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Knowledge and handling of pesticides by the retailers in the north-eastern part of Bangladesh

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ABSTRACT

The application of pesticides is a common practice against insect pests on different crops in Bangladesh. Usually, pesticide retailers are involved in recommending and selling of pesticides to farmers in Bangladesh. A survey was conducted by interviewing 54 retailers and 150 farmers using semi-structured questionnaire in six upazilas across two districts of the north-eastern part of Bangladesh to know the knowledge and experience of pesticide handling by the retailers and attitudes of farmers towards retailers' practices. The interviewees were selected randomly. All the retailers were male, and 85.2% of them were involved in personal business. Most of the retailers (94.5%) got their registration from the Upazila Agriculture Officer (UAO). It was observed that 31.5% of retailers have higher secondary education, followed by secondary (25.9%) and primary (18.5%) education. Surprisingly, only a negligible portion of retailers (1.9%) had technical education on pesticides, and the majority of them (68.5%) received only a short training organized by Agriculture Extension Offices and pesticide companies. Moreover, 20.4% of retailers did not participate in any kind of training on insect infestation while 42.6% attended short training. Although almost 60% of farmers reported that retailers are not well trained, 71.4% of farmers replied that retailer's suggestions about pesticides are effective. A greater percentage of farmers (88.4%) responded that retailers do not visit the farmers field, and 57.8% mentioned that retailers take excess price of pesticide. The standard safety measures (gloves and masks), first-aid kit, and firefighting equipment are not available in most of the retail shops, although 22.2% of shops have poor storage facilities. According to 81.5% retailers, pesticide applications have been increasing over the last 5 years. The overall scenario demonstrates the devastating and inappropriate handling of chemical pesticides without proper knowledge and guidelines. Long-term training of the retailers and strong monitoring of their practices is essential.

1. Introduction

Pesticide retailers are playing an integral part in modern farming by supplying and recommending pesticides to the end-users (Farmers) against target pests (Shuqin and Fang, 2018). The retailers engaged in unethical practices by influencing the farmer to use chemical pesticides for pest control (Anjala, 2018). Due to the potential negative impact of pesticide application, many countries have developed laws and regulations to encourage safe pesticide use in terms of pesticide registration, sale, distribution, transportation, storage, and handling (Ecobichon, 2001). In Tanzania, pesticide's retailers are registered by the Plant Protection Regulations of 1999 Act (Dar es Salaam, 1999). The pesticides regulation law imposes legislative action to registered retailers, including distribute only authorized products and maintain safety practices of pesticides handing to minimize possible health hazards and environmental pollution (Lekei et al., 2014). In India, the state government decided to award a license to the trader only when they have a degree in Agriculture, Biochemistry, Chemistry, Botany, and Zoology to boost the agricultural sector (The Hans India, 2017). A technical advisor is required in the retail farms who is competent enough in the handling of pesticides and understands the possible health hazards (Lekei et al., 2014). It is expected that the technical advisor will supervise all technical operations on the proper entry and distribution of pesticide in a safe manner. Retail farms should have standard safety equipment, well-ventilated premises, first aid kits, fire-fighting equipment, and warning signs (Ecobichon, 2001).

Besides, retailers are required to have sufficient knowledge about handling pesticides safely and to advise end-users appropriately (Lekei et al., 2014). Pesticide retailers influence the farmers while taking decision about pesticide application that is reported worldwide in studies

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conducted in China (Puyun et al., 2007), South Africa (Rother et al., 2008), Vietnam (Van Hoi et al., 2009) and Tanzania (Lekei et al., 2014a). There are several common operational problems related to retail firm, for example, poor storage, inappropriate premises, and sale of banned pesticide are reported in Vietnam (Huang, 2001). Inappropriate handing of pesticides at retail farms possesses human and environmental risk which is a particular problem in developing countries (FAO, 1988).

In Bangladesh, farmers used a huge number of chemical pesticides in their crop fields, for instance around 37,422 metric tons (DAE, 2016) and they were sold mostly through retailers. Several studies have shown that retailer's education, knowledge, experience, household income, level of business profit, self-efficacy, and lack of training in pesticides use influence the level of pesticides recommendation to the farmers (Eliza et al., 2013; Damalas and Koutroubas, 2018; Akter et al., 2018). Normally, retailers get their registration from UAO (Upazilla Agricultural office), who provide registration considering technical knowledge, training experience on pesticide handling, storage, safety measures, and pesticide toxicity. The farmers are mostly dependent on retailer's prescription towards a target pest (Akter et al., 2018). There has been a little information about the retailer's knowledge on pesticide and its handling in Bangladesh. Therefore, this study was conducted to assess the actual status of pesticide retailers and farmers attitude towards retailers' practices in the North-Eastern part of Bangladesh regarding their knowledge and pesticide handling with safety measures.

2. Materials and methods

2.1. Site selection

To conduct the survey on the retailers from Sylhet Sadar, Jaintiapur, Golapganj Upazilas (Sub-district) of Sylhet district (24°53′N, 91°52′E) and Kulaura, Barlekha, and Sreemangal Upazilas of Moulvibazar district (24°18′N, 91°45′E) were selected randomly consultation with the Upazila Agricultural Officers (UAOs) about the status of retailers of the respective Upazilas (Figure 1).

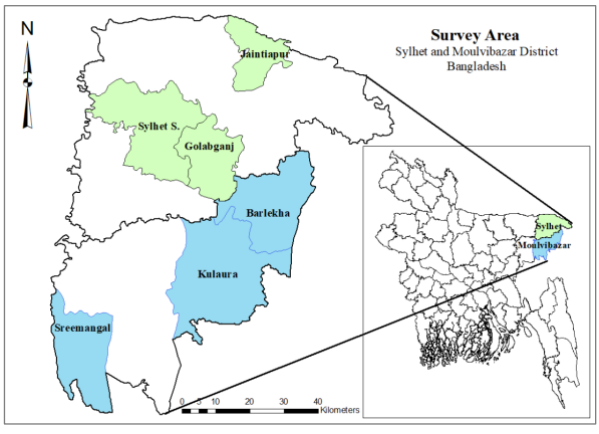

Figure 1. Geographical map of study areas

2.2. Data Collection

An open and closed-ended semi-structured questionnaire was prepared based on the pre-survey as well as the consultation with the UAOs of those selected areas. The retailers were asked the questions in a face-to-face interview during May and July 2019. A total of 54 retailers were randomly selected from the above-mentioned areas (9 retailers from each upazila) by the following equation.

$$n = \frac{N}{1+N*\varepsilon^2}$$

Where, n is the sample size, N is the total number of retailers in each area, and ε is the desired number of errors (Tuan et al., 2014).

With a designed margin of errors of 6%, nine retailers were interviewed from each upazila, for a total of 54 retailers. Interviewers were selected using a simple random sampling design. The sample size was derived using a comprehensive list of retailers provided by UAO in each upazila. A pre-designed semi-structured questionnaire was administered to collect the necessary information from the retailers. Initially, data were collected on the socio-demographic status of the retailers including age, registration status, education, and business type, as well as technical knowledge and training. In addition, they were also asked about the insects, pesticides recommendation to farmers, selling of pesticides, pesticides storage, the availability of standard safety measures and pesticide disposal. Retailers' perception on status of pesticide application by farmers has also been recorded. Moreover, farmers were interviewed to know the retailers' practices, like training of retailers, effectiveness of pesticides suggested by retailers, and visits of retailers to farmers fields in any pest infestation case.

2.3. Data analysis

The recorded data on different aspects of retailers and farmers during the survey was coded, entered, and analyzed with SPSS software version 20 (IBM, Armonk, NY, USA). Each positive response was coded with '1' and each negative response was coded with '0'. Different variables regarding retailers' socio-demographic status, knowledge on pesticide and insect infestation, retailers' store was also coded with subsequent numerical value. Descriptive statistics such as mean and standard deviation were calculated for the continuous variables, and percentage distribution according to different variables of retailers and farmers were calculated for the categorical variables.

3. Results

3.1. Socio-demographic status of pesticides retailers

The sex, age, education, registration, and business status of the retailers were recorded to show their socio-demographic profile. The results found that only men were involved in pesticides trading in Bangladesh. Among the retailers, 35.2% were aged 30-39 years while 22.2% were aged 20-29 and 20.4% were 40-49 years old. Only 11.1% of retailers were found in the age range of 50-60 years and above. 31.5 % of retailers completed higher secondary education followed by 25.9% and 18.5% acquired secondary education and primary education, respectively.

Higher education (graduation and master's education) was completed by 9.3% of retailers whereas 5.6% of were enabling read and write. Almost 95% of retailers had their registration license from upazilla Agriculture office (UAO) while 5.6% were trading without any registration. Meanwhile, 85.8% of retailers were engaged in personal business and others had dealership business (Table 1).

3.2. Retailer's knowledge on pesticide

A wide range of data was found on knowledge retailers about pesticide applications. The majority (68%) of retailers got the knowledge from a short training workshop (1-2 days) organized by the UAO and different pesticide companies. One-fifth of the retailers had a primary idea about pesticides application and management and least number of retailers got, long training (> 10 days), or diploma course. Among the retailers who understand the pesticide application process, 38.9% acquired by training, 13% from personal experience, and 30% from both training and experience. Almost 17% of retailers know the application process by reading the manuals and instructions from pesticide companies, and 1.9% do not know the application process (Figure 2). Farmers have adapted to modern machinery or equipment to apply pesticides from retailers, and it was recorded that 31.5% of retailers have training on pesticide application equipment (Figure 2). Most of the retailers possess proper scientific knowledge on pesticide formulation which is around 82% of the total retailers. Although most retailers know about pesticides, their application processes, formulations, and other processes, the maximum number (85.2%) of retailers realize they need more intensive training on pesticides. In contrast, 14.8% denied their interest in further intensive training because they think it will hamper their business (Figure 3).

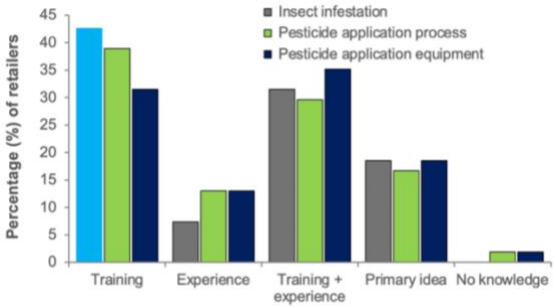

Figure 2. Pesticide retailer's knowledge on insect infestation, pesticide application and pesticide application equipment

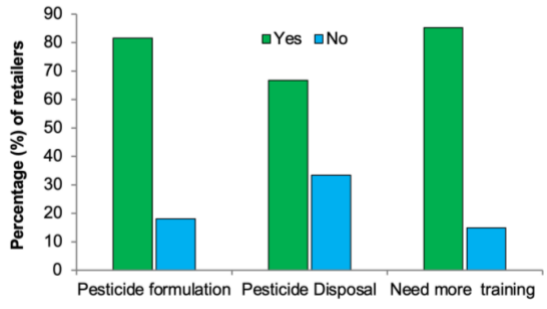

Figure 3. Retailers' knowledge on different process of pesticide application

3.3. Retailer's knowledge on insect and infestation

Before recommending a pesticide, it is necessary to identify the specific insect's damage. Of the retailers surveyed, 61.1% said they had sufficient knowledge to recognize the major insect insect pests in the field, while 27.8% have a primary idea and 11.1% admitted they are not sufficiently familiar with the major insect pests (Table 2). It was reported that 42.6% of retailers acquire this expertise by training programs, 31.5% from training and experience, 18.5% have primary idea and 7.4 % have experience. However, they do not normally visit farmers' fields before suggesting a pesticide. Most of them make their recommendations based on farmers' description of pest infestation. Moreover, retailers recommend pesticides to the farmer based on their personal experience (44.4% retailer), training (22.2%), and both personal experiences and training (29.6%) and only a few retailers (3.7%) have contact with the UAO along with their personal and training experience (Table 2).

3.4. Retailer's shop status

Retailers' stores are mainly concentrated on chemical pesticides rather than other management tools and machinery. It was recorded, 1.9% of stores have only liquid pesticides, whereas 31.5% of stores have both liquid and solid pesticide and more than twice the shops (66.7%) provide all solid, liquid, and gaseous pesticide. However, it is observed that all the shops contain pesticides with labelling. From selling trend of last year and storage, 44.5% of stores served pesticide for all categories of pest but only 1.9% of stores provided pesticides for vegetables pest only. A retail store that sells toxic substances like pesticides should have proper standard safety measures. Alarmingly, 18.5% do not have any standard safety measures (gloves and masks) at all, about double that number (35.5%) have poor status, and 31.5% have medium quality while 14.8% store with high standard safety measures. The scenario of storage conditions was substandard. A low number (1.9%) of the total surveyed store have high-quality storage facilities whereas 20.4% of stores do not have any storage, 22.2% of farms has poor quality storage, and most of them (55.9%) preserve pesticide in moderate standard storage (Figure 4). In the case of health issues, 53.8% retailers did not acknowledge any health problem while 13.5% endured vomiting and headache, 11.5% faced only headaches and 7.7% suffered from inhalation. 42.6% found to return the expired pesticide to the pesticide company, 25% reported to dispose and return while around 30% of retailers dispose the expired pesticide and 1.9% sell it (Table 3). In the case of safely equipment, 88.9% of stores do not possess firefighting equipment and none of the stores have first-aid kits available (Figure 5). Around one-third of stores do not have adequately trained staff, 32% have only one staff and 30% recruit two or three staff.

3.5. Status of pesticide application by farmers addressed by retailers

Most retailers (81.5%) claimed that during the past five years, farmers have applied more pesticides than any other new method of managing pests; however, 14.8% stated that pesticide use has reduced and 3.7% reported that it has remained consistent (Figure 6).

Table 1. Socio-demographic status of pesticide retailers in Sylhet region, Bangladesh

Respondent characteristics		Frequency (%)
Sex	Male	100.0
	Female	0.0
Age (years)	20-29 years	22.2
	30-39 years	35.2
	40-49 years	20.4
	50-60 years	11.1
	Above 60 years	11.1
Education level	Read & write	5.6
	Primary (5^{th} grade)	18.5
	Secondary (10^{th} grade)	25.9
	Higher Secondary (12^{th} grade)	31.5
	Graduation	9.3
	Masters	9.3
Registration Status	Registration from UAO	94.4
	No registration	5.6
	Renew registration	0.0
Business type	Personal	85.2
	Dealership	14.8

Table 2. Retailers knowledge about pesticide applications and pest management

Variable		Frequency (%)
Knowledge acquired about pesticide	Diploma Course	1.9
	Short duration training (1-2days)	68.5
	Long duration training (>10 days)	3.7
	Primary Idea	20.4
	Diploma + short training	3.7
	Short +long training	1.9
Ability to identify major insects	Good knowledge	61.1
	Primary Idea	27.8
	No knowledge	11.1
Insect Infestation	Training	42.6
	Experience	7.4
	Training + experience	31.5
	Primary idea	18.5
Recommendation of pesticide based on	Training	22.2
	Personal Experience	44.4
	Training+ experience	29.6
	Training+ experience+ contact	3.7

Table 3. Status of pesticides retailers store in Sylhet region, Bangladesh

Variables		Frequency (%)
Type of pesticide storage	Liquid	1.9
	Solid +liquid	31.5
	Solid +liquid+ Gaseous	66.7
Pesticide of major crop groups	Vegetable's pest	1.9
	Cereals + vegetable pest	9.3
	Cereals+ Fruits+ vegetable pest	24.1
	Cereal+ Fruit+ veg.+ Household pest	14.8
	Cereal+ Fruit+ veg.+ stored pest	5.6
	Cereal+ Fruit+ veg.+ Household+ stored	44.4
Expired pesticide status	Return to company	42.6
	Sale	1.9
	Dispose	29.6
	Return + dispose	25.9
Number of staff	No staff	32
	One	32
	Tow -three	30
Health Hazard	Vomiting	0.0
	Headache	11.5
	Inhalation	7.7
	Vomiting +headache	13.5
	Vomiting +inhalation	1.9
	Vomiting +headache+ inhalation	11.5
	No health problem	53.8

3.6. Farmer's attitudes and opinions on retailers' practices

A major proportion of farmers (59.2%) reported that retailers are not well trained, although 40.8% did not agree with that statement. According to 85.7% of farmers, pesticide retailers suggest specific pesticides to the farmer, while 14.3% think suggested pesticides are not specific to each crop pest. However, more than 70% of farmers thought the suggested pesticides by the retailers were effective against insect pests, whereas 28.6% of farmers said the retailers' suggestions were not effective. According to 88.8% farmers, retailers do not visit their infested fields before recommending a pesticide. On the other hand, 11.2% of farmers agreed that retailers visit their field regularly. More than half of the farmers reported that retailers take the excess price of pesticide, whereas 42.2% said they buy pesticide at a fair price from retailers (Figure 7).

4. Discussions

The educational status of retailers was not satisfactory in this study. This is a big challenge for improving retailers' practices in Bangladesh. The results are consistent with the study reported by Bhandari et al. (2008) in Nepal, retailers are not well educated, 65% of retailers had higher secondary education and 31% received secondary education. It is also reviewed that there is not a definite age range of pesticide retailers - people from different age groups have been involved in this process.

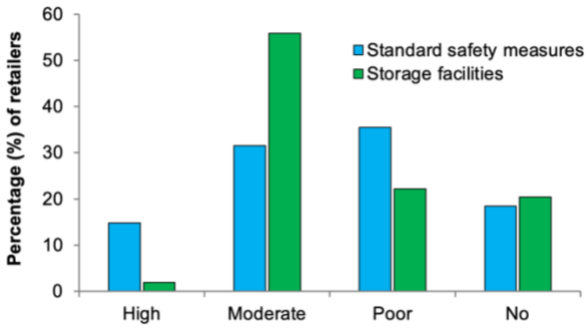

Figure 4. Availability of standard safety measures (gloves and masks) and storage facilities of retailers' shore in the surveyed area

We identified a pattern resembling the results from the study in Nepal, where 45% of the retailers belong to age group 20–39 years, 34% belong to 40–49 years, and the rest were more than 50 years old (Bhandari et al., 2008).

The registration and the renewal of certificates can regulate the retailer to maintain safe measures of pesticide handling. Although this study highlighted that a substantial percentage of retailers were registered in Bangladesh, the process of having a license was not thoroughly justified. However, there is no procedure to renew or recertify the registration after a particular time limit, which could be useful to make our retailer conscious of their practices. It was documented that only 13% of retailers were registered and 44% renewed their license in Nepal (Bhandari et al., 2008) which might have influenced their safety behavior. In Tanzania, over half of the retailer store (58.6%) were not registered (Lekei et al., 2014a).

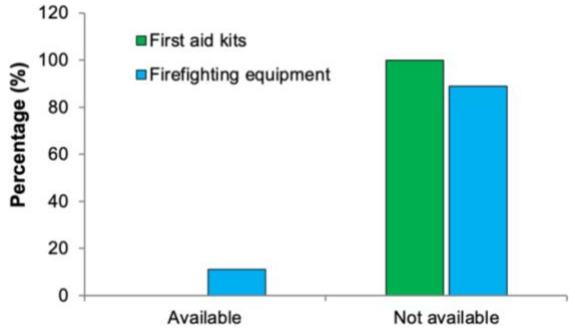

Figure 5. Availability of safety equipment (First aid kits and firefighting equipment) of surveyed pesticides retailer's store

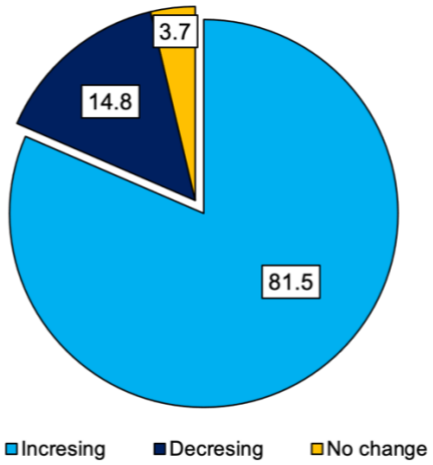

Figure 6. Present status of chemical pesticide application by the farmers addressed by pesticide retailer

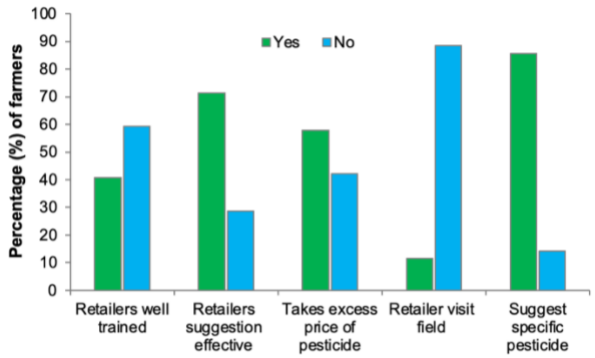

Fig. 7. Farmers attitude towards retailers' status and practices in the study area

Pesticide retailers do not have sufficient knowledge about pesticide handling and insect infestation, because most of them did not receive any institutional knowledge or degree and proper logistical support. Retailers believe this is a simple process, and everything is written in the body of the pesticide bottle or packet. Although retailers were trained shortly by pesticide companies and UAO, this short-term training is not frequent enough and adequate to gain a comprehensive knowledge on pesticides handling. Furthermore, sometimes retailers are not encouraged to attend the training. A study in Sri Lanka reported that lack of training by pesticide retailers and distributors necessitated the proper training of retailers in safe handling and storage of pesticides for risk reduction (Roberts et al., 2003). Yang et al. (2014) emphasized that pesticide retailers require effective educational and inspection programs for pesticide handling in China. It was experienced in Nepal that while 86% of retailers received training on the proper handling of pesticides, only half of them can differentiate the color codes of pesticides and 53% of retailers are not motivated to participate in social discussion, like meetings, seminars, and conferences on pesticide application (Bhandari et al., 2008). There was another major concern that 60% of retailers did not get any support from the district agricultural offices (Bhandari et al., 2008) which has significant effects to motivate a retailer for improved practice. Disposal of damp pesticide bottles and the packet is a prime responsibility of retailer, and it is observed that two-thirds of retailers know how to destroy expired or broken pesticide bottles. A reasonable proportion of retailers in Bangladesh are intimately aware of the pesticide disposal process and mostly disposed expired pesticide on soil by burying it or returning it to company. Whereas in Tanzania, one-half of the retailer disposed damaged pesticides, containers or bottles in municipal disposal site and others disposed through burning and burying (Lekei et al., 2014a). Mixing waste pesticide into municipal dispose sites would create a dangerous environmental hazard.

Pesticide retailers play a crucial role to maintain pesticide supply and farmers are completely or partially reliant on retailer recommendations in Bangladesh. In China, the pesticide retailers are the sole authority to suggest and provide information to the farmers about pesticide application although they have lack of educational and information access (Fan et al., 2015). A study conducted in India reported that only 20% of farmers received the information of pest management from agricultural Extension officer and 80% get information from unreliable source (Shetty et al., 2010). A lower percentage of retailers face a high health hazard, but surprisingly more than half of the retailers did not recognize any long-term effects from pesticide exposure in Bangladesh While handling pesticides. However, the most noticeable (73.8%) acute symptom was observed while pesticide handling by the retailers in Nepal was headaches followed by skin irritation (62.3%), eye irritation (32.8%), weakness (22.4%), and muscle pain (19.1%) (Bhandari et al. 2008). In this study, we observed a positive practice that just a negligible number of retailers are selling expired pesticide. These would be the effects of successful monitoring of retails shop by the Agricultural Extension Officer (AEO) through frequent visits. This can be contrasted with the reported scenario in Nepal where 67% retailers were engaged to sell expired pesticides to farmers (Lekei et al.,

2014a; Haj-Younes et al., 2015) with the potential to cause serious environment and economic impacts. Retailers are not well motivated to use standard safety measures in their shop, and the study showed an alarming record about first-aid kits and fire-fighting equipment (Fig 5). The reason could be lack of health awareness, reluctance, and proper monitoring of responsible authority. In Tanzania, the finding was somewhat different in that 38.6% of farms had first-aid kids following 22.6% firefighting equipment's and 52% semi-trained staff. Surprisingly, one-third of the retail firms did not employ any staff, and others did not have trained staff in this study. This is a huge challenge for safe pesticide management.

According to most of the retailers, the application of pesticides is a rising trend, and this may be due to introduction of high- yielding varieties, expansion of cultivated areas particularly for fruits and vegetables, and availability of retail farms. Consistent results were also found in several studies of Bangladesh and Nepal; Every year pesticide application increases rapidly (YD, 2016; Rahman, 2013). This kind of indiscriminate chemical pesticide application has also been observed in Vietnam where the farmers use mostly pesticides of categories I (31%) and II (54%) but surprisingly they use a few banned pesticides (MARD, 2011). This is happening because farmers are exclusively concerned with improving their production and effectiveness of management for combating pests without considering the risks, safety instructions, and protective measures required (Thuy et al., 2012).

5. Conclusion

Application of pesticide in Bangladesh has been increasing day by day. Mostly, registered pesticide retailers are responsible to sale and suggesting pesticide to the farmers. However, one third of retailers did not receive higher academic education. A major proportion of retailers received technical knowledge on pesticide (68%) and insect infestation (42%) from short training. Moreover, they are not well trained to recommend specific pesticides to the farmers where farmers are mostly dependent on the retailer's suggestion. More than 60% of farmers agreed that retailers are not well trained, but 71% farmers believe the suggestions provided by retailers are effective against insect pest. Application of pesticide by farmers is dominant than all other management approaches like cultural, biological, and mechanical. Retailers' stores are not well facilitated with standard safety measures, firefighting tools, and first aid kits. A small proportion of retailers are facing a variety of health issues like vomiting, headache and inhalation while handling pesticide. However, more than half of them is not well concern about their health hazards and do not follow standard safety measures (gloves and masks) while handling pesticide. The retailer's registration policy would include a specific course on pesticide. The registered authority should be more concerned about ensuring the standard safety measures and trained staff in the retail shop and this could be included as requirements for registration. Moreover, it is necessary to provide long-term training about pesticide handling to the retailers. Finally, strongly defining strategies for better pesticide management would be possible through legislation, control, and technical education. Future research can be planned to justify the effectiveness of pesticide recommended by retailers for different kinds of insect pest infestation.

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Conflict of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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