

# Bedding down crops

New raised-bed systems may counter some of the soil and water problems of irrigated cropping, reports Warren Page

Irrigated cropping is widely practised in Pakistan and in India's rice-wheat belt. Yet the practice contradicts the high value placed on water by being relatively inefficient. Despite cropping rotations being different in Pakistan and India, several common problems are emerging: low yields, the beginnings of salinity, deteriorating soil structures, groundwater depletion and water scarcity.

Pakistan's cropping sector rotates a number of crops including wheat. Irrigated cropping dominates, with 80 per cent of cultivated land relying on some form of irrigation.

India's rice-wheat rotation is vital to the country's efforts to provide enough food. Rice and wheat provide 85 per cent of total cereal production and 60 per cent of the total dietary calorie intake.

The countries are not alone in confronting salinity, water use efficiency, declining yields and soil problems associated with cropping. Australian crop sectors are also seeing the same problems emerge in southern irrigated growing areas.

One innovative approach to these issues is raised cropping beds. These beds are formed and left in place for up to five years. Crops are planted into the beds, with access provided by narrow trenches between the beds.

In Australia, this approach has shown promise in allowing high-rainfall zones to be cropped, and also as a more water-efficient option

for broadacre crops in irrigation areas. In high-rainfall areas, the trenches either side of the beds drain away excess water and prevent waterlogging, while in irrigation areas the trenches deliver a controlled water supply to the root zone.

Two projects are now trialling this technology to see if raised beds can deliver similar water-efficiency solutions to Pakistani and Indian farmers.

Raised beds have been trialled in a past-project with initial results showing yield boosts of 35 per cent for maize. Wheat yields were also increased, by 20 per cent. This new project is helping in the expansion of raised beds in Pakistan.

In Mardan, Pakistan, the project has a dual focus. The first is establishing beds to develop optimal approaches for crops. Three types of beds are being trialled: wide beds, narrow beds and flat basin seed beds, the final as a control.

How these beds affect water interactions is crucial to their long-term viability. Irrigation water is introduced to the trenches between beds.

The movement of this water from the trenches to the root zones under the beds, known as subbing, is measured. This subbing must be at a sufficient level to ensure the crop roots can access water.

Two farmer groups are working with researchers to trial raised beds in the extension focus of the project. Each group has bought a



PHOTO: S S KUKAL

bed former/renovator and seeder for use.

Rabi wheat has been sown, with crops showing superior growth on raised beds than in traditional flat irrigation basins. Some encouraging results are also emerging regarding salinity, with raised beds having less salt in crop root zones than found in normal seed beds.

One aspect helping the Pakistani researchers has been collaboration with their counterparts working on the Indian raised bed project.

The Indian project, now in its fourth year, has been examining similar issues, though for rice-wheat rotations.

Rice planted on the beds has a portion of the root system in unsaturated soil. Although this presents a different challenge than in growing maize and wheat in rotation, many of the issues of water use and crop performance are common in both projects.

Site-specific recommendations have been critical to the success of the project in India. An early finding has been that in many areas, rice yields are lower on raised beds than in conventional planting.

Drying-out of the beds and subsequent water stress during tillering (sprouts emerging from the crown of the wheat plant) is a major factor. Sandy loam soils are particularly vulnerable, but early irrigation and increased sowing rates compensate.

Wheat yields on freshly formed raised beds are, however, higher than those on the flat.

Other options also being investigated are alternative crop rotations, including soybean and maize. When rice is replaced with either maize or soybean on beds, promising yields increases have been reported, including for wheat. In both projects changes in soil and water interactions are being monitored, with positive results reported.

Irrigation management, via drip irrigation, and water being added to trenches are being assessed. Each demonstrates that water savings are possible, but climatic factors might determine which provides the greater savings.

In Punjab province, the Indian team has sampled water to a depth of 1.8 metres, revealing wheat is extracting water at least to this depth. This is an important factor in limiting groundwater depletion and salinity. The lower the depth at which water is extracted, the less salinity rises.

Shallow-rooted crops do not extract water at lower levels, which together with over-irrigation is resulting in water tables rising, freeing up salt trapped in soils and bringing this closer to the surface. Groundwater is, however, over-utilised, depleting this.

Research undertaken in Australia as part of the projects has also produced similar positive results, opening up the possibility that raised beds may become a feature of the cropping landscapes in all three countries.

ACIAR projects are assisting in the expansion of raised-bed cropping in the region.