

# The importance of legumes in cereal cropping systems

## Importance of legumes

Increased cultivation of legumes is essential for the regeneration of nutrient-deficient soils and for providing needed protein, minerals, and vitamins to humans and livestock. Legumes can be a means of improving the livelihoods of smallholder farmers around the world.

## Legumes in human nutrition

- **As a source of protein** – Grain legumes (such as pigeon pea, chickpea, soybean or mungbean) are a good source of protein, with a protein content ranging from 17-40%. By combining cereal and grain consumption, farmers and their families can achieve protein balance and nutritional improvement.
- **As a source of important vitamins and minerals** – Legume seeds contain significant amounts of minerals (calcium, zinc, iron) and vitamins (folic acid and vitamin B).
- **As a way of reducing cholesterol and blood sugar.**

## Legumes for animal nutrition

Cereal crop residues supplemented with forage legumes significantly increase overall animal productivity. For example, increased poultry egg production has been reported when pulse grains are included in their feed.

Adding the residue from legume plants into livestock forage can increase the digestibility and overall quality of cereal crop residues. For example, maize residues tend to be high in carbohydrates but low in protein; therefore, adding leguminous plants will contribute to improved livestock nutrition.



*Figure 1. Beans sown following the maize harvest in order to enrich the soil, diversify the foods available for human consumption, and improve cattle feed.*

## Legumes for crop and soil improvement

For optimum yield, crops require a supply of mineral nutrients, the most important of which is nitrogen. Exhausted soils are often low in nitrogen, meaning that farmers are normally applying inorganic fertilizers. However, as fertilizer costs increase, farmers struggle to obtain good yields. This problem can be addressed by incorporating legumes into the cropping system.

Leguminous plants have a special relationship with nitrogen-fixing bacteria called *Rhizobium*. By biologically fixing nitrogen levels in the soil, legumes provide a relatively low-cost method of replacing nitrogen in the soil, enhancing soil fertility and boosting subsequent crop yields.

### Legumes can be incorporated into cereal cropping systems in a variety of ways:

- Green manuring
- Intercropping
- Grain-legume rotations
- Leguminous shrubs

Legumes can be used as a **green manure**, a general term used for plants that enrich soil fertility. Green manuring with legumes involves growing the plants, then slashing the crop and leaving it on the soil surface. Leaving the crop on the soil surface has additional benefits, as it also reduces soil erosion and conserves soil moisture.

A drawback with green manuring is that it involves the loss of a growing season, especially in areas where there is only one short growing season, since the grain is not harvested from the legume and it displaces the cereal crop. Also, because the grain is not harvested, growing legumes as green manures does not provide the benefits to human diets. However, when soil quality is low and fertilizer prices are high, green manuring is an option for farmers to consider, especially in regions with longer growing seasons.

To overcome the loss of a full growing season, **intercropping** or **relay intercropping** with legumes is a good alternative. With intercropping, alternating rows of the cereal crop and legumes are planted at the same time. However, in some cases the legume may compete with the cereal crop for water and nutrients, reducing the yield of both crops. With relay intercropping, this competition for resources is reduced: the cereal crop is sown first, followed by the legume a few weeks later. In this scenario, both the grain yield and the nitrogen content have been found to improve.

Legumes can also be grown in **rotation** with cereal crops. This system is intended to provide the farmer with a useful harvest while at the same time improving the fertility of the soil. However, since part of the legume crop is harvested (and thus removed from the field), the effect on soil fertility, equivalent to 5-15 kg/ha of nitrogen fertilizer, is not as high as when the entire legume crop is left on the soil surface, as

with green manuring. In order to benefit fully from cereal-legume rotations, farmers need to maximize the productivity of the legume crop in addition to the cereal crop.

**Leguminous shrubs** can also improve soil quality. One option is to grow the shrubs in rotation with the cereal crop, cutting the shrubs to produce mulch and fodder. However, this alternative does involve the loss of a growing season. A second option is to grow leguminous shrubs as hedgerows either within or around the field. When the bushes are pruned, the clippings can be applied as mulch to the soil surface. An added advantage of these shrubs is that farmers can also produce honey during the flowering period.

*It is important to choose the legume carefully, taking the cereal crop into consideration. For example, soybeans, pigeon peas and mungbeans are recommended as relay crops within rice cropping systems. As intercropped with wheat, lathyrus, lentils and chickpeas are recommended. In maize, pigeon pea, sunn hemp and cowpea have positive effects, but vigorous climbers such as velvet bean can choke the maize plants and make harvesting difficult. Extension specialists can assist by making recommendations of crop combinations.*

#### **Constraints to legume production**

- Legume production presents new diseases, pests, and weeds, which farmers will need to learn how to control.
- Low soil pH, high salinity, flooding, and nutrient deficiencies can negatively impact the nitrogen fixation process, preventing the legumes from improving soil fertility to their full potential.
- Legumes are often expected to grow in existing soil moisture conditions. Reduced or non-existent irrigation may lead to drought stress.