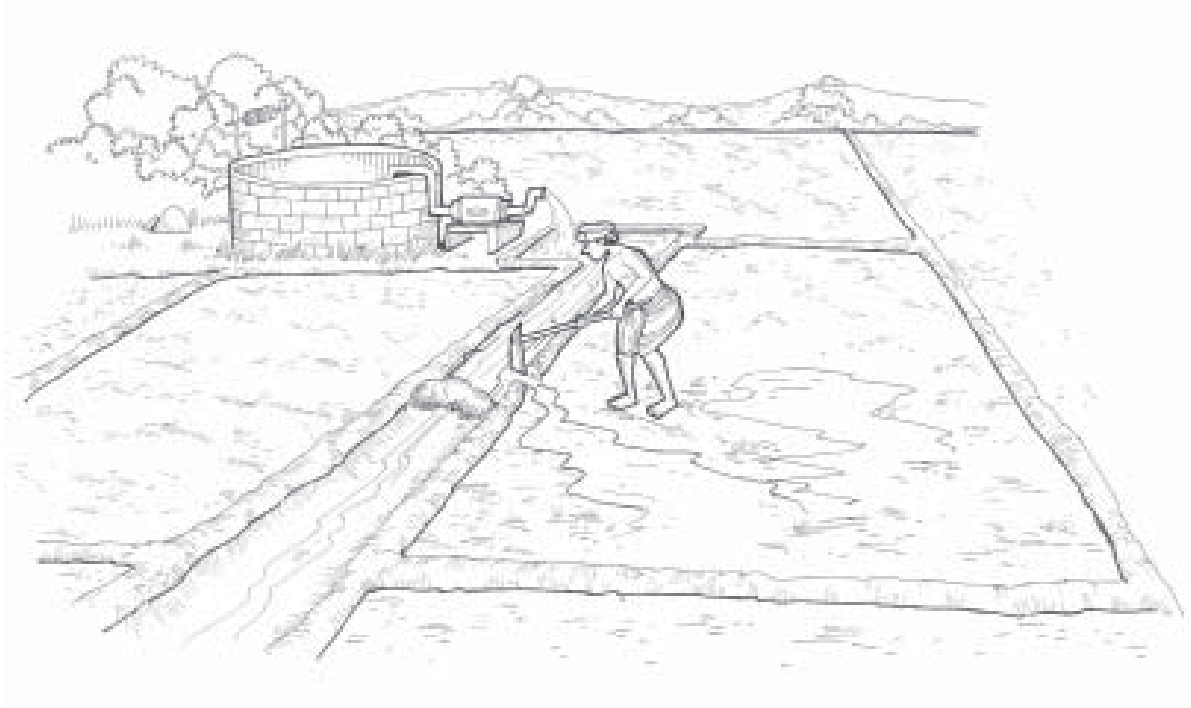


# Improved Water Management Practices in the Rice-Wheat Zone of Sind, Pakistan



**T**he current yields of rice and wheat in Sind, Pakistan are far below their potential yields partly due to improper water management practices. During the rice season, the major problem of water management is an early-season water shortage followed by excessive water with the onset of the monsoon season. During the wheat season, excess soil moisture in ricefields delays wheat planting, and later during the crop season, there is a shortage of irrigation water. Poor water management practices at the farm level cause wastage of limited irrigation water, whereas rice-wheat systems need promising water management practices at the farm level.

## **Water-Efficient Method of Rice Establishment: Direct Seeding of Rice**

In Sind, the traditional practice of rice establishment is to transplant young rice seedlings from nurseries. Adoption of direct seeded rice method improves management of irrigation water. There are two systems of direct seeding of rice: wet and dry.

Under the wet direct seeding system, pre-germinated seeds, obtained by soaking seeds for 24 to 36 hours are sown on the saturated field that has been prepared under wet condition. Land preparation is completed in about a week, avoiding long periods of water losses occurring in transplanted rice. About 30% less water is required to prepare a typical field up to the same puddled condition for wet-seeding of rice than for transplanting rice. Wet-seeded rice yields more in both water-sufficient and water-deficit situations, requires less labor, and produces a better return on investment than transplanted rice.



#### Adoption of Wet Direct Seeding System in Asia

Farmers in the Philippines, Malaysia, and Thailand are adopting wet direct seeded system instead of transplanting rice. Under this system, during the first four to five days after seeding, the field is kept moist, but not flooded. Later, 2 to 3 cm of water is allowed to flood the ricefield. About 10 days after seeding, the water level is increased and maintained at 5cm until crop maturity.

Wet direct seeding is faster and easier than transplanting rice and grain yield is similar or higher than transplanted rice. This technique requires better leveling of the field for good water management and crop establishment. Adequate plant stand establishment and weed control is possible with a recommended seed rate of 100 kg pre-germinated rice seeds per ha.

The technique incurs reduced labor cost because it does not include the steps used for transplanted rice, e.g., nursery preparation, care of seedlings in seedbed, and pulling of seedlings, hauling and transportation. Also, the cropping cycle is shorter because of the absence of transplanting shock. The technique requires shallow water depth to be maintained in the ricefields compared to transplanted ricefields, and thus improves water control and facilitates better water management.

In the dry direct seeding method, field preparation is done under dry condition, immediately followed by seed sowing either before irrigation water is applied or before rain occurs, to enable germination and seedling establishment. The total cropping season could be reduced by about two weeks avoiding nursery preparation and transplanting phase and the overall irrigation requirement is reduced, resulting in significant water saving of up to 25%. Transplanting rice requires more water and results in more wastage than the dry direct seeding system.

## Land Leveling

Farmers should be encouraged to level farmland to improve water conservation. Land leveling effectively facilitates on-farm water control and management. It is a basic requirement at field level to avoid over- or under-irrigation due to the micro-undulations in the ground surface. To facilitate this activity, the local government agencies should provide subsidies, technical assistance, and training to the farmers. Due to clayey nature of the soils, land leveling by bullock and manual labor is very limited in Sind. Hence, farmers can benefit

from laser technology for land leveling. Laser equipment is now being locally manufactured by the private sector. The improved irrigation scheduling and irrigation practices such as land leveling by laser technology and appropriate irrigation method result in reduced seasonal irrigation water requirements and consequently, help in controlling waterlogging and soil salinity in irrigated areas.

## Irrigation Scheduling

Improved irrigation scheduling saves water considerably. Based on soil conditions, irrigation to rice can be delayed for varying periods after infiltration of water from rain or previous irrigation. In the rice-wheat zone of Sind, the entire rice crop is grown in flooded fields, which are initially irrigated individually. Later in the crop season, with the increase in water depth, a largely-uncontrolled water flow takes place from field to field, thereby resulting in continuous flow irrigation. This practice is followed because of the uncertainty of water availability, resulting in over-flooding of ricefields. At the tail end of water channels, the fields are irrigated wherever water is available. Generally, fields are not properly leveled. Consequently, to irrigate the high spots, the fields are over-irrigated resulting in prolonged periods of deep water at the lower spots.

### Water-Saving Irrigation Regimes

Continuous submergence of soil is not necessary to obtain high rice yields. Once the transplanted seedlings are well established, irrigation could be delayed for some period after complete infiltration of ponded water without any yield loss. The potential saving of 20% to 50% in irrigation water primarily results from the reduction in percolation losses. To improve water-use efficiency of rice crop, farmers in Sind should adopt water-saving practices of maintaining a thin layer of standing water in the ricefield, saturated or alternate wet and dry soil regimes instead of the traditional practice of continuous submergence. These irrigation regimes can save 20%-70% of irrigation water without significant yield loss.

In the perennial irrigation areas, wheat is usually grown under the basin flood irrigation method. In these areas, more than 75% of the wheat receives a pre-sowing irrigation. The average interval between sowing and the first irrigation is approximately four weeks in the perennial irrigated areas, and five to seven weeks in the non-perennial areas. Generally, more irrigation is applied in the perennial than in the non-perennial areas. The average maximum interval between successive irrigations is six weeks in the perennial areas where there is a canal closure during January. The interval is slightly shorter in the non-perennial irrigated areas.

By adopting irrigation scheduling of wheat, about 17% of irrigation water could be saved compared to farmers' practices. The irrigation scheduling adjusts water application to climatic evaporative demand and soil water depletion, thereby causing considerable reduction in irrigation requirements for the growing season. Optimum irrigation scheduling prevents waterlogging and soil salinity, increases crop yields, and saves irrigation water.

## Discontinuation of Pancho System

Some farmers in Sind practice the Pancho System of irrigation. This system involves draining of standing water from the field at intervals of four to five days and re-irrigating the same ricefields. The standing water in the ricefields is drained out to adjoining low-lying areas and freshwater is applied. In most of the ricefields, the groundwater table rises and in some areas, reaches the surface layer of soil. Under these conditions, percolation either slows down or does not take place.

The Pancho System has helped farmers in increasing rice production, but in the absence of an efficient drainage system, the water is drained to low-lying areas resulting in waterlogging. For this, the length of the watercourses should be reduced and farmers should irrigate each field separately from the irrigation ditch. Also, minor channels should be constructed. Each field should have a separate water inlet from a watercourse for controlled irrigation.

### **Institutional Management Poses Threats to On-farm Water Management**

Some institutional arrangements and policy decisions affect farm-level water management thus encouraging wasteful use. For example, when groundwater is perceived as a common property, it is in the interest of an individual farmer to pump as much as possible. Collective action arrangements (e.g., restrictions on tubewell installation) should be made for equal distribution of water at the village level. Subsidies on water and on electricity for tubewell pumping are also contributing to excessive use of water. Tradable water rights may ensure efficient use of water resources, while allowing farmers to benefit from their traditional water rights.

The capacity to examine the feasibility of new practices, e.g., conjunctive use of surface water and groundwater, is hampered by lack of sufficient communication and coordination among institutions responsible for management of surface water, public tubewells, electricity supply, drainage, on-farm works, extension, and the reporting of agricultural data.

Source: Harrington, L. 2001. Synthesis of Systems Diagnosis: "Is the Sustainability of the Rice-Wheat Cropping System Threatened?" – An epilogue, pages 119–132 *In: The Rice-Wheat Cropping System of South Asia: Trends, Constraints, Productivity and Policy* (Kataki, P.K., ed.). Food Products Press, New York, USA.

## Improved Layout of Irrigation Ditches and Fields

In Sind, significant amounts of water are wasted due to negligence by farmers, bad layout of water channels, and weak bunds of ricefields resulting in low irrigation efficiency. The channels follow a zigzag pattern, which slow down water speed and cause siltation necessitating frequent cleaning of water channels. To improve the irrigation efficiency, layout of water channels should be straight and clear, and individual fields should be leveled. Farmers should construct proper field bunds to efficiently retain and control water to the required standing depth, and prevent or minimize water losses through reduced drainage effluent.

## Improved Drainage and Reuse of Drainage Effluent

Surface drainage is required for removal of excess water from land currently flooded to excessive depths in kharif rice season. Thus, more land could be made available for cultivation during winter. Subsurface drainage systems should be intensified, supported by government subsidies.

Recycling of drainage water could be practiced for water saving and conservation in the rice-wheat areas of Sind. Besides meeting the water needs at peak demand periods, drainage water reuse would be a quick-response water supply solution during water shortage periods, increasing both the water reliability and rice-wheat crop security.

### Farmers' Participation in Sind

Farmers should be organized to participate in the decision-making process for improving water management. The Irrigation Department should consider them as active partners in this process. This would improve equity and reliability of water distribution, which in turn would result in timely planting of rice and wheat. Subsurface drainage systems operated by the government perform poorly due to management and financial resource constraints. Therefore, participatory drainage management schemes should be established in which farmers share the capital cost and are responsible for operational and maintenance cost.

### Adapted from:

Aslam, M. and S.A. Prathpar. 2001. Water Management in the Rice-Wheat Cropping Zone of Sind, Pakistan: A Case Study, pages 249–272. In: Katak, P.K. (ed). *The Rice-Wheat Cropping Systems of South Asia: Efficient Production Management*. Food Products Press, New York, USA.

Corresponding author:

**M. Aslam**