Second Edition

Controlled Irrigation:

Saving water while having good yield

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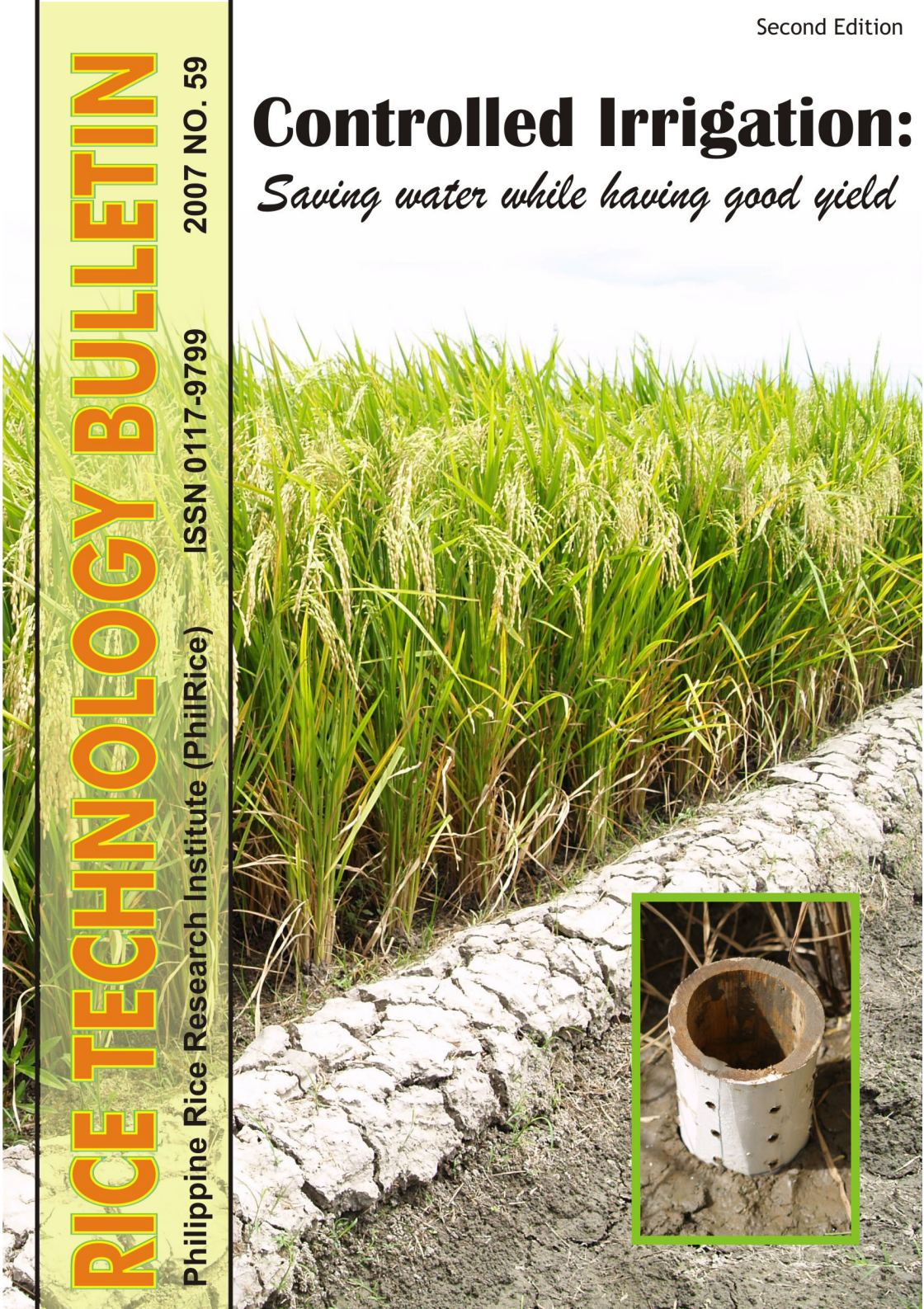

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Foreword

Water is essential to the growth of the rice plant. Under an ideal condition and with good farm management, lowland rice requires around 2,000 liters of water to produce one kilogram of rice at 100 cavans per hectare yield. Farmers, however, use more. They apply irrigation water continuously from land preparation to the hardening of grains. Estimates show that up to 4,000 liters of water is usually used for a kilogram of rice in most Philippine rice farms. But with irrigation water now becoming costly and scarce, it is important to develop schemes that can reduce the amount of water used in irrigated lowland rice without reducing yield.

This technology bulletin offers a practical technique on how to save irrigation water without decreasing rice yield. If farmers near irrigation sources use water efficiently, more farms near the tail-end of an irrigation system might be benefited. For those using water pump, this technique will help increase the farmers' income through reduction of farm inputs such as oil, fuel, and labor.

Technical knowledge on water-saving techniques, importance of water control structures on the distribution channels, farm ditches, and dikes that facilitates water conveyance and control within the farm are being adressed by this Bulletin.

We acknowledge our partnerships with International Rice Research Institute (IRRI), National Irrigation Administration (NIA), and various local government units in developing this technology. I hope this bulletin will guide other staff of our partners in promoting this very important technology.

LEOCADIO S. SEBASTIAN
Executive Director

Introduction

From land preparation to last irrigation, a field area of one square meter that usually yields 0.5 to 0.75 kg rice consumes around 2,000 liters or 10 drumfull of water. However, farmers tend to continuously flood their fields and use 15 to 20 drumfull of water to maintain a paddy water level higher than 7 cm. They do this to store more water, reduce the frequency of field visits, and because of their belief that more water controls more weeds. However, continuous flooding and field water level higher than 7 cm results in too much percolation, seepage, and even run-off. It causes delayed growth and reduced tillering because of impediment in root development caused by reduced oxygen level within the root zone.

Rice plants with excessive water.

Continuous flooding also triggers some yield-reducing factors such as too much leaching, soil nutrient imbalance (zinc deficiency), lodging problems owing to weak base and anchorage of the plant, and environmental problem such as global warming due to high methane gas emission. This also results in lesser and untimely water in the fields near the tail-end, high water-use in gravity irrigation systems, and too much water cost in pump irrigation systems.

Results of studies on water-saving irrigation techniques for transplanted and direct-seeded lowland rice show that continuous flooding is not necessarily required by rice to produce good yield. These studies resulted in a technique called controlled irrigation, which show that water can be controlled to reduce farm inputs and at the same time help the plant grow healthier.

Benefits

- Reduces water used in rice production by 16-35% without decreasing grain yield
- Aids in proper seed germination and seedling survival, tillering, and grain uniformity
- Increases the efficiency of the plants in using soil nutrients and applied fertilizers
- Keeps a good balance of available nutrients in the soil
- Helps in controlling weeds
- Minimizes golden apple snail attack since there is an excellent water level control
- Significantly reduces cost in pump irrigated areas
- Stabilizes soil and plant base, hence helps minimize crop lodging
- Facilitates farm mechanization especially in the harvesting and hauling of harvests
- Reduces farm inputs such as oil, fuel, and labor
- Provides for timely water needs of farms at the tail-end of an irrigation system

Controlled Irrigation can make harvesting so much easier.

Field trial at PhilRice Central Experiment Station, 2007 DS, showed that the performance of a combine harvester is more efficient in a field with Controlled Irrigation (CI) than in a Continuously Flooded (CF) field. The stable soil condition under CI facilitates the operation of the machine and makes harvesting faster.

Target Users

1. Farms with limited water supply or those farms with supplemental irrigation such as the following:

- near tail-end of an irrigation system
- using small water impounding systems
- using small farm reservoir
- using communal irrigation systems
- using pump irrigation system (shallow tube or deep well)

2. Farms near main canals with the following circumstances:

- unstable plow layer or hard pan that causes difficulty in land preparation, harvesting and hauling
- nutrient imbalances such as zinc and sulfur deficiencies
- poor root growth due to accumulation of excessive organic acids from decomposing materials due to insufficient soil aeration

Important Considerations in Irrigating

1. Method of planting

- Transplanted (common during wet season and in places where control of water is difficult)
- Direct Seeded (lesser water is used in direct seeding specially dry seeding)

2. Season of planting

- Dry season (more irrigation water is needed)
- Wet season (less frequent irrigation)

3. Soil texture or soil type

- Fields with clayey (fine-textured) soil have longer pond-water retention, usually 3-5 days at 5 cm initial depth. Hence, irrigation is less frequent.
- Fields with loam to sandy loam (medium-to-course-textured) soil retain pond water for less than 12 hours. Hence, irrigation is more frequent. However, pond-water depth should be kept only in minimum, 2-3 cm, during irrigation to decrease water losses.

How to Determine the Texture of a Soil

The "feel method" can be used to determine the textural class of a soil. Soil samples are moistened and rubbed between the thumb and the fingers.

(A) Fine-textured soil - sticky, cohesive, and forms a ribbon after pressing and rubbing. Examples are clay, clay loam, silty/sandy clay loam.

(B) Medium-textured soil - less cohesive, feels gritty, and does not form a rigid ribbon after pressing and rubbing. Examples are loam, silt loam, and sandy loam.

Pre-planting techniques

1. Fix farm dikes and ditches before or during the first irrigation or before the onset of rainy season.

2. Use appropriate planting method based on water availability and ability to control it.

3. Plow immediately after the first irrigation. Do not allow newly irrigated field to stand unplowed for several days.

4. Use just enough irrigation water during land preparation to facilitate soil puddling, organic matter decomposition, and land leveling.

5. Establish and level the field very well. There should be uniform water distribution in the whole paddy at 2-3 cm depth of pond water.

6. Shorten land preparation time to one to two weeks for non weedy or dry-plowed field, until three weeks for fields with fresh rice stubbles, and four weeks for fields with much weeds and stubbles.

7. Apply minimal irrigation water, about 2-3 cm until 30 days after planting. This will promote better seedling establishment and weed control.

8. When using a herbicide during the first month, follow the water management scheme required by the herbicide being used.

Post-planting procedures

1. Maintain 2-3 cm water depth from planting up to one month. This will help the seedlings survive and this will help control weeds.

2. Apply controlled irrigation techniques by using an observation well. This facilitates the monitoring of water status in the field and helps determine the right timing of irrigation.

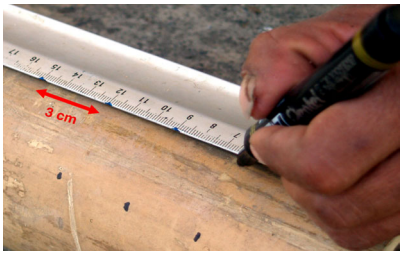
Controlled Irrigation using Observation Well

Making the observation well

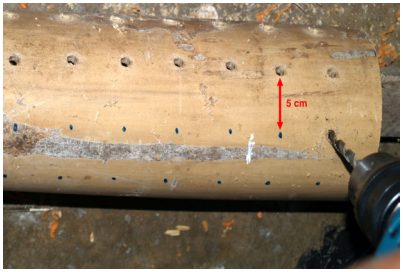
1. Make an observation well out of a plastic tube or bamboo that is 25 cm long with at least 10 cm diameter. When using a bamboo, make sure there is no node within the cut material.

2. Designate one end of the tube as "top". From the topmost part of the tube, make a circumferential mark at 5 cm and 10 cm and label them with "wet season" and "dry season", respectively.

3. Using a manual or electric drill with 3-5 mm diameter, make holes every 3 cm horizontally or length wise.



4. On the other hand, keep a 5 cm distance between holes vertically or cross wise.



Installing the observation well

5. After planting, select a representative site in your field wherein the observation well can be installed. An ideal site is located around 1-2 m from paddy dike to facilitate regular observation of the paddy water.

   For farms with uniform conditions among paddies, only one observation well per hectare is needed. On the other hand, farms with heterogeneous condition or paddies with different soil texture or elevation need one observation well per category (soil texture or elevation).

6. In the selected site, press the tube vertically against the ground as much as you can then pull it back completely.

7. Remove the soil inside the tube after lifting it above the ground by downpouring the soil inside.

8. Repeat step 6 and 7 until the marker "wet season" or "dry season" in the tube is exactly leveled against the ground surface.

9. Fix the observation well vertically and check if the label for a given season (wet season or dry season) is leveled against the ground.

Using the observation well

10. When irrigating during the wet season, flood the field until the water reach the topmost portion of the tube. On the other hand, during the dry season, flood the field until the water reach 5 cm above the ground or the circumferential line marked with "wet season."

Wet Season

Dry Season

11. Irrigate again using the controlled irrigation when there is no more visible water in the observation well.

Important Reminders

- Start irrigating the field based on the observation well 30 days or four weeks after planting. At this time, seedlings are well established and the primary weed control measures were executed already.

- Start irrigating in the afternoon, around 3-4 PM, to minimize evaporation losses and to take advantage of cooler irrigation water.

- During the tillering period, the rice plant and soil are healthy if there is enough oxygen to balance the various physico-chemical and biological activities in the rhizosphere, hence do not flood continuously.

- During flowering, maintain 5 cm depth of standing water in the paddy to avoid the development of unfilled grains due to lack of water.

- Last irrigation should be one week before harvest for light-textured soil and two weeks before harvest for heavy-textured soil.

- Practice shallow rotavation after harvesting. This helps conserve residual moisture and minimizes the development of wide and deep cracks during dry season fallow.

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PhilRice

PhilRice is a government-owned and -controlled corporation attached to the Department of Agriculture created through Executive Order 1061 on 5 November 1985 to help develop high-yielding and cost-reducing technologies so farmers can produce enough rice for all Filipinos.

It accomplishes this mission through research, development, and extension (RD&E) through its central and branch stations coordinating with a network that includes 57 agencies and 70 seed centers strategically located nationwide.

PhilRice implements four new R&D programs (2006-2010)- favorable environment, unfavorable environment, impact and policy research, and knowledge management and promotion. With these programs, PhilRice aims to develop and promote technologies that are ecosystem-based, location- and problem-specific, and profitable to the Filipino farmers.

PhilRice has the following certifications: ISO 9001:2000 (Quality Management System), ISO 14001:2004 (Environmental Management System), and OHSAS 18001:1999 (Occupational Health and Safety Assessment Series).

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