PROMEDRICE
PROTECTING MEDITERRANEAN RICE-BASED AGRO-ECOSYSTEMS

www.promedrice.org
https://x.com/PROMEDRICE

GUIDELINE

Guideline for Late-Season Irrigation Water Input Reduction (WIR) in Flooded Rice (Guadalquivir River Marshes)

Authors: Concepción Mira Rodado[1], Annkathrin Patricia Rosenbaum[1], Joaquín Gutiérrez Evans[1], María Muñoz Villalón[1], Manuel López Tirado[1], Blanca Cuadrado-Alarcón[2], Helena Gómez-Macpherson[2], Sébastien Guéry[3], Fernando Pascual Bernardo[3].
Affiliations:
[1] TEPRO Consultores Agrícolas S.L., Seville, Spain
[2] Instituto de Agricultura Sostenible, Consejo Superior de Investigaciones Científicas (IAS-CSIC), Córdoba, Spain
[3] GIESA, Seville, Spain
Case Study: CS3 – Guadalquivir Marshes, Spain
Best Management Practice: WIR – late-season irrigation **W**ater **I**nput **R**eduction

Introduction

Rice in the Guadalquivir Marshes is grown under continuous flooding, with irrigation water supplied throughout most of the crop cycle. As the plant progresses towards maturity, crop water demand decreases and irrigation supply is normally reduced progressively before the final irrigation cut-off. These late-season reductions may also be influenced by the water availability established at irrigation-community level.

Late-Season Irrigation Water Input Reduction (WIR) consists of applying an additional controlled reduction in irrigation inflow at field level once the crop has passed the reproductive stages that are most sensitive to water and salinity stress and has entered the late grain-filling phase. Irrigation is not interrupted: the field remains flooded and the inlet and outlet are managed in a manner that the water layer is maintained and potential salt accumulation is controlled.

The objective of WIR is to reduce the amount of irrigation water supplied during the final part of the crop cycle, when crop water demand is declining and salt tolerance is higher. Crop development varies with cultivar and seasonal conditions. The decision to start WIR should therefore be based on direct field observation of crop phenology, with implementation to be considered once the crop has entered the **dough grain stage**.

This guideline explains when WIR can be considered, how to apply the reduction, what should be monitored, and when the reduction should be adjusted or reversed**,** based on the PROMEDRICE demonstration in the Guadalquivir Marshes.

Methodology

Description of the WIR – strategy

WIR is an additional field-level reduction in irrigation inflow applied during the final part of the rice-growing cycle. It is implemented once the crop has passed the reproductive stages of greatest sensitivity to water and salinity stress and has entered a later grain-filling phase suitable for reducing irrigation supply.

The timing of WIR should be determined from field-observed crop phenology. The appropriate moment may vary according to cultivar, sowing date, temperature and seasonal growing conditions. As a practical criterion, implementation should be considered once the crop has reached the **dough grain stage.**

WIR does not consist of stopping irrigation earlier. Water continues to enter the field and flooding is maintained until the usual final irrigation cut-off. The intervention consists of supplying less water than under the prevailing

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

PRIMA PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

GUIDELINE

irrigation regime, while managing the inlet and outlet so that the field remains flooded and salinity remains under control.

The magnitude of the reduction is not defined as a fixed percentage. It should be adapted to the irrigation supply already reaching the field, crop development, expected water demand, water depth, salinity and field hydraulic behaviour (Table 1). After each reduction, field conditions should be checked and the inflow should be maintained, further reduced or increased according to the observed response.

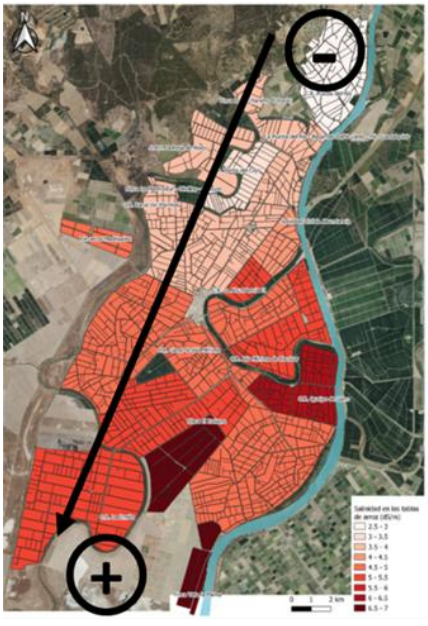
WIR therefore follows a simple management principle: **Reduce → Observe → Adjust**

Table 1. Key characteristics of WIR

Question	WIR practical rule
When?	After the most sensitive reproductive stages, from dough grain stage onwards
What?	Apply an additional reduction in field irrigation inflow
Does irrigation stop?	No. Continuous flooding is maintained
How much?	Adjust according to field response and monitoring.
What must be maintained?	Water coverage across the field, no visible crop stress and controlled salinity
Until when?	Until the conventional final irrigation cut-off, unless field conditions require the reduction to be reversed

Water allocation context in the Guadalquivir Marshes

In the Guadalquivir Marshes, and particularly on the right bank of the river, salinity is a major constraint on rice productivity. This risk becomes more pronounced downstream because of the salinity gradient affecting irrigation water.



Under conditions of limited water availability, irrigation management should therefore prioritise water supply during the vegetative and reproductive phases, when the crop is more sensitive to salinity and water stress. WIR is intended to support this approach by allowing irrigation inputs to be reduced later in the season, once the crop has entered a less sensitive grain-filling stage.

Because irrigation water is managed and distributed at irrigation-district level, the timing and magnitude of water supply cannot be defined solely at individual-field level. WIR should therefore be planned in coordination with the Irrigation Water User Association, taking into account the water allocation and flow actually available to the farm.

This project is part of the PRIMA programme supported by the European Union
PRIMA PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

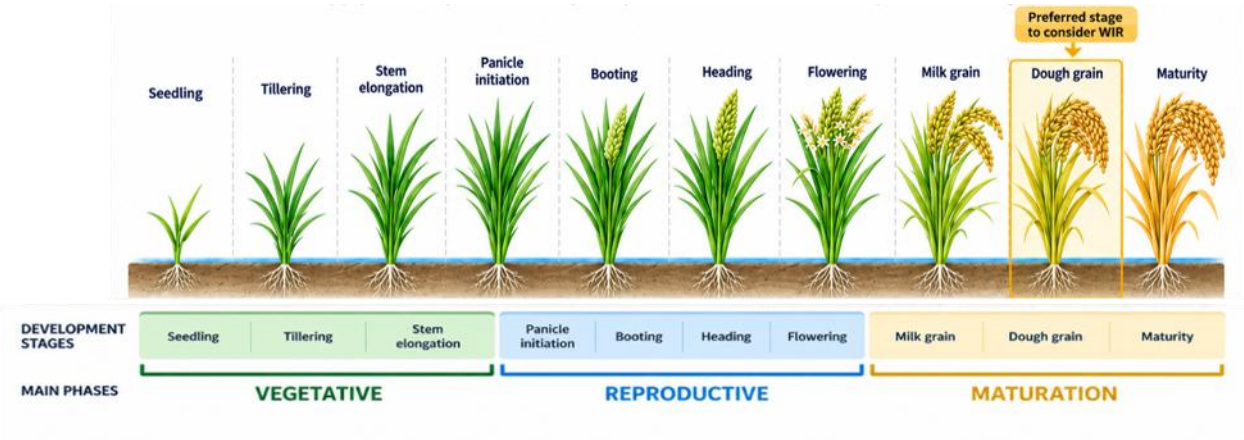
GUIDELINE

How to implement WIR – 5 practical steps

WIR changes only the late-season water-management strategy. Crop establishment, fertilisation, crop protection and harvesting follow the usual management practices.

Step 1. Confirm that the crop has reached the appropriate stage

Confirm that the crop has passed the most sensitive reproductive stages. WIR should be considered from the **dough grain stage onwards**. The decision should be based on the actual phenological stage observed in the field, taking into account the variety and seasonal growing conditions.



Check several representative panicles from different parts of the field. Because grain development is not completely uniform, inspect spikelets from the upper, middle and lower parts of several panicles.

Check their internal consistency:

- **Milk stage:** the grain releases an opaque, milky liquid when pressed. **WIR should not yet be started.**
- **Soft dough stage:** the grain contents have thickened into a soft, pasty material and the kernel can still be pressed or dented. **This is the preferred stage to consider starting WIR.**
- **Hard dough stage:** the kernel is firm and increasingly difficult to dent. WIR can still be applied, provided field water and salinity conditions are suitable.



Do not rely only on panicle or leaf colour. Grain filling is not uniform within the crop, so the decision should be based on kernel inspection from several representative plants.

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

PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

GUIDELINE

Step 2. Check that field and water conditions allow a further reduction

Before reducing the irrigation inflow, check that the field and the current water-management conditions can support an additional reduction.

Confirm that:

- Flooding is uniform across the field. The field remains continuously flooded, with no exposed soil or rapidly drying areas.
- The inlet and outlet can be adjusted to maintain the water layer after the reduction.
- Salinity is under control. Where salinity is a risk, check EC before applying the reduction and use it as a reference for subsequent monitoring.
- Weather conditions are suitable. Avoid making a large additional reduction immediately before periods of high temperature or strong wind, which may accelerate the fall in field water level.
- **The current irrigation supply is known.** Take into account any reductions already applied by the irrigation community. WIR starts from the actual flow reaching the field at that moment and consists of a **further field-level reduction**.

Step 3. Apply the additional inflow reduction

Once crop stage and field conditions are suitable, apply an additional reduction in irrigation inflow at field level.

The reduction should be made progressively rather than by stopping irrigation abruptly.

- Reduce the inlet flow gradually**.**
- Keep irrigation running. WIR is not an early irrigation cut-off.
- Adjust the outlet at the same time, if necessary, so that the field remains flooded and the water level does not fall too quickly.
- Make one adjustment at a time and observe the field response before deciding whether a further reduction is possible.

The magnitude of the reduction should not be defined as a fixed percentage. It depends on the flow already reaching the field, field hydraulics, salinity, weather and crop conditions.

Step 4. Check the field response

After reducing the inflow, check how the field responds before making any further adjustment.

Focus on the conditions that directly determine whether the reduction can be maintained:

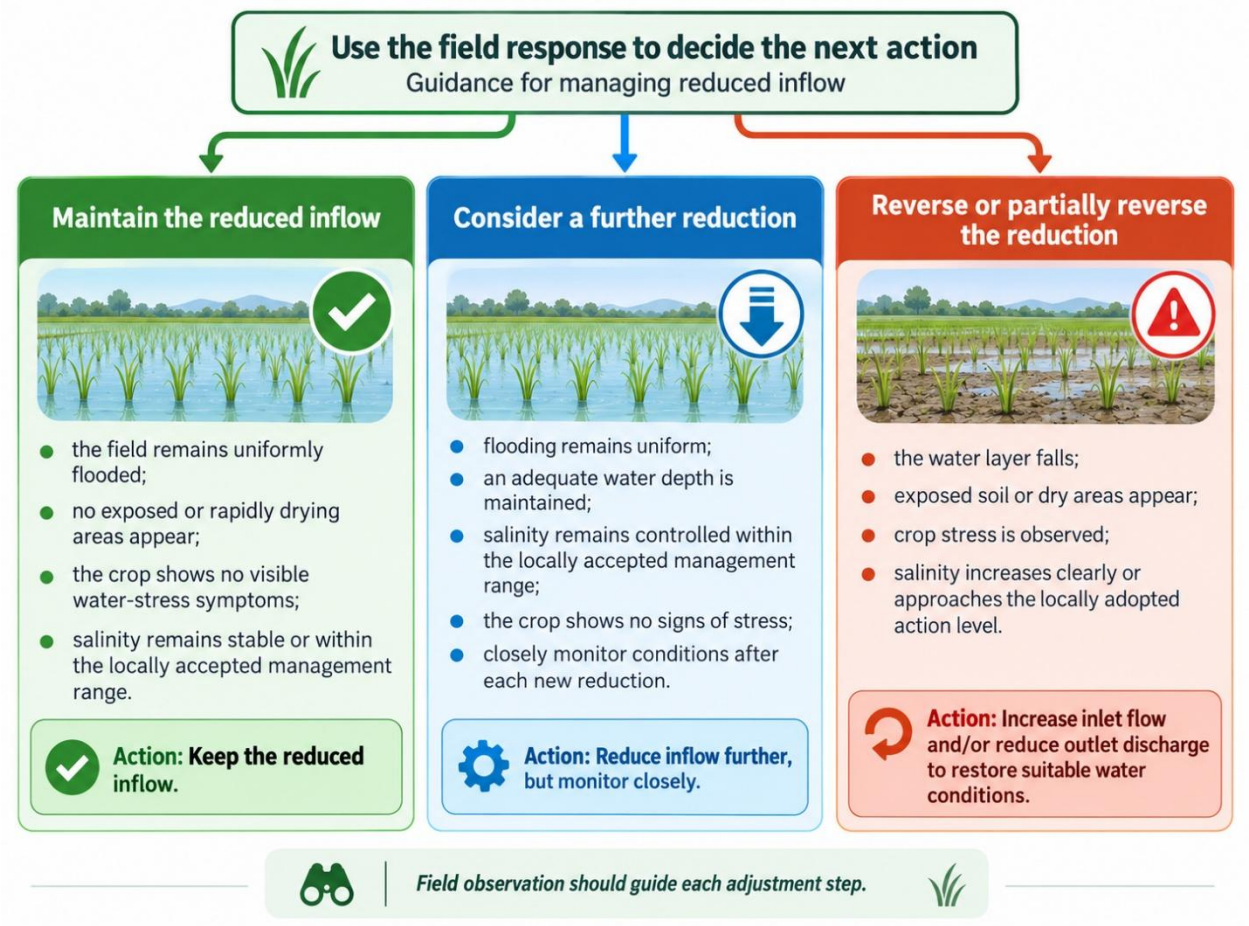
- Water coverage: confirm that the field remains flooded and that no exposed soil or rapidly drying areas appear.
- Crop condition: check for any visible signs of water stress.
- Salinity: where salinity is a risk, monitor EC and pay attention to any clear upward trend after the reduction.
- Water level: confirm that the field water layer is not falling.
- Weather: increase attention during hot or windy periods, when water losses may rise.

Monitoring should be closer during the first days after each adjustment. If field conditions remain stable, the

This project is part of the PRIMA programme supported by the European Union
PRIMA PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

reduced inflow can be maintained.

Step 5. Maintain, further reduce or reverse the adjustment



Potential benefits of applying WIR

When field and crop conditions allow it, WIR can improve late-season irrigation management by reducing the amount of irrigation water supplied when crop water demand is declining.

The main potential benefits are:

- **More efficient use of the available irrigation water.** Reducing water supply during the less sensitive late grain-filling and maturation stages can help prioritise available water for the vegetative and reproductive phases, when the crop is more vulnerable to water and salinity stress.
- **Lower late-season irrigation inputs.** WIR can reduce the volume of fresh irrigation water supplied before the conventional final irrigation cut-off, provided that continuous flooding and salinity control are maintained.
- **Greater flexibility under limited water availability.** The strategy provides an additional management option when irrigation allocations are restricted or when water availability must be distributed more carefully throughout the season.

GUIDELINE

Key recommendations and limitations

WIR is not a fixed irrigation prescription. Its suitability and the magnitude of the reduction depend on cultivar and crop stage, field hydraulics, weather, salinity and the irrigation supply available at farm and irrigation-community level.

Particular caution is required when applying WIR during drought years, periods of restricted water allocation or situations with elevated salinity risk.

Conclusions / Take-home message

WIR is a late-season irrigation-management strategy aimed at reducing irrigation water supplied once the rice crop has passed its most sensitive reproductive stages and reached the dough grain stage.

The practice does not involve stopping irrigation early. Irrigation inflow is reduced progressively while maintaining field flooding and controlling salinity. The appropriate reduction cannot be defined as a fixed percentage: it must be adjusted according to crop development, field water conditions, salinity, weather, field hydraulics and the water supply available from the Irrigation Community.

WIR can contribute to a more efficient seasonal allocation of irrigation water by allowing more of the available supply to be prioritised during the vegetative and reproductive phases, when the crop is more sensitive to water and salinity stress, and reducing inputs later when crop water demand decreases.

The PROMEDRICE demonstration confirmed that an additional field-level reduction could be implemented on top of the reductions already applied at irrigation-community level, however, this will require caution.

The 2025 demonstration was conducted under relatively favourable irrigation-water availability and salinity conditions. WIR should therefore be regarded as context-dependent. In drought years, under irrigation restrictions or where salinity pressure is higher, both the feasibility and the magnitude of any additional reduction may differ.

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

PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA