Food and Agriculture Organization of the United Nations

SAVE AND GROW FARMING SYSTEMS
FACT SHEET 11

RICE/MAIZE

Agro-ecological zone
Monsoon rainfed and winter irrigated

Main cereals Rice, maize

Other crops/products
Vegetables, potatoes, legumes, meat, eggs

High yielding hybrids help adapt to climate change

Traditionally, many Asian rice farmers have maintained year-round production by growing either wheat or rice in the dry winter season, after the monsoon rice crop. Over the past two decades, however, rice-maize farming systems have expanded rapidly throughout Asia, driven by strong demand for maize and by the development of maize hybrids suited to areas with insufficient water for continuous rice cultivation.

Recent expansion of the area under rice-maize rotation has been most rapid in Bangladesh, where farmers began growing maize to sell as feed to the country's booming poultry industry. Between 2000 and 2013, maize production increased from just 10 000 tonnes to 2.2 million tonnes.

Maize grows well in Bangladesh's fertile alluvial soils and yields there are among the highest in the region. The crop is sown at the start of the cool *Rabi* season, in November, after the harvesting of the rice crop grown during the July-December *Aman* monsoon season. While *Rabi* maize is generally monocropped, many farmers also intercrop with potatoes and early maturing vegetables. Peas are also intercropped with maize because they do not compete for sunlight, nutrients or space.

Farmers typically use high-yielding hybrid maize, which requires significant inputs of nutrients. The cost of maize production is actually higher than that of other traditional winter cereals and, as a result, poorer farmers often plant maize on only a small area of land. However, the gross margin from maize sales, per hectare, is 2.4 times greater than that of wheat or rice. Maize also has fewer pest and disease problems.

Diversification to maize could also be a good strategy for climate change adaptation. Maize is more tolerant of high temperatures – a growing problem for wheat – and, per kg of grain, needs less than a third of the water consumed by the rice plant. By reducing groundwater extraction, maize production also helps reduce arsenic contamination of the soil, a severe problem in many areas of Bangladesh.

KEY POINTS

By shifting from rice to maize during the dry season, farmers **save groundwater from over-exploitation**.

Growing dry season maize costs more than other cereals, but **economic returns** are 2.4 times higher.

Farmers trained in resource-conserving crop management obtain maize yields that are **twice the national average**.

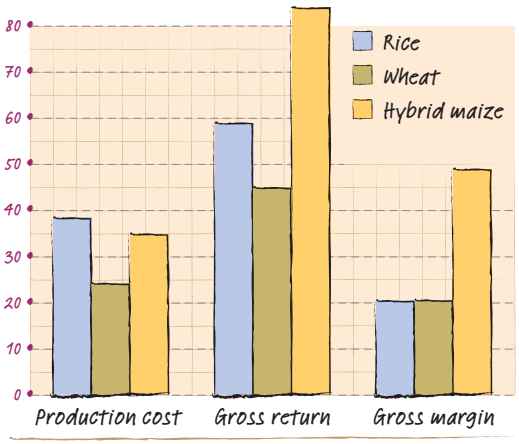
Farmers have **cut fertilizer applications** using poultry manure, and grow legumes to reduce nitrate pollution of aquifers.

Establishing rice and maize on **untilled permanent beds** produces higher yields, using 38 percent less water.

Drill-seeded rice yields are similar to those of transplanted rice, but require less water and labour.

Maize yields tend to decline in fields where it has been cultivated as a dry season crop for five or more years. To ensure the sustainability of rice-maize systems, farmers need to carefully time the planting and harvesting of each crop, improve their soil and water management practices, and use quality seed.

Economics of dry season rice, wheat and hybrid maize production in Bangladesh ('000 Taka/ha)



The soil requirements of rice and maize are very different, which makes the timing of maize planting tricky. Transplanted *Aman* rice is usually grown in well-puddled, wet clay soils, while maize grows best in well-aerated loamy soils. After the rice harvest, therefore, conventional preparation of fields for maize often involves three to five passes of a rotary tiller behind a two-wheel tractor. Farmers need to wait for up to three weeks before the rice fields are dry enough to be tilled. Late planting, in turn, can lower yields by 22 percent.

Conservation agriculture practices are reducing the need for ploughing and, with it, delays in maize planting. Establishing rice and maize on untilled permanent beds, using straw as mulch, has produced higher grain yields, using fewer inputs, than crops sown on ploughed land. Increased productivity is attributed to higher levels of soil nitrogen and generally better soil conditions. In India, permanent beds not only produce higher yields than ploughed land, but do so using up to 38 percent less water. In Bangladesh, saving water is crucial during the dry months from February to May.

The Bangladesh Agricultural Research Institute and the International Maize and Wheat Improvement Center have adapted and promoted drill-seeders originally developed for wheat, so that they can be used to sow maize and rice without tillage. In northwest Bangladesh, farmers using these seeders obtained rice yields similar to those of transplanted rice, but using less water and labour, and were able to harvest the crop two weeks earlier.

A study in Bangladesh compared yields and profitability under ploughing and zero-tillage. With permanent bed planting of maize, the combined productivity of rice and maize was 13.8 tonnes per ha, compared to 12.5 tonnes on tilled land. The annual costs of rice-maize production on permanent beds was Us$1 532 per ha, compared with US$1 684 under conventional tillage.

Hybrid maize requires large amounts of nitrogen to produce high yields. But Bangladesh's reserves of natural gas, which is used to produce urea fertilizer, are finite and non-renewable. One promising solution to soil nutrient depletion is the application of poultry manure, which is becoming abundant – Bangladesh's poultry sector produces about 1.6 million tonnes of manure every year. Good maize yields have been obtained by replacing with poultry manure 25 percent of the mineral fertilizer normally applied. Soil nitrogen can also be replenished by growing legumes after the maize harvest. In tropical monsoon climates, a summer mungbean crop mops up residual nitrogen and prevents nitrate pollution of aquifers.

Planting short duration rice varieties would allow farmers to plant maize earlier. However, those rice varieties produce lower yields, and farmers are generally unwilling to sacrifice the production of their main food crop. The Bangladesh Rice Research Institute is, therefore, developing higher-yielding, shorter duration *Aman* rice varieties. The future of sustainable rice-maize farming in South Asia also hinges on the development of high-yielding maize hybrids that mature quickly and tolerate both waterlogging and drought.

Maize farming in Bangladesh is still new territory for many farmers, and it will take time for them to fully integrate it into cropping systems that optimize production and improve soil health. Critical to the rapid and widespread adoption of sustainable maize production is the training of farmers in the precise timing of sowing and more effective management of irrigation and mineral fertilizer.

Adapted from:
Save and Grow in practice: maize, rice, wheat. A guide to sustainable cereal production (FAO, 2016).
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