Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

CUBA
Biological nitrogen fixation

Rice plays an extremely important part in the cuisine of Cuba and is the central ingredient of many of its national dishes. Cuba's annual rice consumption is estimated as high as 60 kilograms per capita, meaning each person in the country eats more than a kilo of rice a week. To meet this demand, Cuba dedicates some 200 000 hectares (ha) of land to rice production, but, until recently, due to soil infertility and the high cost of chemical fertilizers, the yields were low and more than 55 per cent of the rice consumed was imported. However, a relatively unknown forage crop has changed that. After studying the soil and water situation in Cuba's rice fields, the Joint FAO/IAEA Division worked with scientists and introduced farmers to sesbania, a tropical forage legume that can improve soil fertility through a process known as biological nitrogen fixation (BNF).

Rice production: what Cuba can teach the world

Offseason sesbania fertilizes rice fields

While globally rice fields were increasing steadily during the past decades, Cuba was seeing its rice productivity decrease to the point that its fields only produced enough to meet 45 per cent of consumer demand. As a result, the country was spending more than US $200 million a year to import rice. The government took a stand in support of its rice farmers, and in 2012, set a goal of increasing domestic rice production to 55 per cent of consumption by 2016.

The reason for the low yield was well recognized: soils were poor and needed fertilizer. However, Cuba did not produce fertilizer, and imported fertilizer was usually too expensive for poor, small-scale farmers to buy the in the amounts needed to improve their yields. The Joint FAO/IAEA Division, working with the Cuban Ministry of Agriculture, Instituto de Suelos, initiated efforts to introduce biological nitrogen fixation to Cuba's rice fields.

Nitrogen is a major nutrient required for plant growth, and biological nitrogen fixation (BNF) refers to a process through which certain types of plants, mainly legumes, absorb nitrogen from the atmosphere, convert it into plant nitrogen and then their roots leave it in the soil as residue, which serves as a natural fertilizer that can be used by subsequent crops.

Rice yields surpass government's goals

Collaborating with the Instituto de Suelos, the Joint Division evaluated the rice fields, studied the repository of legumes and forage crops that grew in the area, and determined that the forage crop, sesbania, would be the most appropriate off-season planting for the rice fields. By planting sesbania in rice fields, biological nitrogen fixation would help farmers produce their fertilizer naturally to enhance soil fertility. Thus, when rice was planted in the fields where the sesbania had just been harvested, the BNF had improved soil fertility, and rice yield increased by 35 per cent, or 1 tonne per hectare.

With 200 000 ha of sesbania planted to fertilize rice in Cuba, the rice production in Cuba increased to 70 per cent of consumption, far surpassing the goal the government had expected to meet by 2016. Post-harvest measurements, conducted by measuring stable isotopes in the soil, found that the sesbania plants had converted and produced between 50 and 200 kg of nitrogen per hectare for the subsequent rice crop.

A cornerstone of soil management

Nitrogen fixation is not a new technology. From the 1970s to the 1990s, the Joint Division defined and introduced the technology, determining the fixation potential of a large number of individual grains, forage and tree legumes. Since then, the Division has continuously added to and adapted the technique for various production systems. The work of the Joint Division has helped make biological nitrogen fixation a cornerstone of today's soil fertility management systems.

In this case of rice in Cuba, the Joint Division was able to refer to its portfolio of the various legume crops it had documented and compare that information to the specifics of the Cuban situation. Taking note of the attributes of the legumes and the needs of the rice field, the Division identified sesbania as the crop that would work best.

Not only did rice yields increase from 2.8 tonnes to 3.8 tonnes per hectare in the first rice planting after the sesbania was harvested, farmers were also able to reduce their use of chemical fertilizer by 48 per cent. The combination of increased yields and decreased fertilizer costs meant economic benefits of US $452 per hectare, not to mention the national benefit of the extra 200 000 tonnes of rice for consumption.

Continuing with the programme, the Joint Division and Instituto de Suelos are now working with the National Association of Small Scale Farmers to evaluate the nitrogen fixation potential for different agro-eco regions and have also set up farmer field days and offered training to continue introducing the benefits of crops capable of fixing nitrogen in the soil.

The Joint Division's work with Cuba is part of a 10-country Latin American project aimed at supporting resource-poor farmers by improving soil fertility and crop management. Three other countries in the project that also have high demands for rice – Brazil, Haiti and Panama – are also taking steps to pass on the concept of biological nitrogen fixation to their farmers.

Partners:

National Association of Small Farmers, Cuba

Instituto de Suelos, Cuban Ministry of Agriculture

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