INTERNATIONAL YEAR OF RICE 2004

rice is life

Rice and water: a long and diversified story

- Rice is the only cereal crop that can survive periods of submergence in water, thanks to the adaptation strategies that rice plants have evolved over the centuries.

- Paddy rice consumes more water than any other crop, but much of this water is recycled and put to other uses.

- Rice needs water for evapotranspiration, seepage and percolation, as well as for management practices such as land preparation and drainage.

- Submerged rice cultivation practices help to promote water percolation and groundwater recharge, control flooding during heavy rains, and prevent weed growth in rice fields.

- Scientists are working to develop rice cultivation techniques that require less water. However, the benefits of these new techniques will have to be weighed against the advantages of the present relationship between water and rice, most of which would be lost if that relationship were to change.

THE SITUATION

Rice is the only cereal that can stand water submergence, and this helps to explain the long and diversified linkages between rice and water. For hundreds of years, natural selection pressures such as drought, submergence, flooding, and nutrient and biotic stresses led to a great diversity in rice ecosystems. The plant's adaptation strategies include surviving submerged conditions without damage, elongating its stems to escape oxygen deficiency when water tables rise, and withstanding severe drought periods. Ecologists have distinguished five water-related categories of rice plant: rainfed lowland, deep water, tidal wetland, rainfed upland and irrigated rice.

Historically, rice cultivation has been a collective enterprise. The investment and shaping of the landscape that are needed for the ponding system (terraces) require collective organization within the community. Water management also relies on collective interest: crop and water calendars must be organized for large blocks of fields in order to manage water efficiently and organize such work as land preparation, transplantation and drying for harvesting.

WATER PONDING

The field-level control of water for submerged rice growth has led, over the centuries, to the development of specific water management and cultivation practices that produce specific beneficial outcomes. The terrace system in mountainous areas is a typical product of the ponding technique and allows cultivation even on steep slopes. This technique is instrumental in preventing soil erosion and landslides. Another advantage of the ponding technique is its capacity for flood control: field bunds have a significant water storage capacity, which reduces peak flows under heavy rains. The permanent presence of water on rice fields also generates water percolation and groundwater recharge, which are often beneficial for other water uses. One major advantage of water ponding in rice cultivation is that it prevents weed development, thereby avoiding the use of herbicides or reducing the amount of labour required.

WATER USE IN RICE SYSTEMS

Water plays a prominent role in rice production. While many other cropping systems use water mainly for productive purpose (transpiration), the rice cropping system uses water in a wide variety of ways, both beneficial and non-beneficial.

TABLE 1. Water requirements of irrigated rice

Purpose of water use	Consumptive use *(mm/day)* Low	High	Remarks
Land preparation	150	250	Refilling soil moisture, ploughing and puddling
Evapotranspiration	500	1 200	
Seepage and percolation	200	700	Maintaining water pounding
Mid-season drainage	50	100	Refilling water basin after drainage
Total	**900**	**2 250**	

Rice systems need water for three main purposes: i) evapotranspiration; ii) seepage and percolation; and iii) specific water management practices such as land preparation and drainage prior to tillering. Table 1 shows the total water requirements of irrigated rice, but the actual water demand of farmers is often much higher because conventional application techniques are often less than 50 percent efficient.

In many rice-based systems, a great proportion of water enters the field as precipitation, surface irrigation or spillage/percolation from adjacent fields. It is therefore critical that water budgets be made at an appropriate scale and not limited to the field level. At system level water consumption through rice evapotranspiration can be as low as 25% of the total, the remaining part being for trees, gardens, reservoirs, drainage, etc. as shown in the example (Figure 1).

FIGURE 1. An example of water balance in a rice-based system (Kirindi Oya, Sri Lanka, IWMI)

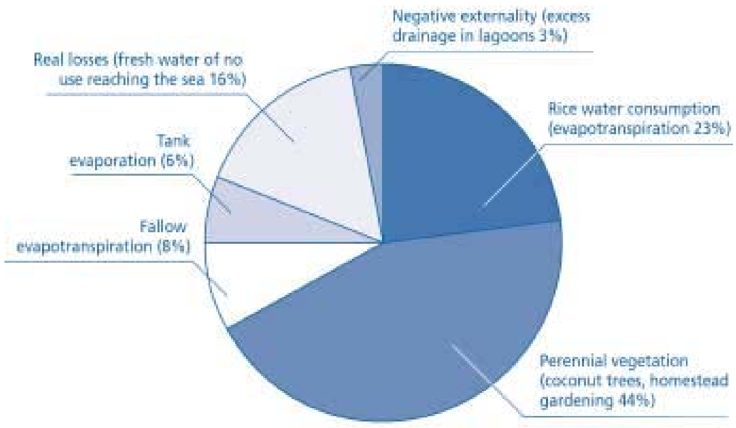

TABLE 2. Positive and negative attributes of different rice systems

	Traditional permanent water ponding techniques	Intermittent wet (ponding) and dry techniques	Dry cultivation (rainfed and irrigated) – no ponding
Advantages	- Generate multiple uses of water - Shared management costs among many water uses - Weed control	- Water savings, but to crop only - Flexible cropping calendar (no ponding)	- No, or only supplementary, additional supply of water required - Field-level water savings
Disadvantages	- High water withdrawal - Potential pollution risk from leaching chemicals - Low flexibility of crop calendar (block organization)	- High-quality service water required - High-cost water management borne by farmers only - Weeding required	- Water conservation technique (mulch) - Weeding required

NEW WATER-SAVING AGRICULTURAL PRACTICES

Worldwide, new rice cultivation practices are being experimented with at the field level. Many of these are motivated by the need to save water in the face of increasing shortages. Paddy rice consumes far more water than any other cereal does, even though much of this water is recycled.

During recent decades, international and national rice institutes have tested various new techniques for growing rice – aerobic, alternate wet and dry system, rice intensification – which partially or totally suppress the need for ponding at the field level.

These new techniques are revolutionizing the age-old idea that rice is an aquatic crop. Rice does develop well in water, and this property gives it a serious advantage in weed control, but recent developments demonstrate that rice can also be grown in dry soils. However, systems that consume less water are far more sensitive to water stress and depend on a reliable water supply during both the wet and the dry seasons. Such a supply can only be achieved by having a performant irrigation infrastructure.

If these techniques realize their potential to improve water productivity, rice will become far more water-efficient, but this may be to the detriment of other water uses in the area. The choice between increasing crop water efficiency or maintaining water productivity for other uses must therefore be carefully considered.

Table 2 shows the main advantages and disadvantages of different rice cultivation systems.

CONTACT

DANIEL RENAULT
Land and Water Development Division,
Water Resources Development and Management Service
Room B-722 Tel.: (+39) 06 57054713 Fax: (+39) 06 57056275
E-mail: daniel.renault@fao.org

Food and Agriculture Organization
of the United Nations
Viale delle Terme di Caracalla
Rome 00100
Italy