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Pesticides and Productivity – a Study of Vegetable Farming in Nepal

In Nepal, agriculture is commercializing day by day and levels of agro-chemical use are growing. This is beginning to raise concerns about the health and environmental impacts of farm chemicals such as pesticides. Thus, a useful question to ask is how and to what extent pesticides help Nepali farmers increase their yields and profitability.

This SANDEE study looks at the effectiveness of pesticides in reducing crop losses amongst vegetable farmers in Nepal. The study is the work of Ratna Kumar Jha from the Department of Agriculture, Ministry of Agriculture and Cooperatives, Nepal and Adhrit Prasad Regmi from Center for Rural Development and Self-help. The results suggest that pesticides do help improve farm productivity. However, farmers use too much pesticides and it would be economically beneficial for them to reduce the amount they use. The average amount of pesticides used on farms in the study area is some four times more than what is needed. While 3 percent of farmers use the optimal level of pesticides, the majority (74 percent) use more than what is economically efficient.

In Nepal, the Department of Agriculture uses the Farmer Field School approach to educate farmers about Integrated Pest Management (IPM). This study recommends that the Farmer Field School curriculum and activities be re-vamped to encourage more efficient and judicious use of pesticides in vegetable farming.

THE PESTICIDE PROBLEM

Chemical pesticides play an important role in agriculture by combating pests. Indeed, in the past fifty years, increases in agricultural productivity have been partly due to the enhanced use of pesticides. In many countries there are, however, growing public objections to the use of chemical pesticides because of their negative impact on human health and the environment. What is more, in their quest to combat pest problems, farmers frequently apply unnecessarily high doses and inappropriate combinations of pesticides. This costs farmers' money and reduces their profitability. Thus, accurate and locally-specific information about pesticide use in agriculture is very important for effective agricultural and environmental policy.

The use of pesticides on vegetable crops in Nepal has increased dramatically in recent years. Use is particularly high in vegetable, mustard and cotton cultivation. Farm chemicals are used intensively in the Terai region and in Kathmandu valley and its surrounding areas where agriculture is significantly commercialized. Jha and Regmi study pesticide use in Cole (Cabbage and Cauliflower) crop production in Bhaktapur district of Nepal.

VEGETABLE GROWING IN BHAKTAPUR DISTRICT

The information for the study comes from a survey of Cole farmers in 2006. This area has a vibrant community of commercial vegetable farmers and produces the largest amount of vegetables among the three districts in Kathmandu valley. Overall, the district is home to 54 vegetable farmer groups, located in 11 vegetable production pockets. As of 2006, some 20 Farmer Field Schools (FFS) had trained a total

This policy brief is based on SANDEE working paper No. 43-09, 'Productivity of Pesticide Used for Vegetable Production in Nepal' by Ratna Kumar Jha and Adhrit Prasad Regmi. The full report is available at www.sandeeonline.org

of 505 farmers (both men and women) in Bhaktapur.

Five vegetable production pockets were selected from an area where farmers cultivated Cole crops intensively from January to May, 2006. A sample of 211 Cole farmers (approximately ten percent of the Cole farmers in the area) were interviewed during the cropping season. This sample included 67 FFS-trained farmers and 144 FFS non-trained farmers. The study collected basic socio-economic information about farm households. Data relating to agricultural inputs and outputs were also collected in successive rounds of interviews; these interviews covered the planting-to-harvesting cycle of the Cole crop.

ASSESSING THE IMPACT OF PESTICIDES

Pesticides are different from other agricultural inputs in that they do not directly boost yields in the way that fertilizers do; instead they reduce crop losses caused by pests. The effectiveness of pesticides in reducing potential crops losses due to pests can therefore be used as a measure of the impact of pesticides on farm productivity. This is the approach that Jha and Regmi take (see sidebar for more on this issue). Their study also identifies the level of pesticide use that optimizes yields and maximizes profits for a farmer.

As part of their study the researchers take into account a wide range of other factors that affect farm productivity. These factors include the amount of nitrogen, phosphorous and potassium nutrients that farmers' use, the labor and capital they employ and whether they have had to deal with hailstorms. The assessment also looks at the effectiveness of FFS training on potential yields.

PESTICIDES DO BOOST YIELDS – UP TO A POINT

Farmers in Bhaktapur use 43 commercial products and 20 different pesticides. Out of all the pesticides used, 76 percent are insecticides and 19 percent fungicides. Overall, an average of 2,633 grams of pesticides is applied per hectare of Cole crop. Farmers spray pesticide nearly 4 times per season on average. Ninety percent of the Cole crop growers spray pesticide 2- 6 times.

The average Cole crop yield per hectare in Bhaktapur is about 23,000 kilograms. Statistical analyses by Jha and Regmi indicates that fertilizer use and labour are among the inputs that boost yields; using all three fertilizers together, however, does not have any yield increment. This suggests that farmers may not be using fertilizers in correct combinations, an issue that is linked to how farmers learn to use fertilizers and the operation of the Farmer Field Schools. An important finding is that FFS training seems to have no significant impact on farm yields.

Figure 1: Area- Bhaktapur District, Nepal and Study Locations

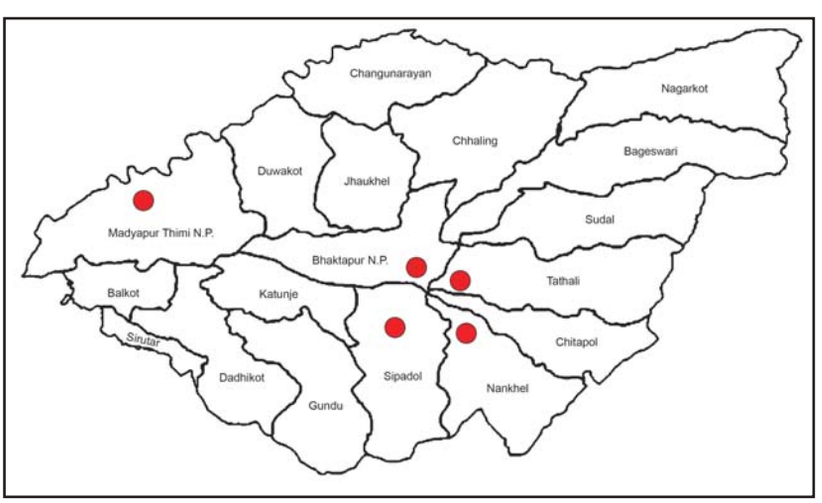
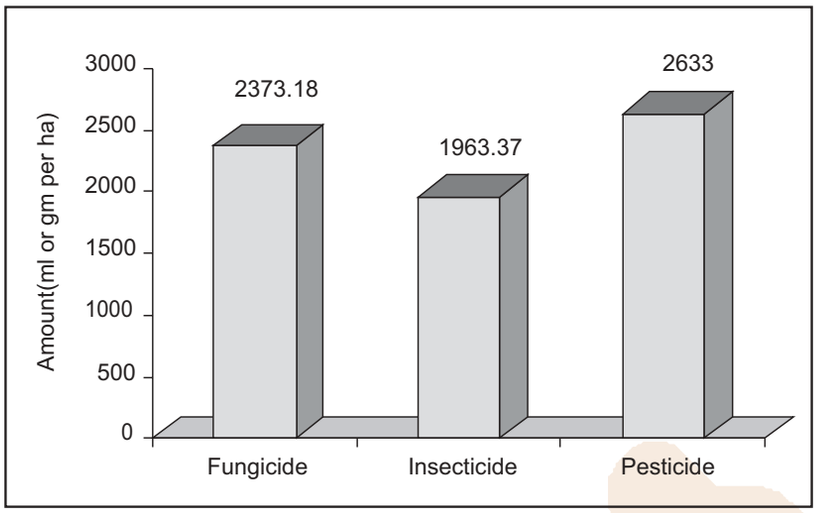


Figure 2: Average Amount of Pesticides Used on Cole Crop (grams a.i./ha)



Pesticide use contributes significantly to Cole crop production by limiting yield losses. The average Cole crop yield in cases where no pesticides are used is 6,703 kg per hectare, which is 35 percent of the average production of Cole in Bhaktapur. The maximum yield that can be obtained using pesticide is 20,938 kg per hectare. As expected, the impact of pesticide use declines as the amount used increases. What is interesting is that when pesticide use increases to above 850 grams per hectare, it stops having any significant extra effect on yield.

FARMERS USE MORE THAN THE OPTIMAL LEVEL OF PESTICIDES

Based on some careful economic analyses of the marginal productivity of pesticides, the authors establish that the optimal level of pesticides for Cole crops is 680 grams per hectare. The average amount of pesticides used on farms in the study area (2,633 grams per hectare) is some four times more than what is needed. Only a small proportion of farmers (3 percent) use the optimal level of pesticides, with the majority (74 percent) using a lot more. The results suggest that a reduction of pesticide use from the current level will be economical and will not decrease yields significantly.

A majority of farmers in the study area understand that pesticides are harmful to human health and that they hurt a range of beneficial organisms present in the farm ecosystem. Furthermore, on average, Cole Crop growers lose about 2 % of production costs (NRS 1465 per hectare) because of their inefficient use of pesticides. Yet, over-use of pesticides is an on-going phenomenon. It is possible that farmers deliberately apply an overdose of pesticides because they are uncertain about correct dosages. Or, they may want to 'be on the safe side' in order to avert the risk of pest attacks.

Interestingly, the extent of overuse of pesticides differs between farmers educated on IPM through Farmer's Field Schools and farmers without this education. Estimates show that farmers with FFS training use 2.7 times the optimal dose as compared to farmers without FFS, who use 4.4 times the optimal dose.

HOW TO IMPROVE PESTICIDE USE

In general, there are four key reasons behind the overuse of pesticides: (i) ignorance about their environmental impact; (ii) lack of alternatives; (iii) an underestimation of the short and long-term costs of pesticide use; and (iv) weak enforcement of laws and regulations relating to pesticide use. All these reasons apply to Cole farmers in Bhaktapur. Thus, there is considerable scope for agricultural extension services to improve the situation.

Farmers educated in Farmer's Field Schools are more aware of the 'overuse' issue than those who

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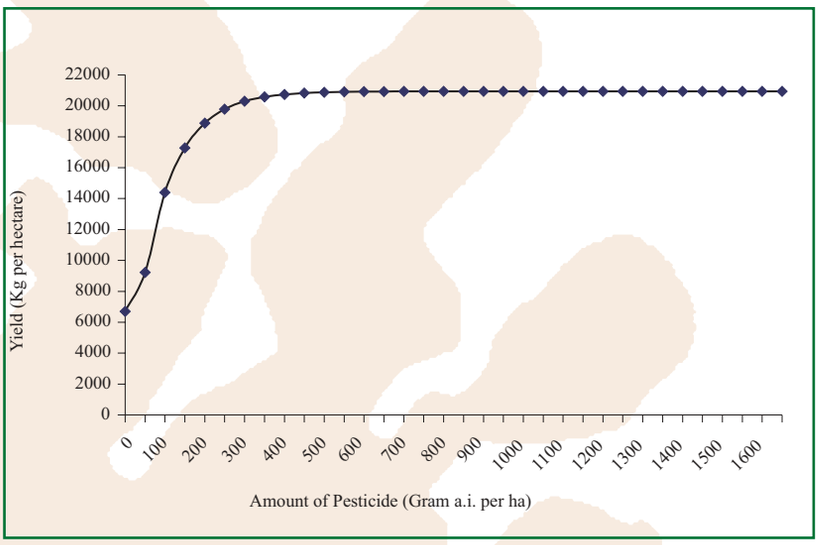
Figure 3: Pesticide Use and Impact on Yield



haven't had this training. However, both trained and untrained farmers overuse pesticide. It is important for policy makers and planners to review the IPM program in Nepal and revise the Field School curriculum in order to make the training imparted more effective. Extension services and trainers also need to understand better how farmers make decisions under uncertainty, so training and information dissemination can be geared to help famers make better decisions when risks are not fully known.

ASSESSING THE IMPACT OF PESTICIDE USE

Despite the recent rapid increase in pesticide use in vegetable farming in Nepal there are very few studies that have evaluated the productivity of pesticides in the agricultural sector. Two studies have come close to achieving this goal: one is a household survey (Pujara and Khanal, 2002), the other a socio-economic study (Shrestha and Neupanel, 2002). These studies show that the profits from farming vegetables (potato, tomato, bitter gourd and chilly) when pesticides are used are higher than for other crops. However, these studies took an approach that either considered pesticides as a normal yield-enhancing input or relied on partial budget analysis.

Lichtenberg and Zilberman (1986) suggest that the contribution of pesticides (which they view as damage control agents) to production will be better understood if researchers look at agricultural output as a *net* result of two interdependent components: potential yields and potential losses due to pests. Theoretically, pest attacks can cause the complete loss of a crop or not affect a crop at all; in turn pesticides can theoretically have no impact on pests or can control them completely. This approach provides a more accurate framework for the analysis of the pesticide productivity relative to traditional production function analysis. Jha and Regmi's study uses a similar strategy.