The Amazing Effects of Rice Straw: Recycling Crop Residues to Improve the Soil

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How the recycling of crop residues improves the soil

Does rice straw have any value? Looking at the practices of most farmers, it seems not! The burning of rice straw is a common sight during the harvest period in many parts of Asia. Yet a number of farmers think otherwise. One of them is Isidro Prado from Alba in the municipality of Tago, Surigao del Sur, Philippines. He does not consider rice straw as trash to be disposed of in the easiest way. Instead he recognizes rice straw as essential for maintaining the fertility of his rice field. About eight years ago, he learned that returning the rice straw could help to overcome the problem of zinc deficiency that was prevalent in his rice field at that time.

Prado, now 69 years old, started cultivating the rice field he inherited from his parents in 1969. For about 15 years he cultivated his rice field like most farmers: using high yielding varieties (HYV), fertilizers and pesticides. Although he considered a yield of about 40 *cavans* (one *cavan* equals 50 kg or 110 lbs.) from his 0.38 hectare (0.94 acre) field acceptable, he felt lucky to have even five sacks of *palay* (unhusked rice) left over for consumption; barely enough to last his family a few months. Unfortunately, most of his produce went to the money lender who asked up to 10 *cavans* as payment for each 1,000 Philippine pesos (1 US dollar = P 47.2) of borrowed capital.

A zinc deficiency became apparent in Prado's fields during the early nineties. Within a couple of years yield went down to 12 to 17 sacks, an equivalent of about 30 *cavans* per hectare. During that time the rice plants always looked somewhat sickly, but the worst result was that most seed heads were not filled with grain.

The condition of his land improved when in 1996 he joined a farmers' group served by the Tago Center for Sustainable Agriculture (TCSAI), a newly formed NGO. The NGO workers encouraged Prado to return rice straw to his field after each harvest. They also introduced several traditional and newly bred lines of rice from the MASIPAG network (Magsasaka at Siyentipiko para sa Pag-unlad ng Agrikultura – Farmer Scientist Partnership for Development, Incorporated). These rice varieties grew well and brought about yields comparable to the HYVs, although Prado no longer applied chemical fertilizers.

Within two years (or four croppings) the yield of his rice crops was back to normal. The signs of zinc deficiency were gone. He soon realized another big advantage: because he no longer needed to buy fertilizers and pesticides, he needed less capital. Now, Prado needs to borrow only P 2,000.00 per cropping, for which he has to pay an equivalent of seven sacks of *palay*. Thus he is able to keep most of his rice for consumption. He covers most of his cash needs by selling copra (dried meat or kernel of coconut) and banana.

Due to this experience, Prado keeps on spreading the rice straw in his field after every harvest. He says it is best to do it immediately after harvest. "If you wait longer, the straw becomes hot and it is more difficult to broadcast it," he explains. Besides, the straw starts to develop molds which cover the straw with an unpleasant dust. Once a year, he adds about 20 sacks of rice hulls from the nearby rice mill as additional soil conditioner.

Many farmers are reluctant to scatter rice straw in the field, because they expect problems during land preparation. "Not so," says Prado, "but you have to let the rice straw decompose for about one month on the surface." An extension worker once told him that this way microbes involved in the decomposition process will even add nitrogen to the soil. "If you incorporate the rice straw immediately and plant again, the microbes that decay the straw would take away nitrogen from the young crop. Besides, methane gas will be released which disturbs the young rice plants."

In addition to the reduced expenses as well as the more filled and tastier grains, Prado realized another important benefit. He no longer has to work with farm chemicals. Before, whenever he had to spray pesticides he felt very exhausted and even sickly afterwards. Even though several of his neighbors continue to use pesticides, pests do not seriously affect his rice.

To be sure of a good harvest, Prado usually plants at least three different rice varieties. At the time of writing, he was testing two varieties in smaller plots. In another small portion he was planting a glutinous rice variety called Tapol, which his family uses for special occasions.

Asked what he would recommend to other farmers, Prado replies that it would be good if farmers could stop burning the straw and utilize it instead on their farms. "Considering that the straw of an average harvest contains 25 to 40 kg (55 to 88 lbs.) of nitrogen, they are really burning money," he reasons.

What may be even more important than the nitrogen is the energy (carbon) contained in the straw. Soil microbes convert most of the carbon into humus, which ensures the supply of nutrients to the next crop. Energy from the straw also enables soil organisms to better contribute to the maintenance of good soil structure, allowing for better aeration and enabling the soil to absorb and hold more water. Thus, Prado considers recycling of rice straw an essential step towards reducing the costs of rice farming and improving the situation of farmers.

The value of rice straw

Per metric ton, rice straw typically contains 5 to 8 kg (11 to 17.6 lbs.) nitrogen, 0.7 to 1.2 kg (1.4 to 2.64 lbs.) phosphorous, 12 to 17 kg (26.4 to 37.4 lbs.) of potassium and 40 to 70 kg (88 to 154 lbs.)

silica. When the straw is burned, the carbon, which comprises 40 percent of the straw, goes immediately into the atmosphere and increases the CO_2 content, thus contributing to the problem of global warming. Otherwise, it could have supplied soil organisms with energy.

Likewise, 93 percent of the nitrogen content is lost. Therefore, on average about 30 to 40 kg (66 to 88 lbs.) of nitrogen per hectare is unnecessarily released into the atmosphere. In addition, 25 percent of the phosphorous and 21 percent of the potassium are lost during the burning. Heat also renders the silica in the ash less soluble than in fresh straw.

Where does the soil nitrogen come from?

For eight years, Isidro Prado has no longer applied nitrogen fertilizer to his fields. Yet, on average, he obtains between 4,000 and 4,500 kg (8,800 to 9,900 lbs) of *palay* per hectare. Assuming that one metric ton (2,200 lbs.) of harvested rice contains about 12.5 kg (27.5 lbs.) nitrogen, the cereals harvested from one hectare (2.47 acres) remove about 54 kg (118.8 lbs.) of nitrogen. The straw left in the field contains around 30 kg (66 lbs.) of nitrogen. Thus, the harvest from one hectare represents about 84 kg (184.8 lbs) of nitrogen. But with the retention of the rice straw, probably most of the 30 kg (66 lbs.) nitrogen in the straw from the previous harvest will have been reincorporated into the soil.

Additionally, soil scientists claim that biological nitrogen fixation related to the decomposition of the straw can potentially supply an additional 20 to 25 kg (44 to 55 lbs.) of nitrogen. There remains a gap of 25 to 30 kg (55 to 66 lbs.), from the nitrogen that is removed with the crop (i.e., grains and straw) during harvest. Although a small part of this nitrogen comes with rainwater, this is strong evidence that various nitrogen-fixing microorganisms in the paddies supply most of the balance.

This is made possible through the association of bacteria living on the surface of roots, giving rice plants (as well as various other grasses) access to nitrogen that certain bacteria fix from the air. [*Editor: Choudhury and Kennedy cite the role of plant growth-promoting rhizobacteria (PGPR) such as Azotobacter, Clostridium, Azospirillum, Herbaspirillum, Burkholderia and Rhizobium, in improving the ability of the rice plant to assimilate soil N*]. It is essential that the soil be well aerated for such bacteria to thrive. Therefore, if the situation allows, rice fields should be flooded and drained alternatively. Additionally, these bacteria require sources of energy, such as straw, to function efficiently. If the soil is deprived of straw and other types of organic matter, nitrogen-fixation processes cannot occur.

These effects were obvious on Isidro Prado’s farm when he transitioned away from several years of intensive application of synthetic fertilizers. With his rice field losing fertility and the crop suffering severely from zinc deficiency, it was not until he began to recycle the rice straw that conditions improved. Now Prado regularly returns the straw to the field to enhance the fertility of his rice field.

References

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