Food and Agriculture Organization of the United Nations

SAVE AND GROW FARMING SYSTEMS
FACT SHEET 7

MAIZE/LEGUMES

Agro-ecological zone
Temperate, sub-tropical rainfed and irrigated
Main cereal Maize
Other crops
Grain and forage legumes

Traditional system makes more productive use of land

Maize-legume systems come in three basic configurations. One is intercropping, in which maize and legumes are planted simultaneously in the same or alternating rows. Another approach is relay cropping, where maize and legumes are planted on different dates and grow together for at least a part of their life cycle. Maize and legumes may also be grown as monocultures in rotation, with maize being planted in the same field after the legume harvest.

Such systems are practised throughout the developing world. Commonly planted legumes include beans, pigeon peas, cowpeas, groundnuts and soybeans, which are grown mainly for food, and non-edible legumes, such as velvet beans and jack beans, which are used as feed for livestock. All fix nitrogen in the soil and are useful as sources of mulch.

Maize-bean intercropping is a traditional practice in Latin America, especially in the land-scarce highlands. In Peru, practically all beans are planted along with maize. In areas of Central America where land is limited and rainfall low, maize is often intercropped with field beans.

When maize and beans are intercropped, their yields are generally lower than those of maize or beans grown in monoculture. Studies have found that maize yielded 5.3 tonnes per ha when monocropped, 5.2 tonnes when intercropped with bush beans, and 3.7 tonnes when intercropped with climbing beans. However, under intercropping, production costs per unit of output are usually lower and, because beans sell for up to four times the price of maize, farmers' income is higher and more stable.

Being drought-tolerant, pigeon pea is often intercropped with cereals in smallholder farming systems in Asia, Africa and the Caribbean. Pigeon pea is also deep-rooting, so it does not compete with maize for water, and is slow-growing in its early stages, which allows maize to establish properly.

As with maize and beans, both maize and pigeon pea,

KEY POINTS

Maize-legume systems usually produce less maize than monoculture, but provide **higher economic returns**.

Generally, **rotations provide better yields** and higher profits than maize-legume intercropping.

Higher land productivity makes maize-legume systems **especially suitable for smallholders**.

One hectare of soybeans fixes 22 kg of nitrogen, produces 2.5 tonnes of forage, and reduces *Striga* infestations.

Under conservation agriculture, the highest yields are achieved when maize is **rotated with legumes**.

Climate change mitigation funding would encourage smallholder adoption.

when planted together, yield slightly less than they do when cultivated alone. However, the overall yield from intercropping exceeds that which would have been produced by the corresponding monocrops – a comprehensive study of maize-pigeon pea intercropping in South Africa found that the system was nearly twice as productive as monocrops per unit of area. In maize-pigeon pea systems in India and Sri Lanka, planting four rows of maize to two rows of pigeon peas provided the highest net returns.

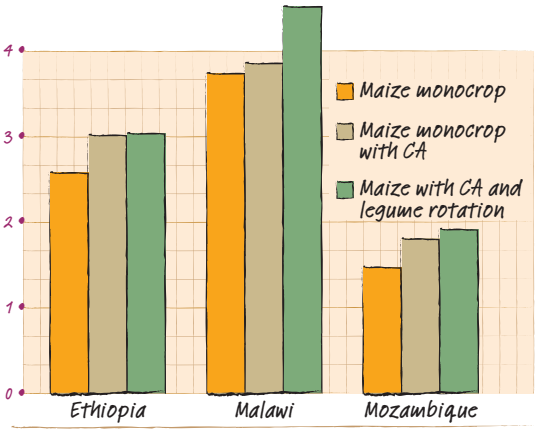
A study in central Malawi found that intercropping maize and pigeon peas under conservation agriculture produced almost double the vegetative biomass, and in drier years 33 percent more maize grain than conventionally tilled maize monocropping. In Mozambique, long-term maize-legume intercropping and zero-tillage improved rainfall infiltration five times over, thanks to good quality biomass production, which provided mulch. In Panama, planting maize on jack bean mulch saved farmers 84 kg per ha in nitrogen applications.

Relay cropping is practised in Brazil, Colombia and Central America, where maize is planted in May-June and beans are sown between the maize plants in August-September. In northern Ghana, planting fields with cowpeas, from three to six weeks before maize, yields a nutritious food at a time when other crops are not yet mature and provides nitrogen to the soil.

Maize-legume rotations also help to maintain soil fertility. In Mexico, smallholder farmers grow velvet beans in the maize 'off-season', which leads to significantly higher levels of soil pH, organic matter and nitrogen and a 25 percent increase in yields of the subsequent maize crop. Studies in Eastern and Southern Africa found that, under conservation agriculture, the highest maize yield increases were achieved when the cereal was rotated with legumes such as beans, cowpeas and soybeans. In Malawi, farmers' normal practice obtained maize yields of 3.7 tonnes per ha; with CA, yields rose to 3.9 tonnes; with CA and after soybeans, yields reached 4.5 tonnes.

A highly productive maize-soybean rotation system is practised in Nigeria. Planted before maize, the soybeans reduce *Striga* infestations by inducing premature germination of its seeds. Per hectare, soybeans produce about 2.5 tonnes of grain and

Impact of conservation agriculture (CA) and legume rotation on maize yields (t/ha)



2.5 tonnes of forage, and residues that supply from 10 to 22 kg of nitrogen. The system's maize yields are more than double those of monocropping.

In the Brazilian states of Mato Grosso and Paraná, planting maize on the mulch of early maturing soybeans improves moisture availability for the maize and reduces soil erosion. The rotation allows two harvests from the same field and alleviates pest pressure on both crops.

While the benefits of maize-legume systems are well known, smallholder farmers who rely on food crops for household food security are often reluctant to occupy their fields with non-edible legumes, regardless of the long-term benefits. Adoption of these systems in Africa is also constrained by dysfunctional markets for rotational crops, the unavailability of seed and the farmer's perception of risk.

Governments could invest in smallholder maize-legume systems as a means of ensuring food security, improving farmer incomes and improving soil health. Since non-edible legumes, such as velvet beans, have very high carbon sequestration potential, climate change mitigation funding may be available to encourage adoption.

Differences in the suitability of certain varieties for maize-legume systems have been observed. Breeding efforts should exploit productive interactions, such as strong-stalk maize that supports higher weights of beans.

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