R4D INITIATIVES

ICARDA
Science for Better Livelihoods in Dry Areas

August 2014

North Africa and West Asia

Growing More Olives with Less Water

This initiative aims to improve and stabilize olive yields through the implementation of advanced and sustainable irrigation systems, helping to raise farmer incomes, strengthen rural livelihoods, and improve water productivity. The Project demonstrates and disseminates effective, low-cost, and sustainable techniques that use irrigation water more effectively in water-scarce environments in Syria and Morocco.

BACKGROUND

Despite the importance of olive production in Morocco and Syria, the absence of modern production methods such as irrigation prevent the sector from reaching its full potential. Although widespread water-scarcity in North Africa and the Middle East complicate the shift to surface irrigation, smart interventions such as rational irrigation systems and efficient water management practices could boost yields, raise incomes, and reduce chronic water stress.

OLIVE PRODUCTION IN SYRIA AND MOROCCO

Morocco and Syria are highly dependent on the cultivation of olives. In Morocco, around 950,000 hectares (ha) are cropped with olive trees, over two million people rely on the crop's production, and the sector generates more than 11 million working days each year.

Likewise, in Syria, over 10% of the country's planted area is covered by olive trees, more than 100,000 families depend on olive production for their main source of income, and the sector generates up to 38 million workdays each year.

Challenges and constraints in the olive sector

Unfortunately, olive production in both countries is also unpredictable. In Syria, yields are unpredictable and vary by a factor of 10 from year to year due to unfavorable weather conditions. In Morocco, yields are also low - fluctuating between 0.5 and 1.5 tons per hectare (t/ha) in rainfed areas and 1.5 and 3 t/ha in irrigated areas – due to a range of constraints including traditional irrigation techniques, poor fertilizer management, and inadequate disease and pest control.

Sustainable irrigation regimes

In response to these low and variable yields, ICARDA and its national partners are stabilizing crop yields through the implementation of advanced and sustainable irrigation systems, helping to raise farmer incomes, strengthen rural livelihoods, and improve water productivity. The initiative demonstrates and disseminates effective, low-cost, and sustainable techniques that use irrigation water more efficiently in water-scarce environments.

The main focus is on drip irrigation – applying water around the base of the trees – which both raises yields and minimizes the amount of water needed for irrigation. Alongside the introduction of new irrigation technologies, the Project instructs smallholder farmers in a range of other potential yield-raising interventions: the cultivation of improved cultivars, fertilization and pruning, pest and disease control, and tillage management.

PROJECT RESULTS: RAISING YIELDS WHILE IMPROVING WATER PRODUCTIVITY

Results have been encouraging and clearly demonstrate the effectiveness of the new technologies being introduced. In comparison to traditional flood irrigation, the alternative regimes being tested have successfully raised yields, improved the quality of olive oil, increased incomes, and conserved scarce water resources. This performance is convincing researchers that drip irrigation can play a dual role – supporting the expansion of both countries' olive sector while reducing chronic water stress.

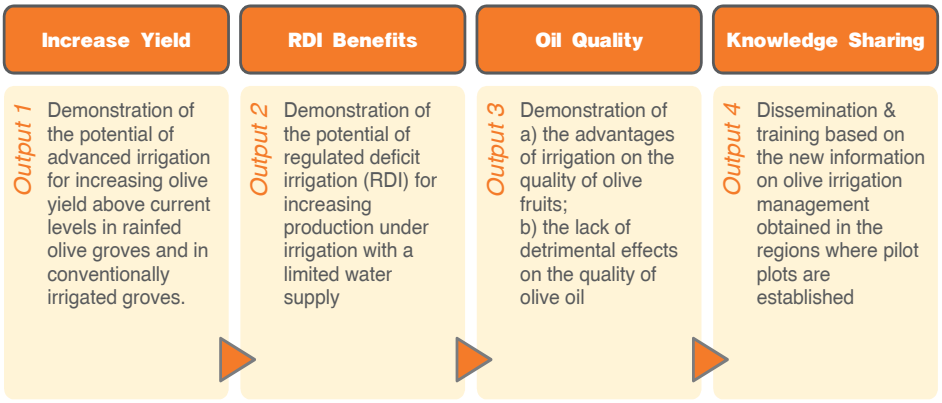

Figure: Schematic representation of project outputs

Results in Morocco: the promise of drip and deficit irrigation

Deficit irrigation, the targeted application of water during drought-sensitive growth stages, demonstrated significant potential in Morocco where it reduced water stress and produced significant water savings compared to full irrigation. If applied at the country level there could be savings of millions of cubic meters.

A combination of deficit irrigation and deep tillage also achieved yields of up to 9.3 t/ha – an improvement on the 7.9 t/ha produced under flood irrigation, confirming the need to switch from traditional production methods to alternative irrigation regimes. Furthermore, sensory evaluations of olive oil revealed a far superior product under deficit irrigation conditions.

The impacts of deficit irrigation (Morocco):

- Improved water productivity compared to flood and drip irrigation
- Olive yields of up to 9.3 t/ha – an improvement on the 7.9 t/ha achieved by flood irrigation
- Higher quality olive oil and improved farmer incomes.

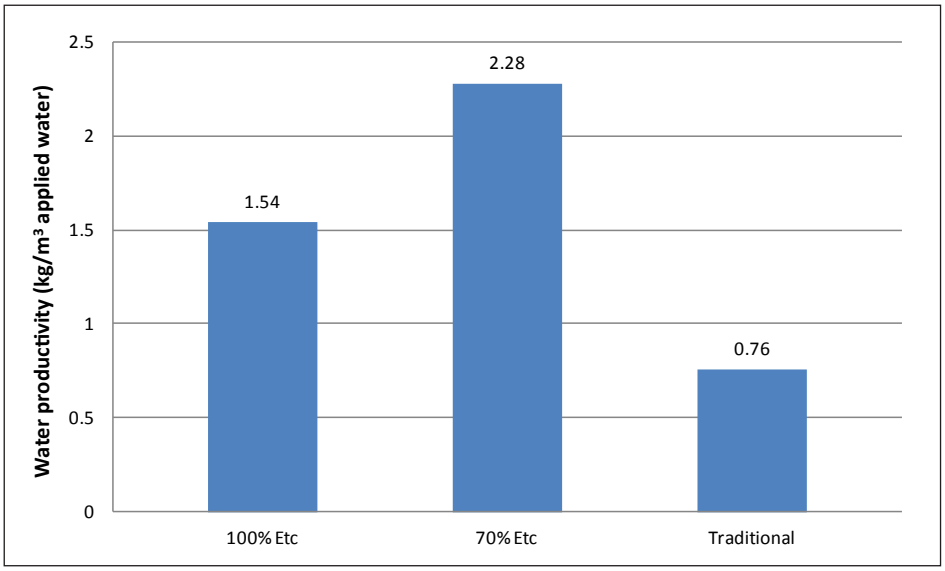

Figure: Water productivity rates for different irrigation regimes

Growing more olive with less water: supporting Morocco's olive expansion

Morocco is set to double the area under olive orchards by 2020, ambitious plans that reflect the rising global demand for olive products. Unfortunately, this expansion could also bring serious consequences for the country's water supplies.

Drip irrigation – applying water just around the base of trees – can dramatically reduce the amount of water use for irrigation, and the technology is being increasingly recognized as a sustainable means of producing olives in dryland countries.

In Morocco, the results of its application are clear: Early maturity, the rapid growth of young trees, a 70% reduction in the amount of water used for irrigation, and higher-quality oil. Word has spread and increasing numbers of farmers are now adopting the technology.

Bensadek Mokhtar is one. After adopting the technology, he has sufficient water to irrigate his land and has seen significant growth in olive yields – up to 5 tons per hectare. "When we used water from the dam, we had no control over when we could water our trees, and they were often stressed," he says. "Now we can apply water when the trees need it most, and have enough left over to grow potatoes for sale and alfalfa to feed our cattle."

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Switching from flood to drip irrigation

Flood irrigation is wasteful – large amounts of water can be lost, particularly from evaporation and leaks from irrigation canals. Shifting to more sustainable alternatives is no easy matter, however, requiring a change in mindset among producers, particularly those with well-established orchards.

"Getting farmers to switch from flood irrigation to drip irrigation is more of a challenge in mature orchards than new plantations," says Mohammed Idrissi, Head of the Institute Nationale de la Recherche Agronomique's (INRA) Tessaout research station. He adds: "Mature olive trees that have been flood irrigated have wide-spreading, shallow root systems, and lots of branches and leaves."

This requires pruning of olive trees to balance roots – which many farmers wrongly believe will reduce olive yields. However, research results demonstrate that this pays off, producing significant water-savings, higher olive yields, and higher-quality oil.

The project is now conducting several field days to demonstrate to farmers and extension agents the benefits of drip irrigation and deficit irrigation. Efforts are also underway to help farmers wishing to put drip irrigation systems in place.

Farmers like Bensadek Mokhtar (pictured) are receiving higher olive yields and incomes as a result of drip irrigation.

Results in Syria: sustaining olive production

Deficit supplemental irrigation produced water savings of 1400 m³/hectare compared to full supplemental irrigation, a promising result that could translate into millions of cubic meters at the national level. While fruit yields were reduced by between 1100 and 1600 kg/ha when switching from full to deficit supplemental irrigation, the results indicate that losses can be endured during water-shortage situations.

Compared with rainfed production, fruit yields under deficit supplemental irrigation increased by between 3900 and 5150 kg/ha.

The impacts of supplemental irrigation (Syria):

- Water savings of 1400 m³ compared to full supplemental irrigation
- A 3900 – 5150 kg/ha increase in fruit yields compared to rainfed irrigation
- Higher water productivity compared to conventional irrigation

Boosting olive yields in Syria

In Syria, where olive growing was expanding rapidly before the recent troubles, little or no rain falls when trees need it the most – in the late summer and early autumn when the fruits grow rapidly and oil accumulates.

Supplemental irrigation is the obvious solution. Not only can it offset the effect of inter-annual variability in rainfall, it can also reduce variability in olive yields. The problem is that water is in short supply in Syria, especially in drier areas, and every drop must be made to count.

Drip irrigation has been installed at research sites, alongside a package of improved management practices, including fertigation, applying fertilizer with irrigation water, and cultivation practices to reduce evaporation and improve weed control. The impact on olive yields has been dramatic: yields increased by 90-125% on plots using deficit irrigation, with additional improvements in oil quality.

Dr. Vinay Nangia, coordinator of the olive irrigation project, reflects on these results: "Research elsewhere has shown that olive oil produced under deficit irrigation is of a higher quality – both in taste and storage properties – than that produced under full irrigation. If this proves to be the case in Syria as well, deficit irrigation may offer the best combination of fruit yield, oil content and oil quality."

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The implementation of advanced and sustainable irrigation systems are stabilizing crop yields and raising water productivity in the drylands of Morocco and Syria.

Treatment	Fruits yield Kg/tree	Fruits yield Kg/ha	Oil yield Kg/ha	Oil ratio %
Full irrigation	75	7500	1751	23.34
50% irrigation	64	6400	1648	25.75
Rainfed	36	3600	908	25.23

Table: Impact of deficit irrigation on fruit and oil yield

PROJECT TITLE:

Program for the Development and Dissemination of Sustainable Irrigation Management in Olive Growing

DONORS:

- International Olive Council (IOC)
- OPEC Fund for International Development (OFID)

NATIONAL PARTNERS:

- Institut Nationale de la Recherche Agronomique (INRA)
- General Commission for Scientific Agricultural Research (GCSAR)

INTERNATIONAL PARTNERS:

- Instituto de Agricultura Sostenible (IAS-CSIC)
- Instituto per I Sistemi Agricoli e Forestati del Mediterraneo (CIR-ISAFOM)

PERIOD:

2010-2014