Water Management

Much needs to be better understood about water management as part of the SRI strategy. The presently recommended practices were developed entirely empirically, and with the aim of introducing minimal changes in farmers' operations since SRI was already making a number of rather radical departures from usual practice. The group considering these issues underscored that we need to start with a better idea of *what works* as a basis for understanding *why it works*, and *what might work even better*.

Water Application

One of the most promising adaptations of SRI ideas to new water and soil management practices appears to be the use of **raised beds** being experimented with under the Rice-Wheat Cropping Systems Consortium.[1] These beds are elevated 10-15 cm above the bottom of furrows in which irrigation water is intermittently issued. Their length and width will vary depending on available land, labor and implements. This can give water savings of 25-30%, with positive effects on yield due to soil aeration plus retention of adequate moisture.

The standard SRI practice recommended from Madagascar experience has been to keep the soil **moist, but at least intermittently aerated**, during the vegetative growth phase. This involved small daily applications of water (if there was no rainfall that day), with drying out of the field to the point of surface cracking several times during this period. After panicle initiation, 1-2 cm of water is kept on the field up to 15 days before harvest. A similar regime is followed in Sri Lanka. In both cases about a 50% of saving in water is attained.

A study of 108 farmers in Madagascar who were using both SRI and conventional methods on their farms found that most of them were not managing water on their SRI fields as carefully as recommended. Instead, they were flooding their fields for a period of time (ranging from 1 to 10 days) and then draining it for a similar period (the average was 4.4 days of flooding, followed by 4.8 days drained, alternating throughout the vegetative growth period), with sometimes some variation in length of the periods during the growing season. This **alternate wetting and drying** (AWD) is certainly labor saving, and it may increase farmers' returns to their labor. Whether it increases their returns to land and water is not known.

Coordination with Transplantation

In Cambodia, timing of seedling raising in the nursery and transplantation is matched with the timing and concentration of rainfall, given that country's monsoon climate. Water can be stored in canals to be used during low rainfall periods. Early transplanting of seedlings is done several months before the monsoon in order to give the rice plants time to get well established and to accomplish abundant tillering before the rains start. This way the plants can better withstand the monsoon flooding and do not elongate as much as when less mature plants are submerged.

Timing of Irrigation

The duration of time for keeping a field saturated with water should depend on the relative effects of flooding on weed control (standing water inhibits weeds) and on the growth of the plant's roots and tillers (standing water inhibits the plants). Research should be con-

[1] *This includes the national agricultural research systems (NARS) of India, Bangladesh, Nepal and Pakistan, and the international agricultural research centers IRRI, CIMMYT, IWMI and ICRISAT, plus some individual members, including Cornell University (CIIFAD). The consortium was represented at the Sanya conference by its coordinator, Dr. Raj Gupta.*

ducted on the timing of irrigation to determine the best/optimum times and levels of flooding to strike a balance between these two objectives: suppressing weeds and promoting rice growth. At the same time, potential water savings under different water regimes and irrigation practices should be evaluated.

Water-Use Efficiency

This is an important concept and measure for assessing the potential efficiency of the SRI technique. Studies should be conducted (on-farm) on different aspects of irrigation water management in terms of efficiency of water use. Also different methods may be beneficial under various agroecological, biophysical or socioeconomic conditions. In Sri Lanka, some farmers have experimented with a **sprinkler system** to sustain their SRI crop during a period of drought. Yields were in the 3-4 t/ha range, not high by SRI standards, but at least these farmers got a crop, whereas their neighbors' crops failed completely.

SRI methods encourage rice plants' roots to begin growing deeply into the soil during the first few weeks. If these roots get well established, they can withstand subsequent drought conditions by tapping residual soil moisture at lower horizons. When seedlings are transplanted into a hypoxic flooded environment, their roots remain close to the surface, and such plants are very vulnerable to water shortages later during the growth cycle.

Not every rice farmer faces water constraints. The importance of water-use efficiency depends on whether water is relatively scarce. For many farmers, water saving is not a consideration. Increasingly around the world, conditions of scarcity are arising or getting more severe, however. In such situations, the evaluation of water management should be in both *agronomic* terms — what timing and amounts of water application will best meet the plant's needs — and *socio-economic* terms — what are the net benefits of different water regimes considering opportunity costs for water being used in rice production, and what are the *distributional effects* of costs and benefits associated with the use of water for rice compared to other uses.