Farmer's Adoption of Neem as an Organic Pesticide in Nagpur, India: A Case Study of "The Neem Foundation" Activities

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1. Background and purpose

This paper aims to analyze data collected from farmers who participated in The Neem Foundation (NF) activities and used homemade Neem pesticides (HNP) and normal chemical pesticides under commercial field conditions. This study examines the relationships between farmers' acceptance of Neem pesticide and their socioeconomic status. According to Sharma [4], the process to make a general organic pesticide is time consuming and complicated, and this is the main reason why farmers do not want to adopt it. However, none of the previous research focuses on Neem pesticides or socioeconomic factors. We analyze the farmers' acceptance of Neem as an organic pesticide, and assess the impact of farmers' education level, annual income, and other factors.

People are becoming more concerned about the food they eat. Many people are increasingly in support of food that is environmentally friendly, sustainable and healthy. The growing international market for organic agriculture requires quality products that are free of synthetic pesticides. Not only internationally, but also at the domestic level in India, the market for organic goods is expected to rise in the coming years [2]. The products of the Neem tree, which grows widely and abundantly in India, can be utilized as an environmentally friendly pesticide. Even though Indian farmers have decades of experience in using Neem fruits and leaves as pesticides, the emergence of the "Green revolution" promoted its application in competition with synthetic pesticides. The Neem tree therefore has tremendous potential to bring some of the fruits of the global market for organic products to rural farmers in India. Yet even after the Government

of India and UNIDO spent US \$700,000 to spread the use of HNP under various activities in Nagpur, India through NF, the use of HNP did not increase.

This is the first study of its kind to investigate the reasons behind this failure. We discuss the reasons and relationships between farmers' acceptance of Neem pesticides and their socioeconomic status.

2. Neem tree and process to make HNP

Neem is a tropical tree with fruit whose extract traditionally had been used as an insecticide. But since the green revolution, the farmers in India substituted chemical pesticides for Neem. There are various traditional indigenous ways to make HNP. NF developed the following process to make HNP. The Neem fruit only ripens from June to September in India. After collecting, seeds must be depulped at the earliest possible stage, dried for 12 weeks and stored in a dry, cool and dark place. Dry seeds are separated from the shell of Neem fruits and crushed into fine flour powder to spray as pesticides. To make the pesticides, powder is mixed with water and adjuvant for a night. Until spraying Neem pesticides, the seeds must be stored properly. It takes three months to complete these processes (collecting, drying, and crushing) and the product can be used in the next season if stored properly.

3. Methodology

Approximately 1000 farmers participated in the NF activities, which were conducted in 100 villages in Nagpur. To conduct the survey of participant farmers (PF), our base was in the NF head office in Nagpur. The distance to interview the PF was up to 155 km. Lack of funding and high temperatures (43° Celsius in

March and April of 2006) complicated administering the survey at sites up to 100 km from the base. In total, we visited 247 PF households. Among them, 144 PF refused or could not be contacted even after visiting more than twice. We interviewed 103 farmers who actually participated in NF activities, such as an “awareness and training program”, where farmers got experience in making HNP. Some of them also participated in demonstration trials, where they used a part of their own farmland for HNP under the supervision of NF staff and saw the price difference between chemical pesticides and HNP. The study involved asking farmers their opinions on Neem organic pesticide through a structured interview. Interviewees described views towards the chemical pesticides and HNP. In addition, we also asked if the farmers understood the preparation and usage of HNP as taught during the training program conducted by NF. To investigate risk aversion to using HNP, we asked about socioeconomic factors such as PF education level and annual income, which were used as independent variables. How much risk they believe HNP use entails was used as the dependent variable. Because the dependent variable is categorical, we use the logit model.

4. Possibility to make HNP

Before discussing the reasons for not adopting the HNP, we will discuss the time required to make HNP for one acre of land in Table 1. One acre of farmland requires 4 kg of Neem seed powder, which is made from 5 kg of dry seeds. This requires 30 kg of wet seeds. According to Ostermann [3], seeds and fruits are mainly collected by women and children, with approximately one kilogram obtained per hour of labor. For one acre, then, farmers would need to spend at least 30 hours for collecting seeds plus four hours for processing. In general, the actual spraying time for HNP and chemical pesticides are the same.

According to our survey, PF have 8.5 acres of land in average and spend Rs. 1000 per acre for chemical pesticides, which is 8,500 Rs. for 8.5 acre (Table 2). The average size of land holding in Nagpur district is 6.5 acres [1]. Our findings shows three ways to make

and/or use HNP: i) Self sufficient by family labor; ii) Self sufficient by hiring laborers; or iii) Purchase processed Neem seed powder from NF.

For 8.5 acres it would require 289 hours (45 hours/acre $\times$ 8.5 acres) to produce enough HNP by themselves. (Ref. Table 1) Another option is to hire laborers to make HNP. Average wage rate for women in Nagpur is Rs. 50 per day in the month of June to September. Hiring laborers to make HNP will cost farmers Rs. 1806 (Rs. 50/day $\div$ 8 hrs/day $\times$ 289 hrs).

Starting in 2006 NF will be trying to sell the processed Neem seed powder at Rs. 50 per kg. This cost for 8.5 acre is Rs. 1700 (50 Rs/kg $\times$ 4 kg/acre $\times$ 8.5 acre), and is still cheaper compared to chemical pesticides (Rs. 8500). In this way farmers can save the time required for collection and processing. The months from June to September are the ripening season for Neem fruits, and are simultaneously the busiest time for farmers to plough and sow. Therefore farmers have no excess time to make HNP by themselves. Because of this it is largely impractical for farmers to make HNP with the help of family labors. This is the main

Table 1. Average time for collecting Neem seeds per acre

Requirement seeds per acre (Wet)	30 kg/ac.
Collection time (1 hrs=1 kg)	30 hrs.
Processing time	4 hrs.
Total time for one acre	34 hrs.

Source: Field Interviews of NF staff in Nagpur.

Table 2. Comparing cash cost between family labor. Surveyed for the average farm 8.5 acre of PF

	Family labor. (hrs)	Cash cost. (Rs)
Chemical pesticides.	0	8500
Neem pesticides.		
i) Self sufficient by family labor	289	0
ii) Self sufficient by hiring laborers	0	1806
iii) Purchase processed Neem seed powder from NF	0	1700

Source: Field Interviews of NF staff in Nagpur.

Table 3. Risk aversion to use HNP by education and Income. (90 farmers)

Variables	Description
Dependent variable Risk with HNP	How much risk do you believe is associated with HNP for the product in the commercial field of agriculture product? 1=High risk or Little risk (32 farmers). 0=No risk (58 farmers).
Independent variables Education	Highest level of education. 1=2 yr. collage, 5 yr. collage or Graduates (24); 0=Illiteracy, Junior secondary school or Senior secondary school (66).
Income	Annual income of farmer. 1=less than 10,000 Rs (4); 2=10,000–25,000 Rs(21); 3=25,000–40,000 Rs (22); 4=40,000–55,000 Rs (18); 5=55,000–70,000 Rs (12); 6=70,000–1,00,000 Rs (6); 7=>1, 50,000 Rs (7).

reason why HNP cannot be popularized in Nagpur.

As explained in Table 2, making HNP by hiring laborers is another available option. Neem seeds can only be collected from June to September in the rainy season, which is a period of shortage of laborers. Because of the above reasons, using family labor or hiring laborers to make HNP is impractical.

The only remaining option is buying Neem pesticides from NF. Without using family labors or hiring laborers they save time and storage facilities, in addition to the higher costs of chemical pesticides. In that case, risk and uncertainty are the only factors for not adopting HNP. We will discuss how farmers' evaluations of Neem pesticide vary according to socio-economic status using the logit model.

5. Logit model analysis

Table 3 lists the dependent variable and independent variables. As to the variables to the analysis, we selected two socioeconomic variables related to PF attitudes of risk aversion towards using HNP in the commercial field of agriculture products.

Table 4 shows the result of the logit model. Education level and income are significant values correlated with the attitude towards HNP usage. Firstly, those farmers with a higher education level perceive higher risk. We believe that educated farmers have more scientific knowledge about chemical pesticides. However, there is a lack of scientific results to

Table 4. Estimated results

Variable	Estimated parameter	Wald Statistic
Education	1.093	3.51*
Income	−0.587	9.652**
Constant	1.133	3.414

Nagelkerke R²: 0.180; count R²: 0.711; *p<0.1, **p<0.01

Source: Authors Estimation from Field Survey 2006.

prove the benefits of organic Neem pesticides. This makes it difficult for educated farmers to understand the advantages of organic Neem pesticides, and they feel that it is higher risk than chemical pesticides. On the other hand, uneducated farmers easily believe educated people such as NF staff and feel less risk than educated farmers towards organic Neem pesticides. Secondly, as farmers' income grows, they feel less risk. Large landholding farmers might use a small proportion of land for Neem pesticides for the time being and reduce the overall risk factor, even though results are slow or uncertain. For them, in spite of taking risks, there will be no effect on their daily life.

6. Conclusion

Environmentally friendly and healthy food is becoming an important priority for consumers. The Neem tree in India is free and abundantly available and has potential to provide its fruits to rural farmers in India for producing organic products. Even though HNP is much cheaper compared to chemical pesticides, the

overall process to make HNP is time consuming and complicated. Our study shows that making HNP with the help of family labor or hired laborers is impractical. To buy Neem pesticide powder from the NF is a substitute for family labor or hiring laborers, and is a valid way to use Neem pesticides. Our estimation results shows educated farmers feel that using HNP is high risk, while high-income level farmers feel less risk. For wealthy farmers, using HNP on a small part of their land may reduce the overall risk of using organic pesticides. Additional scientific studies on the benefits of HNP may reduce risk aversion and encourage broad utilization.

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