Food and Agriculture Organization of the United Nations

SAVE AND GROW FARMING SYSTEMS
FACT SHEET 6

RICE/WHEAT

Agro-ecological zone
Sub-tropical monsoon and irrigated

Main cereals Rice, wheat

Other crops
Maize, potatoes, sugar cane, cotton, legumes

Conservation agriculture the key to food security

Stretching 2.25 million sq km across South Asia, the Indo-Gangetic Plains are both the rice bowl and breadbasket of 1.8 billion people. Over the past 30 years, thanks mainly to Green Revolution improved varieties and technology packages, farmers there have developed a crop rotation system that produces rice during the summer monsoon and wheat during the short winter.

In northwest India, the expansion of the rice-wheat area and yield increases of 3 percent a year allowed India to boost wheat production from 20 million tonnes in 1970 to 65 million tonnes by 1995. Around that time, however, rice and wheat productivity began to decline, owing to 'soil fatigue', a continuous drop in input-use efficiency, groundwater depletion, and rising temperatures.

In response, the Rice-Wheat Consortium, an eco-regional initiative of national agricultural research systems and the Consultative Group for International Agricultural Research, launched a concerted effort in 1995 to promote resource-conserving technologies for cereal production, including zero-tillage, retention of crop residues, raised bed planting, crop rotation and the dry-seeding of rice.

A major constraint to wheat productivity is late sowing. Rice transplanting starts in July but often continues until late August, owing to the uncertainty of rains, the high cost of pumping groundwater, and labour shortages. Those delays result in a late rice harvest, which postpones the sowing of wheat. Precious time is also lost owing to the farmers' practice of thoroughly ploughing the harvested rice fields.

In many areas, the wheat planting date wheat has been brought forward by direct-seeding – sowing is done after the rice harvest with no prior tillage operations. Zero-tillage contributes to higher wheat yields, in the range of 6 to 10 percent, because it allows for timely sowing and produces a better crop stand. It also generates big savings on tractor operations, time and fuel. In some areas, irrigation water productivity has improved by 65 percent above that obtained under conventional practices. Water productivity improves further when wheat is planted on zero-tilled, furrow-irrigated raised beds.

The adoption of zero-tillage in wheat production has reduced farmers' costs per hectare by 20 percent and increased net income by 28 percent, while reducing greenhouse gas emissions.

For rice, the Consortium promoted the substitution of long-season cultivars with short-seasons ones, and direct

KEY POINTS

Zero-tillage direct-seeding raises wheat yields while reducing water and fuel costs.

Alternate wetting and drying of rice fields results in water savings of 30 to 50 percent.

After precision land-levelling, farmers need **40 per cent less water**, use less fertilizer, and harvest more grain.

"Needs-based" nitrogen management cuts fertilizer applications by 25 percent with no reduction in yield.

Clover grown in rotation **suppresses weeds** that might otherwise infest subsequent cereal crops.

Adoption of direct-seeding has been facilitated the ready **availability of seed drills** developed by the private sector

dry-seeding which, by eliminating the need for transplanting, reduces water use, energy costs and labour requirements.

During crop growth, various approaches are being promoted to help farmers increase rice productivity. One is alternate wetting and drying, in which the paddy is flooded and the water is allowed to dry out before re-flooding. Another is aerobic rice, where seeds are sown directly into the dry soil, then irrigated. Both approaches result in water savings of 30 to 50 percent.

Another resource-conserving technology introduced to the plains is laser-assisted land-levelling. Traditionally, farmers levelled their fields using scrapers and wooden boards. Now, laser-guided tractors, operated by private contractors, offer more precise levelling of fields at prices smallholders can afford. The technology reduces water losses by as much as 40 percent, improves the efficiency of fertilizer, and boosts yields by from 5 to 10 percent.

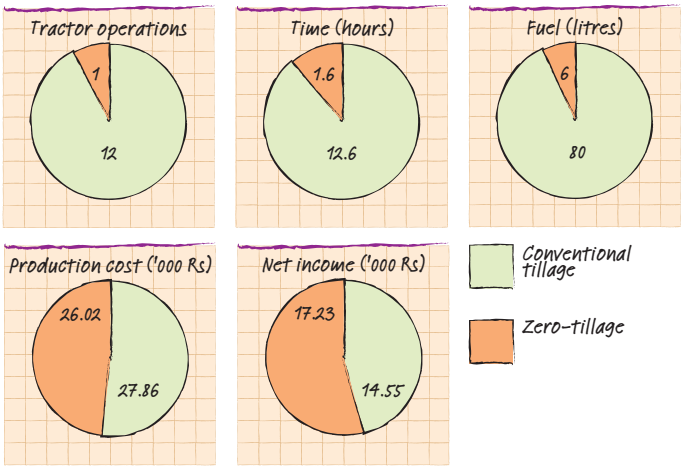
Farmers have also adopted new crop rotations. In Pakistan's Punjab province, smallholder farmers rotate rice with berseem clover, which improves soil fertility and suppresses weeds that might otherwise infest subsequent cereal crops. On the eastern plains, where fields generally remain fallow for 80 days after the wheat harvest, a summer mungbean crop planted on zero-tilled soil produces 1.45 tonnes per ha.

To reduce the wasteful use of fertilizer, the Rice-Wheat Consortium promoted 'needs-based' nitrogen management by introducing leaf colour charts indicating the best times for fertilization. Using the charts, farmers have reduced fertilizer applications by up to 25 percent with no reduction in yield.

Village surveys conducted across the plains in 2009 found that one in three farm households had adopted at least one resource-conserving technology. In northwest India, zero-tillage seed drills were the most common item of agricultural machinery after tractors. Their high adoption rate was made possible by the ready availability of seed drills developed by the private sector, with strong government support.

The impact of Save and Grow practices and technologies is reflected in recent increases in wheat production in India. Following poor yields from 2003 to 2007 in Punjab state, for example, wheat

Economics of zero-tillage and conventional tillage in wheat production, Haryana, India (per ha)



productivity has increased steadily, and average output exceeded 5 tonnes per ha in 2012.

To date, zero-tillage has been adopted mainly for the wheat component of the rice-wheat system. Applied to rice, it would lead to further, urgently needed, reductions in the use of irrigation water. Numerous trials of zero-till, dry-seeded rice have shown that puddling is not essential for high yields.

A decisive shift to conservation agriculture in rice – particularly the retention of crop residues – would create positive synergies in production of the two cereals. While many farmers have adopted the drill-seeding of wheat into residues of the preceding rice crop, most continue to burn rice straw after the harvest, which leads to serious air pollution.

To discourage burning-off, and encourage mulch-based zero-tillage, the Governments of Punjab and Haryana states are now upscaling a new technology, the 'Happy Seeder', which can drill wheat seed through heavy loads of rice residues.

Accelerated uptake of resource-conserving technologies also depends on improvements in policy support, technical knowledge, infrastructure and access to input and output markets. Needed is a systems approach, rather than commodity-centric technologies which make intensive, and unsustainable, use of labour, water and energy. A convergence among proven technologies would harness the full benefits of conservation agriculture.

Adapted from:
Save and Grow in practice: maize, rice, wheat. A guide to sustainable cereal production (FAO, 2016).
ISBN 978-92-5-108519-6
The book can be downloaded in PDF from:
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