

PROMEDRICE: Effective farming practices to protect water resources in Mediterranean rice-based agroecosystems

SUSTAINABLE RICE PRODUCTION IN THE GHARB REGION-MOROCCO

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Introduction

Rice production in the Gharb region is strategically important for Morocco, but it faces growing water scarcity, high labour costs and limited efficiency under conventional flood irrigation. PROMEDRICE therefore tested field-scale alternatives that could reduce water demand while maintaining productivity. Drip irrigation reduced irrigation water use by about one third while maintaining or improving rice performance. For sustainable modernization of Moroccan rice production, the priority package is direct seeding combined with drip irrigation, supported by precise water, weed and system maintenance management. The experimental objective was to compare the agronomic and hydric performance of rice under two seeding methods and two irrigation systems.

Methodology

The trial was conducted at the Sidi Allal Tazi Experimental Station in Morocco's Gharb region. A split-plot randomized complete block design with four replications was used to evaluate two factors: seeding method—direct seeding (DS) versus conventional seeding (CS)—and irrigation system—drip irrigation (DI) versus flooding irrigation (FL).

The measured data covered growth, biomass, grain yield, irrigation water volume, and water-use efficiency. The results confirm that drip irrigation increases water productivity and that direct seeding benefits particularly from precise localized irrigation.

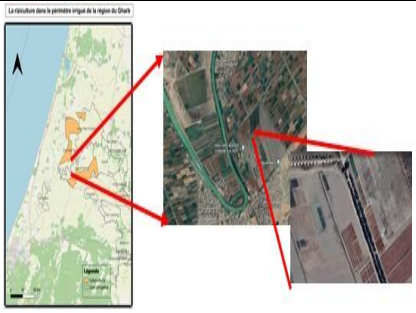


Figure 1. Location of the experimental site at Sidi Allal Tazi in the Gharb region



Figure 2. Field implementation of the rice trial at Sidi Allal Tazi

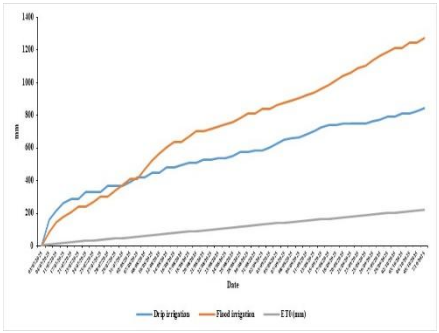


Figure 3. Evolution of irrigation water volume under drip irrigation and flooding

Results

Compared with conventional seeding under flood irrigation (CS × FL), direct seeding combined with drip irrigation (DS × DI) used approximately 33% less water while producing 8.98 t/ha, equivalent to 95.5% of the reference yield. Grain water-use efficiency increased by 43%, from 0.74 to 1.06 kg/m³, while plant height and fresh biomass were maintained or slightly improved. Within direct seeding, replacing flooding with drip irrigation increased grain yield by 15.5%, from 7.77 to 8.98 t/ha, and grain water-use efficiency by 73.8%, from 0.61 to 1.06 kg/m³. DS × DI therefore represents a promising water-saving practice that maintains satisfactory rice productivity.

This project is part of the PRIMA programme supported by the European Union



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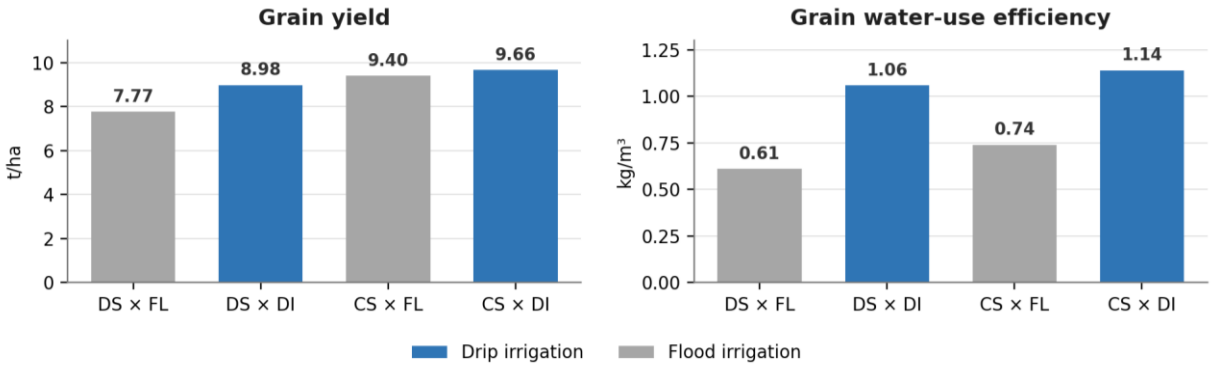


Figure 1. Grain yield and grain water-use efficiency across the four treatments (DS, direct seeding; CS, conventional seeding; DI, drip irrigation; FL, flooding).

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DIRECT SEEDING OF RICE IN THE GHARB REGION, MOROCCO

FACT SHEET

What is the Direct Seeding DS?

Direct seeding of rice is a cultivation method in which rice seeds are sown directly in the field, eliminating the need for nursery production and seedling transplantation. It reduces labour, soil-preparation requirements, water use, and production costs while improving the overall efficiency of the rice-production system.

This practice is particularly suitable for rice-growing areas in the Gharb region and similar zones affected by water scarcity and high labour costs. It is a high-priority practice for rice farmers, agricultural advisers, irrigation technicians, professional organizations, and agricultural development services, especially when combined with localized irrigation.

Where and why to use it?

Application area	Well-levelled rice fields in the Gharb and comparable water-constrained Moroccan rice schemes.
Main objective	Reduce nursery/transplanting operations and improve overall resource efficiency.
Target users	Rice farmers, advisers, irrigation technicians and professional organizations.
Priority	High when direct seeding is coupled with drip irrigation and integrated weed control.

Implementation steps

1. Select and level the plot
Use a representative, well-drained field; correct uneven areas before sowing.

2. Prepare a fine seedbed
Create a regular surface and good seed-soil contact without unnecessary deep tillage.

3. Use adapted seed
Select high-quality seed and a density consistent with the variety and local advice.

4. Secure emergence
Maintain sufficient moisture through germination and early establishment.

5. Control weeds early
Combine mechanical and reasoned chemical measures within an integrated strategy.

6. Monitor and adjust
Track emergence, tillering, plant height and soil moisture; adjust irrigation promptly.



Figure4. Direct seeding of rice using a specially adapted seed drill.

Direct seeding is a sustainable option when crop establishment, weeds and irrigation are managed precisely. Its strongest water-productivity result in the Gharb trial was obtained with drip irrigation.

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DRIP IRRIGATION OF RICE IN THE GHARB REGION, MOROCCO

FACT SHEET

What is the Drip Irrigation DI?

Drip irrigation supplies water directly to rice roots through pipes and emitters, avoiding continuous field flooding. It reduces water losses, improves water-use efficiency, and supports fertilizer application, but requires careful design, monitoring, maintenance, and weed control.

PROMEDRICE trials in Morocco showed that drip irrigation reduced water use by more than 33% while increasing grain yield to 8.98 t/ha under direct sowing and 9.66 t/ha under conventional sowing. It also substantially improved water-use efficiency, demonstrating its potential for productive rice cultivation under water-scarce conditions.

Why Drip irrigation?

Localized irrigation targets the rice root zone and reduces avoidable losses through surface evaporation and deep percolation. Under Gharb trial conditions it was the strongest BMP for lowering water demand and increasing water productivity.

Implementation steps

System prerequisites

- Water source with adequate pressure and quality
- Filtration sized to protect emitters
- Correct mainline, lateral, emitter spacing and flow-rate design
- Operator training in scheduling, flushing and cleaning
- Soil-moisture and pressure monitoring
- Fertilization and weed management adapted to a non-flooded system

Implementation and maintenance

1. Diagnose the field
Assess soil texture, drainage, levelling, water availability and water quality.

2. Design the network
Size pipes, lateral spacing, emitters, filtration and pressure control for the site.

3. Install and test
Check pressure, flow and distribution uniformity before crop establishment.

4. Schedule irrigation
Maintain moisture in the active root zone without prolonged excess saturation.

5. Prevent clogging
Inspect pressure and flow, clean filters and flush laterals throughout the season.

6. Measure performance
Record water volume and yield, then calculate WUE at the end of the cycle.



Figure. Drip irrigation system installed in a rice field.

In the Gharb trial, drip irrigation used about one third less water. Grain WUE rose from 0.61 to 1.06 kg/m³ under direct seeding and from 0.74 to 1.14 kg/m³ under conventional seeding.

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