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Insecticide usage pattern among vegetable farmers: A case study in Chapainawabganj, Bangladesh

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Abstract
A survey of insecticide use patterns in vegetable cultivation was carried out in this study. The study was conducted in three different upazilas of Chapainawabganj district. Forty vegetable growers were chosen at random and questioned using a pre-structured questionnaire. The study reveals that, the majority of vegetable growers in the study areas had medium-sized families (70%), were middle-aged (50%) and illiterate (47.5%). Farming was the sole profession for 55% of the farmers, and the majority of the respondents had medium experience in farming (55%). During the initial stages of an insect infestation, half of the respondents (50%) applied insecticides. The vegetable growers applied the insecticide in various doses and recommended by the nearest dealer. 37.5% of respondents knew about insect pest control through relatives. Only 22.5% of respondents received pest management training. During the spraying of insecticides, most farmers did not take any precautions (52.5%). The majority of responders (57.5%) dumped empty containers into a nearby pond/field and stored insecticide in the storeroom (67.5%). Hence, it is essential to educate the farmers on recommended insecticide usage practices and rational use of insecticide in vegetable cultivation.

Keywords: Insecticide, pest management, socioeconomic profile, vegetable cultivation

1. Introduction
Agriculture is Bangladesh's most important economic sector, accounting for over 23% of the country's GDP and employing about 62% of the entire labor force (BER, 2007) [3]. Crops, livestock, fisheries, and forestry are the sub-sectors that make up agriculture's structure. Rice, wheat, pulses, oilseeds, sugarcane, potato, vegetables, jute, and tea are some of the country's most important crops. Vegetables are an essential agricultural group that contributes nutrients and vitamins to the diet (Mohiuddin *et al*., 2009) [10]. It is also quite advantageous in terms of financial returns. Vegetables are grown on 1.8 percent of Bangladesh's total cultivatable land (BBS, 2020) [2]. Vegetables have a considerably higher income elasticity than major crops like rice, which is an essential, attribute (Kammizzaman and Takeya, 2008) [8]. The majority of the vegetables grown in Bangladesh are susceptible to insect infestations. Insecticides are chemicals, which are used to kill or inhibit the growth of insects. The use of insecticides in agriculture has enhanced production. Several insecticides are known to cause health problems in humans and livestock, as well as have a negative influence on plant diversity and the environment in the short and long term (Atreya, 2007; Pimental, *et al*., 1993) [1, 11]. Insecticide misuse can result in accidental poisoning as well as acute and chronic health impacts (Sharma *et al*., 2012) [14]. Insecticide exposure can lead to long-term health problems such as dermatosis, cancer, and genotoxic, neurotoxic, and respiratory consequences in the long run (Wesseling *et al*., 2001) [16]. The use of obsolete, non-patented, more toxic, and environmentally persistent insecticides is one of the primary causes of greater toxicity in developing countries (Ecobichon, 2001; Van Der Maden *et al*., 2014) [5, 15]. Furthermore, due to a lack of technical understanding about insecticide toxicity levels and safety procedures to protect themselves from exposure, farmers in underdeveloped nations are exposed to harmful chemicals (Atreya, 2007; Wesseling *et al*., 2001; Yassin *et al*., 2002) [1, 16, 18]. The improper handling of insecticides occurs mainly at the time of mixing and application, during storage, and during insecticide disposal (Sharma *et al*., 2012; Yang *et al*., 2014) [14, 17]. Vegetables are grown all year round in the Chapainawabganj district, and a huge number of farmers are participating in the process. Vegetable farming is significant in Chapainawabganj these days for a variety of reasons. To protect vegetable crops from various species of insects, farmers in this region utilize a variety of chemical insecticides.

Farmers' awareness and skills regarding the safe and efficient application of insecticides were insufficient, exposing them to the risk of insecticide poisoning. As a result, this study was conducted among farmers in the Chapainawabganj district to learn about insecticide handling practices during purchase, mixing, spraying, storing, and disposal. The purpose of this study was to find out more about how vegetable growers in Chapainawabganj use insecticides and what they consider proper insecticide usage.

2. Materials and Methods

2.1 Study area

The study took place in the Chapainawabganj district of the Rajshahi division. Between the latitudes of 24˚22' and 24˚57' and the longitudes of 87˚23' and 88˚23', Chapainawabganj is located. The research was carried out in the Chapainawabganj district's Nawabganj Sadar, Nachole, and Gomastapur upazilas.

Fig 1: Location of the study area

2.2 Data collection procedure and analysis

Forty respondents were chosen at random from the survey area's vegetable farmers. Between November 6th and December 15th, 2020, an interview was conducted. A systematic questionnaire was developed to obtain the relevant information. The questionnaire was divided into three parts: The first component is the socioeconomic profile of the respondents (age, education, occupation, family size, and farming experience). The second half of the survey focuses on farmers' perceptions of pest management, with the majority of the questions being closed-ended (source of insect pest control information, method of insect pest control, time of insecticide application, source of insect pest control information, and farmers' participation in pest management training program). The final section focuses on respondent farmers' insecticide safety and storage practices (farmer awareness about the detrimental effect of insecticide use, protecting measures taken by the farmers during insecticide application, disposal of empty insecticide container or packet, storage practice of insecticide by farmers, and farmers' response to recommended insecticide dose).

The data were analyzed and interpreted using statistical tests such as frequency counts, percentages, mean, and standard deviation.

3. Results and Discussion

3.1 Socio-economic profile of the respondent farmers in the study area

The respondents ranged in age from 21 to 68, with an average age of 43.05 years. According to table 1, respondents' ages were divided into three categories: young, middle, and old (Haider, 2010) [6]. Table 1 shows that middle-aged persons accounted for 50% of respondents,

followed by old people (27.5%) and young people (22.5%). According to the findings, a substantial percentage of farmers were in their middle age. Khan *et al*., (2022) [9] also observed the majority of vegetable farmers in Chapainawabganj were middle-aged to older, with a small number of young farmers.

Respondents' educational backgrounds ranged from illiteracy to a bachelor's degree and beyond. Table 1 shows the five categories into which respondents were divided. Table 1 shows that 47% of respondents were illiterate, with primary education (27%), secondary education (15%), higher secondary education (8%), and graduation or higher education (3%) following closely behind. As can be seen in table 1, more than 42% of respondents were educated in either primary or secondary school. According to Rana *et al*., (2020) [12] about 43 percent of vegetable farmers had no formal schooling.

The respondents' family size was divided into three categories: small (2-4 members), medium (5-10 members) and large (>10 members) (Zaman *et al*., 2010) [19], with a median of 5.65. According to the distribution of respondents by family size (table 1), the majority of respondents (70%) are from families with 5 to 10 members.

The respondents' occupations were divided into four groups: farming & wage earning, farming & business, farming & service, and farming as a sole profession. According to the survey, 55% of farmers rely only on farming, while 27.5% rely on farming & business, 10% on farming & service, and 7.5% on farming & wage-earning.

According on their farming experience, respondents were categorized into three groups. Low experience (up to 10 years), medium experience (10 to 30 years), and high experience (above 30 years) are all examples of farming experience scores. According to the data in table no. 1, the majority of respondents (55%) had medium farming experience, followed by high (30%) and low (15%). Dewi *et al*., (2022) [4] found that 63.8 percent of farmers had medium farming experience.

Table 1: Socio-economic profile of the respondent farmers in the study area

Variable	Categories	Frequency	Percentage
Age	Young age (<35)	9	22.5
	Middle age (35-50)	20	50.0
	Old age (>50)	11	27.5
Education	Illiterate (0)	19	47.5
	Primary (Class 1-5)	11	27.5
	Secondary (Class 6-10)	6	15
	Higher secondary (Class 11-12)	3	7.5
	Graduation or Above	1	2.5
Family size	Small (2-4 members)	11	27.5
	Medium (5-10 members)	28	70.0
	Large (>10 members)	1	2.5
Occupation	Farming as sole profession	22	55
	Farming & service	4	10
	Farming & business	11	27.5
	Farming & wage earning	3	7.5
Farming experience	Low (Up to 10 years)	6	15.0
	Medium (10 to 30 years)	22	55.0
	High (Above 30 years)	12	30.0

3.2 Farmers' perception of pest management in the vegetable field

The majority of respondents (37.5%) said they got insect management advice from relatives, while 30% said they got it from their neighbors, 22.5% from extension workers, 2.5% from radio and television, and 5% said they got it from other sources (table 2). It suggests that there was a communication gap between extension workers and farmers since the interviewers did not gather enough information from them.

Insect management methods were divided into four categories. The four categories were chemical methods, biological methods, cultural methods, and others (traps and baits). According to table 2, 85% of respondents in the study region utilized chemical methods to control various insects, while 15% used traps and baits to control various insects. There were no biological or cultural techniques used by the respondents. Rijal *et al*., (2018) [13] also found that the majority of the farmers (80%) applied chemical pesticides solely to manage insect pests in vegetable crops.

Based on table 2, the insecticide application time was divided into three categories. They were observed before the attack, during the initial attack, and during the severe attack. Half of the respondents (50%) use insecticide during the initial attack, 45% before an insect attack, and the remaining 5% during a severe attack. In the study area, vegetable growers did not appear to make spray decisions based on the economic threshold values. Insecticide applications applied before the emergence of pests in the field resulted in unnecessary costs (Atreya, 2007) [1].

The majority of the respondents (90%) used a spray machine to apply insecticide and only 10% of the respondents used other equipment or open hand to apply insecticides.

Table 2: Farmers' perception of pest management in the vegetable field

Variable	Categories	Frequency	Percentage
Source of information about insect pest control	Extension Workers	9	22.5
	Neighbor	12	30.0
	Radio	1	2.5
	Television	1	2.5
	Relatives	15	37.5
	Other sources	2	5.0
Method of insect-pest management	Chemical method	34	85.0
	Biological method	0	0.00
	Cultural method	0	0.00
	Others (Traps & baits)	6	15.0
Timing of insecticide application	Before attack	18	45.0
	During initial attack	20	50.0
	During severe attack	2	5.0
Insecticides spraying techniques	Spray machine	36	90.0
	Other means	4	10.0

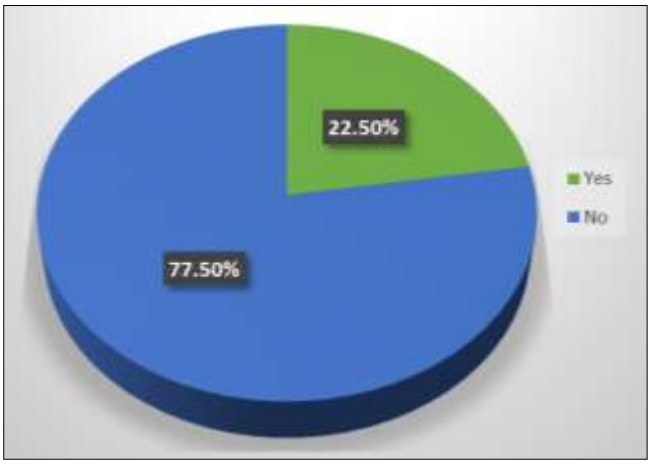

Fig 2: Farmers' participation on pest management training program

Figure 2 shows that 22.5% of respondents received pest management training, while the rest did not. The majority of respondents had never received pest management training from any training organization, according to the study. This implies that they are unaware of any insecticide management training programs.

3.3 Insecticide safety and storage practices followed by vegetable farmers

Farmers' understanding of the adverse effects of insecticides was classified into six groups in table 3. The majority of farmers in the study area were unaware of the negative consequences of insecticide use. The majority of responders (62.5%) did not respond to this question. Only 5% of respondents said they were aware of air pollution, 10% of respondents said they were aware of water pollution, and 22.5% of respondents said they were aware of the health risks associated with insecticide usage.

The majority of the farmers (52.5%) did not wear personal protective equipment. Only 5% of farmers covered their entire body when applying pesticide, 10% of farmers covered their face and body while applying insecticide and 35% of respondents covered their face while spraying. Similarly Mohiuddin *et al.*, (2009) [11] reported that during the application of insecticides, 39% of vegetable growers did not use any safety precautions.

Insecticide packets are mainly prepared by polythene that is not easily decomposed and is harmful to the environment. 57.5% of respondents dumped the pesticide packets into a nearby pond/field, no farmer recycled insecticide packets, 22.5% of farmers burned the insecticide packet, and 20% of farmers threw the insecticide in the dustbin.

For chemical elements, insecticide storage practices are important. In this study location, the majority of respondents (67.5%) said they kept insecticide in the storeroom, 22.5% said they kept the packets in the farmhouse, and 7.5% said they kept it in the kitchen. Insecticide packets were stored in other places by 2.5% of respondents, and no one put insecticide packets in the cow shed. According to Jallow *et al.*, (2017) [7] majority of farmers (59%) stored their pesticides in secured chemical warehouses reserved only for pesticides.

Table 3: Insecticide safety and storage practices followed by vegetable farmers

Variable	Category	Frequency	Percentage
Farmer awareness about the detrimental effect of insecticide use	Air pollution	2	5.0
	Water pollution	4	10.0
	Harmful to natural enemy	0	0.00
	Not harmful	0	0.00
	Health hazard	9	22.5
	No response	25	62.5
Protecting measures taken by the farmers during insecticide application	Cover face	13	32.5
	Cover body	2	5.0
	No protection	21	52.5
	Cover face and body	4	10.0
Disposal of empty insecticide container or packet	Burned	9	22.5
	Throwing the dustbin	8	20.0
	Recycling	0	0.00
	Throwing nearby pond/field	23	57.5

Storage practice of insecticide by farmers	Storeroom	27	67.5
	Cowshed	0	0.00
	Kitchen	3	7.5
	Farmhouse	9	22.5
	Others	1	2.5

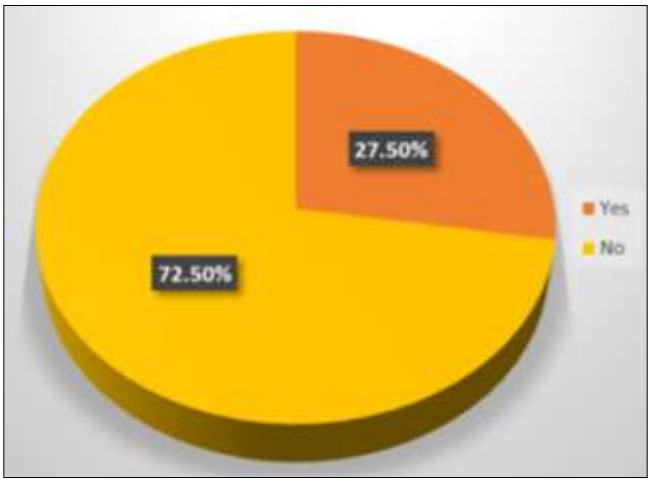

Fig 3: Farmers' response on recommended dose of insecticide

The majority of responders (72.5%) did not follow the recommended insecticide dose (figure 3). They applied different doses and received information from the local insecticide dealers.

4. Conclusion

According to this study, the insecticide usage pattern of vegetable growers revealed that the majority of the vegetable producers in the Chapainawabganj district use the chemical method of pest control as well as various chemical doses. During the growing season of vegetables, the respondents used insecticide two main times, according to the researcher. Initially, before the infestation of insects, and lastly, the initial infestation of insects. For vegetable producers in the research area, relatives were the primary source of insect-pest management information. The majority of those interviewed had no idea that chemical pesticides have negative side effects. As a result, they did not use any safety clothing during the application of insecticide. Regardless of the extent of insect infestation, most farmers use insecticides on their crops regularly. Because the majority of farmers did not participate in any training programs, they lack proper pest management knowledge. As a result, they follow the instructions of local insecticide dealers. To improve the current situation, educational and training initiatives on insecticide handling and safety measures are required.

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