Turning the “Green revolution” green
The first Green Revolution substantially increased rice production in many countries in Asia, using a package of new seeds, fertilizer and irrigation. In his book The Doubly Green Revolution: Food for all in the 21st century, Gordon Conway calls for a second Green Revolution that stresses environmental protection as an integral part of crop management. While many factors are involved in rice production (e.g., land preparation, variety, nutrient, water, etc.), this paper looks at the role of pesticides and trends in their use in Asia and the changes needed in their use to help green the “Green revolution”.

The world’s rice parks cover some 150 million ha of land. These rice parks need to be kept healthy and vibrant.

The pesticide explosion
The most damaging environmental consequence of intensive farm production in the past 30 years has been farmers’ widespread use of pesticides, especially insecticides. Of all the agro-chemicals, insecticides are typically more toxic then other agro-chemicals. Insecticide use exploded because of both supply and demand factors. On the demand side, farmers worried that their larger and more frequent harvests would attract insect pests. This fear, along with aggressive marketing by pesticide producers, led farmers to spray ever-increasing quantities of these chemicals on their crops (Figure 1).
Figure 1. Trends in use of insecticides and other pesticides in wetland rice production in Indonesia. Source of raw data: Cost Structure of Paddy and Secondary Food Crops, Badan Pusat Statistik, Indonesia (various issues).

The “costs” of pesticide use
The primary reason behind the increase in insecticide use has been the relatively low cost of these products. Advances in the chemical industry have produced highly affordable pesticides. Many observers mistakenly view pesticides as expensive inputs that destroy farmers’ profit margins. The fact is that pesticide costs, even in intensive production, absorb only a small share of the total value of the rice crop (Table 1). Farmer surveys conducted for five years in eight rice bowls in China, India, Indonesia, Thailand, Vietnam and the Philippines found that total pesticide costs accounted for less than 73% of the gross value of production, on average across the sites. In the Philippines, the share was just 52%.

Table 1. Pesticide use per crop in some rice bowls of Asia, (1994-99) (arranged in order of increasing pesticide use).

<table>
<thead>
<tr>
<th>Sites</th>
<th>Pesticide use (kg active ingredient ha-1 crop-1)</th>
<th>Hand weeding (pd/ha)</th>
<th>Pesticide costs as a % of gross value of production</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Insecticide</td>
<td>Herbicide</td>
<td>Others</td>
</tr>
<tr>
<td>Tamil Nadu, India</td>
<td>0.29</td>
<td>0.11</td>
<td>0.01</td>
</tr>
<tr>
<td>Central Luzon, Philippines</td>
<td>0.18</td>
<td>0.34</td>
<td>0.18</td>
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In addition to direct monetary costs, there are however, many hidden costs associated with the indiscriminate use of pesticides. Pesticides kill the natural predators of many insect pests, such as spiders, thus contributing to pest outbreaks instead of preventing them. One of the worst examples of this phenomenon occurred on the Indonesian island of Java in the 1980s, when excessive pesticide use decimated the insect populations that preyed on the brown planthopper. The planthopper’s short breeding cycle then allowed it to breed unchecked by predators.

Worse, excessive pesticide use has damaged the health of farmers and consumers. Because of poor training and/or lack of money for buying proper pesticide application equipment, farmers are directly exposed to chemicals that injure their eyes, skin, respiratory tract and nervous system. Studies by Agnes Rola of the University of the Philippines Los Baños (UPLB) and Prabhu Pingali, formerly of IRRI, showed that the costs to farmers’ health outweighed the benefits gained from pesticides. Furthermore, farmers sometimes apply pesticides very close to harvest, which may endanger the health of consumers.
Hopperburn caused by rice brown planthopper

Insect predators of rice insect pests
Insect predatory spiders: a large complex is active in the rice field

Parasitoids of rice insect pests: very active in the field
Many farmers in Asia use poor and unsafe application practices when applying agro-chemicals.

**Trends in pesticide use – cause for hope**

Yet there are grounds for optimism. For example, in the Philippines, farmers in the above-mentioned survey applied by far the lowest levels of insecticides in any of the areas surveyed. The next lowest users, farmers in Tamil Nadu, India, used 60% more insecticides than the Filipinos. The highest users were farmers in Zhejiang, China, who applied more than 20 times as much active ingredient as the Central Luzon farmers.

The low level of insecticide use in the Philippines is the culmination of a declining trend that began slowly in the mid-1980s and accelerated in the 1990s (figure 2). Among farmers surveyed in Central Luzon, the quantity of insecticide active ingredient applied per hectare increased ten-fold from 1966 to 1979, from less than 0.1 kg/ha to nearly 1.0 kg/ha. But by the middle of the 1990s, this figure had been cut in half. Since then, use has declined even more, and levels of insecticide use are now slightly below what they were before the first Green Revolution began. Recent data from Vietnam also show that farmers have successfully reduced the number of sprays used in rice cultivation by half due to the effects of a well-designed information campaign. In contrast, recent data from China show that per hectare pesticide costs in rice cultivation increased steadily from 1980 to 1998. A similar trend is happening in northern Vietnam. Figure 1 above also shows that insecticide use has been increasing in Indonesia.
Factors involved in reduced pesticide use
Two main factors appear to account for low insecticide use by Filipino rice farmers. First, education campaigns based on research findings from entomologists at UPLB, the Philippine Rice Research Institute, IRRI and other organizations appear to have enjoyed some success in convincing farmers of the dangers of insecticide use. Second, insecticide prices are relatively high in the Philippines – double the prices in Thailand, Vietnam and Tamil Nadu, and six times China’s subsidized prices. That said, remember that pesticide costs are still a relatively low 52% of total farm revenues for irrigated farms in Central Luzon – revenues that, by the way, are higher than in the rice bowls of neighboring countries. Thus, Filipino farmers can afford insecticides, but they are choosing to use them carefully, if at all.
Hands on farmers' training in Farmers' Field School (FFS)

Farmers' training - Agro-ecological mapping (FFS)

Discussion on insect management with rice farmers.
The challenge in reducing pesticide use
The downward trend in insecticide use in some countries is heartening, but much remains to be done. Many farmers still overuse insecticides, which can damage water supplies and the environment. More farmers must learn to differentiate harmful, harmless and beneficial insects, and about the damage pesticides do to the environment and their own personal health. The second Green Revolution against insecticide overuse in countries such as the Philippines is not over. But the good fight is underway, and substantial progress is being made.

Selected References


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