

# Raised beds prove their worth

The versatility of conservation agriculture was demonstrated in Pakistan, where trials were found to vastly decrease hardships for wheat–maize croppers. But no progress is ever truly possible without a broader social coalition willing to drive it.

BY MELISSA MARINO

Conservation agriculture (CA) is not a 'one-size-fits-all' approach. While its key principles of minimal soil disturbance, permanent soil cover and crop rotations remain consistent, the methods used to realise them can vary.

In Pakistan, ACIAR-funded CA research has centred on the use of permanent raised beds. This is largely through 10 years of work in the north-west, near Peshawar, led by Western Australian soil physicist Greg Hamilton.

In this part of Pakistan, maize–wheat crop rotation systems are common, as distinct from the rice–wheat and cotton–wheat systems found throughout the Punjab region, which covers Pakistan's centre and south, as well as the north of India. As the work concentrated on maize–wheat, most of the results and the best outcomes are from this system.

Mr Hamilton says results from two trial sites and several hundred hectares of farmer adoption in Mardan, north-east of Peshawar—where permanent raised beds using furrow irrigation are used to replace flooding irrigation—found many advantages. These led not only to an improved environment but also a greater overall profit.

From 1999 to 2010, through two ACIAR projects interspersed with Pakistani government funding over 24 cropping seasons, farmers across the Mardan district achieved an average increase in gross margin profits of 23–25%, Mr Hamilton says. This is due to several factors.

First, a raised-bed system requires less seedbed preparation compared with flood irrigation, replacing three or four separate field operations with one or two. This provides significant cost savings in labour, fuel and herbicides. Labour and herbicide use were also reduced because the system aids weed suppression. Raised beds have 30–50% fewer weeds than traditional systems, he says.

Water savings too were significant, with 30–50% less water used. And deeper and improved root zones, created by a deep-blade loosening and furrow making, led to increased

yields. There was a 10–20% yield increase in wheat and maize yields grew by 30–50%, Mr Hamilton says.

Dr Christian Roth, who was ACIAR research program manager for land and water resources at the time of the project, says the raised beds worked well for maize–wheat crop rotations, bringing the dual benefit of major water savings and improved soil structure.

Mr Hamilton says healthier soils improve water usage. "Over three or four years, soils developed that were much more stable to wetting and irrigation efficiency improved dramatically," he says.

Soils in Pakistan's north-west have been degraded over centuries due to over-cultivation and flood irrigation. "Excessive cultivation removes all the root material and soil organisms that feed off the root material, making the soil less physically stable and fertile," he says. "Soils in this condition fall apart when irrigation water is applied and the water is far less able to penetrate the soil."

Improved farming systems are urgently needed because Pakistan is one of the most water-insecure countries in the world and highly dependent on irrigated systems for

food. Over time, cultivated land has suffered substantial productivity declines, which have been estimated to be as high as 25% of gross production.

Mr Hamilton's project replaced flood irrigation with raised beds and furrow irrigation. The system uses two machines: a no-till disc seeder; and a bed-former deep-blade loosener that creates a bed in which the crop is grown and excavates two furrows that align with tractor wheels, creating a controlled-traffic environment.

This machinery applied CA principles, ensuring there was minimal soil disturbance and maximum root retention. But the precise nature of the machinery is also one of the key reasons that, despite the success of the trials, the system has not been more broadly adopted.

While it is not complex, the machinery is specific, Mr Hamilton says, and therefore has to be specially manufactured. Australia provided three sets of machinery for the trials and ongoing use, but manufacturing and selling the machines in Pakistan has proven problematic.

The machines, by local standards, were expensive to produce and parts hard to source. Attempts to adapt the machinery using cheaper, more readily available materials







Maize crop grown on permanent beds using the conservation agriculture and furrow irrigation practices of the ACIAR-sponsored technology in Mardan, Pakistan.



An Australian machine in Mardan, Pakistan, renovates beds on which maize was grown. The undisturbed stalks of the previous crop and seeds on the bed surface illustrate the retention of root systems and lack of soil inversion.



A Pakistan-made copy of the Australian no-till seeder is tested in a field near Faisalabad, Pakistan.



Conservation agriculture trials also impact wheat crops in maize-wheat farming systems in Mardan, Pakistan.

was difficult within the project's parameters and time frame, so development languished. While some prototypes were produced it is not known whether further production continued after the project ended in 2010.

"When you are trying a new technology with different and comparatively expensive machinery you've got yourself an adoption barrier," Mr Hamilton says.

"First, you've got a psychological barrier of a farmer having to change his ways; and second, at the same time he is required to buy new, more expensive machinery, so adopting the new technology can quickly fall into the 'too-hard basket'."

Efforts to break through this barrier were complicated by another obstacle entrenched in the Pakistani farming system: irrigation land is generally owned by wealthy landlords who lease smaller plots to tenant farmers.

"The motivation for landlords to change systems and invest is often just not there because they are financially comfortable," Mr Hamilton says.

"Advances in agriculture come from farmers who are sufficiently motivated to push the envelope or live on the edge."

Other institutional challenges to adoption came in the form of autonomous governments at provincial and national levels resulting in changing personnel and a lack of continuity, and travel restrictions in Pakistan making coordinated research and extension more difficult.

But with baseline research in place and some committed local partners, Mr Hamilton hopes the groundwork has been done from which adoption programs can be launched should the impetus arise.

"Water conservation and productivity increases mean this is a very impactful technology with many benefits," he says. "I would hope the follow-up could be institutionalised in Pakistan so support and promotion services are in place to aid broader adoption." ■

#### PARTNER COUNTRY PAKISTAN

**PROJECT:** LWR/2002/034: Refinement and adoption of permanent raised-bed technology for the irrigated maize-wheat cropping system in Pakistan 2004-10  
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