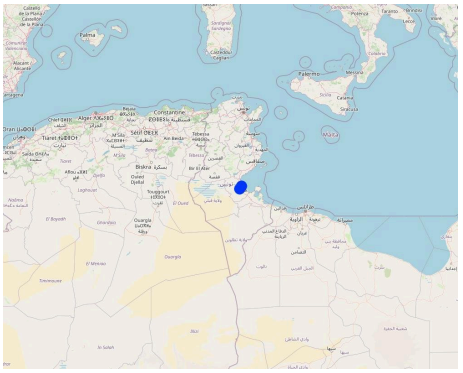
Shallow tillage - sometimes called “superficial” or “light” tillage – disturbs only the topsoil and brings several benefits. These include:

* Soil Structure Preservation: Maintains the underlying soil structure, reducing the risk of compaction and erosion.
* Moisture Conservation: Helps retain soil moisture by reducing evaporation from deeper layers.
* Reduced Erosion: Minimizes soil erosion by maintaining residues.
* Increased Microbial Activity: Promotes beneficial microbial activity in the topsoil, enhancing soil health.
* Nutrient Management: Allows for targeted application of fertilizers and amendments, as it primarily affects the upper soil layer.
* Time and Labour Efficiency: Generally, requires less time and fewer resources compared to deep tillage methods.

Smallholders in Gabes, South-East Tunisia practice shallow tillage and were interviewed to gain extra insights into this technology. They were welcoming and happy to share their knowledge while gaining information about enhancing their own production systems.

These smallholders farm in “The Oasis of Gabes” where there is a specific design of multi-storey agroforestry with trees, shrubs and vegetable crops. This requires specific agronomic practices. One of these practices is shallow tillage. A machine tiller has recently replaced animal traction for this purpose. They would prefer a no-till technique, however this would be more costly because it requires extra manure and soil cover by mulching or sand backfill. This may be possible for another category of farmers.

LOCATION



Location: Gabes, Gabes, Tunisia

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 10.00213, 33.79214
- 10.09221, 33.90435

Spread of the Technology: evenly spread over an area (approx. < 0.1 km2 (10 ha))

In a permanently protected area?: Nee

Date of implementation: more than 50 years ago (traditional)

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

This is tilled land that will be used for vegetable cropping. The tillage has been carried out by a semi automated tiller (minimum tillage), Owner of the land is Hedia Brahimi. (Wiem Haouari)

A second plot where the farmer has freshly applied light tillage in order to incorporate sheep manure. The farmer is Youcef Rehouma (Wiem Haouari)

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
- [x] 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: Ja - Agro-pastoralism (incl. integrated crop-livestock)

Cropland

- Perennial (non-woody) cropping: medicinal, aromatic, pesticidal plants - perennial
- Tree and shrub cropping

Number of growing seasons per year: 2
Is intercropping practiced? Ja
Is crop rotation practiced? Ja

Waterways, waterbodies, wetlands - Main products/ services: Drainage, it is the main traditional canalisation to drain excessive irrigation water from the oasis.

Unproductive land - Specify: Because of the raise of salinity amount ,lands are in degradation and many of them become unproductive

Water supply

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

Purpose related to land degradation

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

Degradation addressed

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

soil erosion by wind - Et: loss of topsoil

chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion), Cp: soil pollution, Cs: salinization/ alkalinization

physical soil deterioration - Pc: compaction, Ps: subsidence of organic soils, settling of soil

biological degradation - Bc: reduction of vegetation cover, Bh: loss of habitats, Bl: loss of soil life

water degradation - Ha: aridification, Hs: change in quantity of surface water, Hp: decline of surface water quality

SLM group

SLM measures

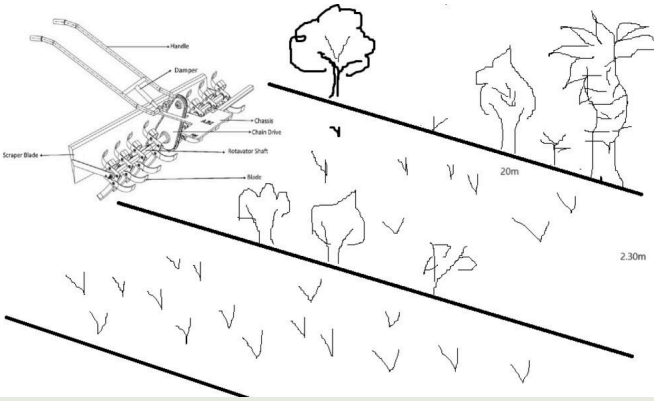
- improved ground/ vegetation cover
- minimal soil disturbance
- integrated soil fertility management

agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility, A3: Soil surface treatment (A 3.2: Reduced tillage (> 30% soil cover))

TECHNICAL DRAWING

Technical specifications

The figure is showing the main components of the rotavator. It is the mechanised tool used by oasian farmers. This type of tillage is the only one adapted to oasian ecosystem and small spaces. The boarders of every cultivated interculture space is bordered by trees, shrubs or palm trees.



Author: Wiem Haouari

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **are**; conversion factor to one hectare: **1 ha = 1are = 100square meter**)
- Currency used for cost calculation: **TND**
- Exchange rate (to USD): 1 USD = 3.07 TND
- Average wage cost of hired labour per day: 30-40

Most important factors affecting the costs

The most important factors affecting the costs are: the need to keep more moisture in the soil, good aeration for roots, improvement of soil texture and increase in organic matter.

Establishment activities

n.a.

Total establishment costs (estimation)

150.0

Maintenance activities

1. Exposing the soil to the sun to kill pathogens (Timing/ frequency: July-August)
2. Keeping the soil dry and more stable (Timing/ frequency: the mid final August)
3. Contracting with labour and machinery (Timing/ frequency: August)
4. Making the minimum tillage (it depends on the surface) (Timing/ frequency: September-October)
5. Tillage (Timing/ frequency: Twice a year)

Total maintenance costs (estimation)

350.0

NATURAL ENVIRONMENT

Average annual rainfall

- [x] < 250 mm
- [ ] 251-500 mm
- [ ] 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

Average annual rainfall in mm: 159.0
Gabès has dry periods in January, February, March, April, May, June, July, August, September, November and December.
On average, October is the wettest month with 26 mm of precipitation.
On average, July is the driest month with 0 mm of precipitation.
A wet day is one with at least 0.04 inches of liquid or liquid-equivalent precipitation. The chance of wet days in Gabès varies throughout the year.
Name of the meteorological station: Institut national de météorologie
In Gabès, the summers are hot, muggy, arid, and clear and the winters are cool, dry, windy, and mostly clear. Over the course of the year, the temperature typically varies from 46°F to 91°F and is rarely below 40°F or above 99°F.
A wet day is one with at least 0.04 inches of liquid or liquid-equivalent precipitation. The chance of wet days in Gabès varies throughout the year.

Slope

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

Landforms

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

Altitude

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

Technology is applied in

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

- [ ] steep (31-60%)
- [ ] very steep (>60%)

- [ ] valley floors

- [ ] 2,001-2,500 m a.s.l.
- [ ] 2,501-3,000 m a.s.l.
- [ ] 3,001-4,000 m a.s.l.
- [ ] > 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)
- [x] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [ ] fine/ heavy (clay)

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

Topsoil organic matter content
- [ ] high (>3%)
- [x] medium (1-3%)
- [ ] 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)
- [x] good drinking water
- [ ] poor drinking water (treatment required)
- [ ] for agricultural use only (irrigation)
- [ ] unusable

Water quality refers to: surface water

Is salinity a problem?
- [x] Ja
- [ ] Nee

Occurrence of flooding
- [ ] Ja
- [x] Nee

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

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

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

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

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

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

Gender
- [x] 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)
- [x] communal (organized)
- [ ] leased
- [x] individual

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

Access to services and infrastructure

health	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

Crop production

decreased ✓ increased

The farmer adopts rotation in crop systems, we can't then make a comparison for different yield of diffrent crops

crop quality

decreased ✓ increased

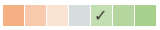
Farmers notice less pest attacks and better sweetness in vegetable tasting.

fodder production

decreased  increased

Farmers noticed better revenues in producing the main fodder specie of the Oasis, namely alfafa (Medicago sativa).

fodder quality

decreased  increased

The leaves were developed generously and there was more concentration of chlorophyll in leaves. We assumed this to higher concentration of soil nitrogen and phosphorus held in the soil.

animal production

decreased  increased

As there is abundance of weed intercrops, animals are taking enough fodder from grazing.

Socio-cultural impacts

food security/ self-sufficiency

reduced  improved

Better self supply and self sufficiency

cultural opportunities (eg spiritual, aesthetic, others)

reduced  improved

By using animal tillage, farmers have a myth that it is a sign of fortune for good agricultural season.

SLM/ land degradation knowledge

reduced  improved

Farmers need more direct contact with SLM specialists and agriculture engineers. The indicators mentioned before could be enhanced if combined by other synchronised measures.

Ecological impacts

soil moisture

decreased  increased

We noticed better retaining of water in the soil

soil cover

reduced  improved

Farmers are more aware about the importance of covered soil in order to avoid water and wind erosion.

soil loss

increased  decreased

By keeping the soil covered,soil loss has decreased.

soil accumulation

decreased  increased

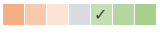
soil crusting/ sealing

increased  reduced

The intervention to make tillage is minimum and there is a recovery of the lost soil,that's why

Off-site impacts

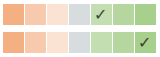
reliable and stable stream flows in dry season (incl. low flows)

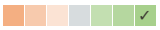
reduced  increased

The management of water resource referring to water availability is assured by the groupement de développement agricole Gabes centre

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 temperature increase: not well at all  very well

seasonal temperature increase: not well at all very well

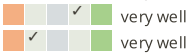
annual rainfall decrease: not well at all  very well

Season: summer

Climate-related extremes (disasters)

tropical storm: not well at all  very well

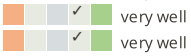
local sandstorm/ duststorm: not well at all very well

local windstorm: not well at all  very well

heatwave: not well at all very well

extreme winter conditions: not well at all  very well

drought: not well at all very well

epidemic diseases: not well at all  very well

insect/ worm infestation: not well at all very well

Other climate-related consequences
sea level rise

not well at all very well Answer: not known

ADOPTION AND ADAPTATION

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

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

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

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

Number of households and/ or area covered
120

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

- [x] Ja
- [ ] Nee

The technology was adapted through design and material - specifically the type of machine use for tillage.

To which changing conditions?

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

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- The technology has several virtues for Oasis ecosystem. Since it is a specific agriculture system, it requires constant interventions and various techniques. The technology allow farmers to care about their lands sustainably.
- The technique is not costly affecting the farmer
- The technique is adapted to the oasian ecosystem and the bioeconomy circumstances.

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

- The technique is not costly. Agriculture costs affect the decision of farmers in this area
- It is a revenue incoming for cultivator owners
- The timing adapted by farmers to till is very important. The technique enhances the manure and incorporation of fallen leaves. This enhances the amount and stability of organic material in the soil.

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

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

- It is a limited technique because of small plots of land expanding the cultivated area
- it requires physical effort encouraging precision mechanisation

REFERENCES

Compiler
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Editors

Reviewer
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Camilla Steinboeck

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Resource persons
Mohamed Raouf Mohamed Raouf Brahimi - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/af/wocat/technologies/view/technologies_7348/
Video: https://player.vimeo.com/video/1027738539

Linked SLM data
n.a.

Documentation was faciliated by

Institution
- FAO Tunisia (FAO Tunisia)

Project
- Groupement de développement agricole Oasis centre Gabes (GDA Oasis centre Gabes 2024)

Key references
- https://www.laboasis.org/oasis-traditional-water-systems/:

Links to relevant information which is available online
- Les eaux de drainage de l'oasis de gabes: https://www.eyrolles.com/Litterature/Livre/les-eaux-de-drainage-de-l-oasis-de-gabes-9783841663160/