Ecological and Economic Impact of Plant Protection Application in Cotton

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Introduction
The main intention of the introduction of pesticides was to prevent and control insect pests and diseases in the crops. After the green revolution the consumption of pesticides increased in India. Pesticides, besides being poisonous in nature to the targeted pests, there are the environmental costs and human health hazards associated with the use. To reduce the extent of use of pesticides and environmental pollution through Integrated Pest Management approach. This paper examines the awareness and adoption level of IPM in cotton, economic and environmental impacts of plant protection measures in IPM and Non-IPM cotton growing areas in the western zone of Tamil Nadu. Cobb-Douglas production functions to analyze the resource-use efficiency in IPM cotton Non-IPM cotton. The coefficients of pesticides were negative and significant indicates the over usage of pesticides and increased cost of production there by reducing yield. Environmental Impact Quotient index (EIQ) was used to quantify the impact of pesticides on human health and environment in sample farms. The high EIQ values denote in Non-IPM cotton (46.93) compare to IPM cotton. The important safety precautions like using masks or gloves were followed by only very few farmers in all sample farms.
pollution through Integrated Pest Management approach. IPM indicates not only the chemical pesticides to control the pests but also the physical, biological, cultural and mechanical methods also integrated to control the pests. The chemical pesticide used in the method is less toxic pesticides. The study was conducted in western zone of Tamil Nadu, the state department of agriculture is conducting IPM training in rice, cotton and other crops, among all crops cotton crop occupies very less area and consumes more than half of pesticides in the western zone. The present study focused (i) to analyze the awareness and adoption of IPM technique (ii) to analyses the economics of pesticide use and its efficiency in paddy and cotton; and (ii) to assess the environmental damage potential of pesticide use in paddy and cotton.

Materials and Method
The study was conducted in the Western zone that comprises Erode and Coimbatore districts in the year of 2005-06. In Tamil Nadu, among all the crops, cotton and paddy are the two crops that consume 45-60 per cent of the total quantity of the pesticides. In the districts, two taluks were chosen based on the proportion of area under cotton crop to the gross cropped area at the Zonal level. Two villages, one representing the IPM adopters and one non-IPM adopters were randomly selected from each taluk. In the third stage, fifteen farmers each growing IPM cotton and Non-IPM cotton respondents were randomly chosen from each village, to constitute 60 sample respondents. Production resource-use efficiency in IPM and Non-IPM cotton and environmental impact of pesticides on human health were quantified by Environmental Impact Quotient technique (EIQ).

Awareness and Adoption of IPM
In samples, more than 90 per cent of the them reported awareness of IPM practices like physical control (sanitation), cultural control (fallowing, green manuring and trap crops), chemical control (use of phyrithroids) and use of bio-products (neem oil, NPV and sex pheromones) in IPM cotton sample farms. Awareness level about other practices was higher and it ranged from 78.74 to 89 per cent. Adoption was reported by more than 70 per cent of the farmers who had the awareness in respect of physical control (fallowing and crop rotation), chemical control (use of organophosphorous, pyrethroids) and biological control (use of neem oil and NPV of Helicoverpa) practices. For other practices, it ranged between 43.50 and 68.85 per cent.

Production Efficiency Measure
Among the non-IPM sample cotton growers, awareness about the IPM practices was very less compared to IPM sample cotton growers. Awareness and adoption rate of bio-products like NPV and sex pheromone traps were very negligible. More than 75 per cent of sample respondents reported awareness of chemical control and crop rotation and the adoption rate was creditable at more than 60 per cent.

In IPM-cotton, seeds, organic manure, nitrogen fertilizer and human labour were significant indicating that increase on the use of these resources over and above the present level lead to a significant increase in the yield. Plant protection cost indicating that in IPM-cotton, plant protection by not only the chemical pesticides as well as the cultural, physical, mechanical and
biological control methods were integrate to replace the excessive use of pesticides and the environment protected in IPM cotton.

In non-IPM cotton, the results showed that the variables namely, seed, labour, plant protection cost and potassium were significantly influencing the yield. It also revealed that the influence of variables namely; inputs like potassium, labour and plant protection cost were negative and significant indicating the need to cut the use of plant protection chemicals, which would not only enhance the efficiency in use of plant protection chemicals and reduce environmental pollution, but also enhance the yield and net returns through the reduction in cost.

Usage of Different Pesticides in Cotton Cultivation
The usages of pesticide in the sample farms were given in Figure 1. The number of pesticides used and the application rate were less in IPM cotton compared to non-IPM cotton. Use of highly hazardous chemicals like carbofuran and monocrotophos were only 0.457 kg/ha and 1.793 kg/ha, respectively. Whereas in non-IPM cotton, it was 4.620 kg/ha of carbofuran and 5.652 kg/ha of monocrotophos, Phorate (6.34 kg/ha) and methomyl classified under highly hazardous categories were used only in Non-IPM cotton growing areas. Eco-friendly bio control agents like Bacillus thuringiensis and azadirachtin were applied only in IPM paddy and IPM cotton growing areas. The average cost of pesticides used was less significantly in IPM cotton at Rs.729.52 compared to Rs.1795.27 in Non-IPM cotton. Average cost of pesticides used for Bt cotton was also less at Rs.899.50 compared to Non-IPM cotton.

![Pesticide Usage in Sample Farms](image-url)

Figure 1. Pesticides Usage in Sample Farm Households

Environmental Impact Quotient (EIQ)
The EIQ Values of The results furnished in the Table 2, would show that cultivation of Non-cotton resulted in more EIQ values than IPM-Cotton. The EIQ values were 36.93 in IPM and in 46.93 Non-IPM cotton indicates the number of highly hazardous chemical application and environmental ill effects were present in these farms.
Table 2. EIQ Values of Pesticides Used Sample Farms

<table>
<thead>
<tr>
<th>Crop</th>
<th>EIQ Values for</th>
<th>Combined IPM and Non-IPM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IPM</td>
<td>Non-IPM</td>
</tr>
<tr>
<td>Cotton</td>
<td>36.93</td>
<td>46.93</td>
</tr>
</tbody>
</table>

Effect of Pesticide Exposure on Human Health

The results are furnished in the Figure.2 Effects on health due to pesticide use in cotton growing sample farmers were more compared to paddy growers. Symptoms like allergic dermatitis and tiredness were reported by about 78.33 per cent and 80.00 per cent of sample cotton growers, respectively. More than 40 per cent of the sample cotton growers at the least reported other problems. The analysis revealed that more farmers reported these problems among the Non-IPM cotton crops.

![Figure 2. Effects of Pesticide Exposure on Health in IPM and Non-IPM Sample Farm Household](image)

Nearly 73.00 per cent of the sample respondents of Non-IPM cotton growers complained about symptoms of headache, which was less (56.67 per cent) among IPM cotton growers.

Conclusion

The present study revealed that the productivity difference between IPM and non–IPM cotton farmers. The pesticides cost had negative and non-significant influence on yield on IPM-cotton farmers. It was negative and significant in IPM Cotton indicating the need to cut the use of plant protection chemicals. The highly hazardous chemicals like monocrotophos, carbofuran and phorate were used more in non-IPM sample farms and the application rate also high. More sample farmers among the Non-IPM cotton crops reported symptoms like allergic dermatitis and tiredness. EIQ values on IPM-cotton farms 36.93 compared to Non-IPM cotton of 46.93 indicate the hazardous chemicals not only included the cost of farmers but the negative environmental impacts also associated with in these farms. Therefore, it is necessary to motivate the farmers to
highlighting the environmental toxicity of over use of pesticides and to cultivation of IPM cotton with appropriate extension strategies and policy measures.

Acknowledgement
Author is thankful to Dr. M. Chandrasekaran, Director, Planning & Monitoring, Tamil Nadu Agricultural University, Coimbatore-641003 for his kind guidance, motivation and unconditional support for this work.

References