Farmers' use of pesticide during vegetables production and its impact on environment in Bangladesh

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Abstract: An investigation was carried out to study use of pesticide during vegetable production by the farmers' and its impact on environment. A structured questionnaire and researcher's observation were used for this study. The data were collected from six different villages of sixty farmers at Ghatail upazilla under the District of Tangail in Bangladesh during February to May, 2015. More than half of the respondents (51.7%) were illiterate and lack of knowledge on pesticide use. About 60% respondent had 16-20 years farming experience and showed comparative knowledge on pesticide use. About 56.7% respondent practiced monthly communication with extension worker (Block Supervisor). About 66.7% respondent spent 04-06 hours to media every day. Half of the respondents had low level knowledge on pesticide use, where only 3.3% respondent showed high level knowledge on pesticide use. About half of the respondents (51.7%) used pesticide 16-20 times during the season. About 21.7% respondent used pesticide 21-25 times during the season. For selective vegetable okra showed highest frequency, about 16.7% respondent used pesticide 26-30 times during the season, while one third of the respondents (33.3%) used pesticide 16-20 times. About 58.3% respondent used pesticide 16-20 times for brinjal, while 8.3% respondent used 21-25 times. About two- fifth respondents (41.7%) used pesticide 16-20 times and 21-25 times for bitter gourd, while 8.3% respondent used 05-10 times and 10-15 times. About 58.3% respondent used pesticide 16-20 times for snake gourd, while 16.3% respondent used 21-25 times. About 66.7% respondent used pesticide 16-20 times for cucumber, while 16.7% respondent used 21-25 times. It indicated farmers used pesticide to their field 1-2 times in a week during the season in some vegetable cultivation. Routine research work with wide public awareness, government and NGO participation, and Government regulation are needed for safe and sound environment.

Keywords: Farmers, pesticide, vegetables, impact, environment, Bangladesh.

Introduction

Vegetable cultivation is one the most economically important and dynamic branches of agriculture. It's an important group of crops and they constitute a major part of the diet contributing nutrients and vitamins. It has become an important source of income for both farmers and field laborers, serving as a vehicle for reducing poverty in rural areas. It provides more return than other field crops. Vegetables give 350% higher monthly net return than rice (Hassan, 2005). For that reason vegetable cultivation is increasing comparatively past. In the year of 2011-12, 2012-13, 2013-14 vegetables were cultivated 881000 acres, 885000 acres, and 908000 acres land area respectively (BBS, 2015). At the same time, vegetable cultivation is becoming more costly due to the increased use of purchased inputs, such as pesticides and fertilizers, to sustain production levels. In Bangladesh, the use of pesticides, which was on average 3,850 metric tons annually during 1973-2000, has gradually increased to a record use of 37,712 metric tons in 2014 (BBS, 2015).

Most of the vegetables grown in Bangladesh are vulnerable to be attacked by insect pests. The role of insecticide use has become critically important with modernization of agriculture in Bangladesh. Sabur and Mollah (2000) observed an increase in use of pesticides by farmers in combating pests throughout Bangladesh.

The abuse of pesticides, including the use of excessive rates and non-registered chemicals, as well as a disregard for re-entry and harvest-delay intervals, have resulted in both loss of pesticide effectiveness as well as damage to the environment and human health. Around 47% of the farmers of Bangladesh were found to have overused pesticides, with an average overuse rate of 3.4 kg per growing season (Dasgupta *et al*., 2006). The massive pesticide leads also to the environment pollution in many forms inflicting global warming and depletion of ozone layer, pest migration and expansion that affects productivity, profitability and safety of food products (Ghimire, 2007).

Pesticide poisoning is a major global health problem, and it is more prevalent in countries like Bangladesh. The harmful effects on human beings in the form of acute and chronic toxicity exposed to insecticides are well established. The incidence of pesticides poisoning is increasing, and it is estimated that about 5 million people die every year as a result of intentional, accidental and occupational exposure worldwide (Singh and Gupta, 2009). Vegetables were often grown close to the household, thus creating the potential for exposure of women and children.

Overuse of pesticides not only increases the cost of production but also decrease the quality of crops leading to yield lost. Insects, mites, weeds, nematodes, rodents and others significantly contribute to high farm production costs and reduce quality and yields (Henneberry et al., 1991). The yield loss varies in different environment conditions but can exceed 65% in Bangladesh (BARI, 1999). Vegetable farmers use a wide range of pesticides at different levels to reduce losses from pests and diseases. However, despite the contribution of pesticides to agricultural production, evidences in the last few decades have shown that they could also be detrimental to human health and the ecosystem (Tadesse and Asferachew, 2008). Most of the farmers do not concern about pesticide impact on environment. In Bangladesh many government and non-government organization are working in the field of agriculture. Several works have done on pesticide use impact on environment during vegetable production. In this study an attempt is taken to make a document on the frequency of pesticides use during vegetable cultivation at farmer's level in Ghatail upazila and its impact on environment.

Materials and Methods

Farmers used pesticide for improving their production. They use pesticide more than their requirement and its

resulting environmental problems such as underground and surface water pollution. The study was conducted among the sixty (60) farmers of Ghatail upazilla at six (06) different villages e.g. Momrez Golgonda, Sadurpara Golgnoda, Dowjani, Fulhara, Korna, and Halua Para. Ten (10) farmers were selected from each village. The data were collected from the selected farmers through personal interview using a pre-designed and pre-tested interview schedule.

Measurement of the independent variables: The independent variables of the study were age, educational qualification, family size, farm size, occupation, farming experience, innovation, extension contact, media exposure, organizational participation, knowledge of pesticide use, frequency of pesticide use, and indigenous farming practice. Age of the respondent was measured in the term of years from his birth to the interview time. A score of one was assigned for each year of her age. The education was measured on the basis of a respondent's year of schooling in the educational institution, which was determined by his /her response. An education score of 01 was given to an illiterate respondent, education score of 02 was given for primary education, education score of 03 was given for secondary education, and education score of 04 was given for higher education. The family size was measured by total number of member in the family. Similarly 1 for each number of children. The farm size of the respondent was measured in khata. The farm size of the respondent was measured in khata on the basis of his/her response. The occupation was measured on the basis of a respondent works, an income source which was determined by his or her response. Farming experience was measured in term of years he or she involved in farming. It referred to the exposure on the extent of contact of a respondent with different information sources. 1 for not available 2 for Regularly 3 for Weekly 4 for Monthly. Media exposure of respondent was measured by computing a media exposure score on the basis of his or her exposure with 05 selected media such as radio, television, daily newspaper, krishikatha or other magazine, folk media. 1 for Not used 2 for 0-03 hours 3 for 04-06 hours and 4 for >06 hours. Organizational participation of a respondent was measured according to the nature of his/her involvement and duration of participation in different organization. A respondent's organizational participation score for a single organization was measured by multiplying his year of involvement by 1, 2, and 3 in case of ordinary member executive committee member, executive committee officer. Finally a total score of all organization were added to obtain his total score of organizational participation. Knowledge on the use of pesticides was measured by using nine (09) questions. A score of (3, 2, and 1) was given to each correct answer for the respective question and 0 for incorrect answer, while number was also considered for partially correct answer. Thus, score of all the question were summed up to get total knowledge score could be 0 to 25. Where 0 indicate no knowledge and 25 indicate highest level of knowledge. Pesticide use frequency during season was measured by total number of pesticide application on respective vegetable crop during the season. 1 for (5-10) times spray 2 for (11-15) times 3 for (16-20) times 4 for (21-25) times 5 for (26-30) times and 6 for above 30 times during a season. Three (03) question in closed form were set up as regard to indigenous practices, which could be answered by checking 'Yes' or 'No' . 'Yes' stand for score 2 where 'No' stand for 1.

Measurement of dependent variable: Farmer awareness on the effect of pesticides to environment was considered as the dependent variable in this study. It was measured by using seven (07) question which could be answered by checking 'Yes' or 'No' . 'Yes' stand for score 2 where 'No' stand for 1.

Results and Discussion

Characteristics profile of the respondents:

Characteristics profile of the farmers were determined and presented in Table 1.

Table 1. Socio demographic characteristics profile

Category	Variable	Frequency	Percent
Age (years)	31-35	17	28.3
	36-40	22	36.7
	41-45	9	15.0
	46-50	6	10.0
	51-55	4	6.7
	56-60	2	3.3
Education level	Illiterate	31	51.7
	Primary education	21	35.0
	Secondary education	7	11.7
	Higher education	1	1.7
Farm size (katha)	06-10	29	48.3
	11-15	25	41.7
	16-20	5	8.3
	21-25	1	1.7
Farming experience (years)	10-15	14	23.3
	16-20	36	60.0
	21-25	4	6.7
	26-30	4	6.7
	31-35	0	0
	36-40	2	3.3
Communication ability	Not available	24	40.0
	Regularly	1	1.7
	Weekly	1	1.7
	Monthly	34	56.7
Media exposure (hours)	0	4	6.7
	0-03	16	26.7
	04-06	40	66.7

Pesticide use frequency ranged from 5-30 times in a season with mean 3.02 times and standard deviation 0.97. The farmers were categorized on the basis of their pesticide use frequency in a season which is present in Table 2. The highest proportion (51.7%) of the respondents were used pesticide 16-20 times during the season, while 21.7% of the respondents were used pesticide 21-25 times, 11.7% of the respondents were used pesticide 5-10 times and 11-15 times, and 3.3% of the respondents were used pesticide a great proportion 26-30 times during the season (Table 2).

Table 2. Distribution of respondents by pesticide use frequency in a season (February to May)

Pesticide frequency	Frequency	Percent	Mean	SD
5-10	7	11.7		
11-15	2	11.7		
16-20	31	51.7	3.02	0.97
21-25	13	21.7		
26-30	2	3.3		

The highest proportion of responded (60.0%) involved with media exposure had 16-20 years farming experience in this group 43.8% respondents were exposed to media 0-03 hours. About 23.3% respondents exposed to media had 10-15 years farming experience, among them 25% did not use media,18.8% responded use 0-03 hours media and 25% used 04-06 hours. About 6.7% respondents exposed to media had 21-25 years farming experience, among them 25% were not use media , 0-03 hours media exposure were 12.5 % and only 2.5% used 04-06 hours. About 6.7% respondents exposed to media had 26-30 years farming experience, among them 25% were use media 0-03 hours. Lowest proportion of media exposure who had 36-40 years farming experience were 3.3% (Table 3).

Table 3. Distribution of respondents based on the farming experience with media exposure

Farming experience (years)	% of media exposure			Total respondent percentage
	Not use	0-03 hours	04-06 hours	
10-15	25%	18.8%	25%	23.3%
16-20	0%	43.8%	72.5%	60%
21-25	25%	12.5%	2.5%	6.7%
26-30	0%	25%	05%	6.7%
31-35	0%	0%	0%	0%
36-40	50%	0%	0%	3.3%

Highest proportion of knowledge level of pesticide use respondents (59.3%) had 16-20 years farming experience. While 23.7% responded knowledge level of pesticide use had 10-15 years farming experience, 6.8 % respondent knowledge level of pesticide use had 21-25 and 26-30 years farming experience, 3.4% responded knowledge level of pesticide use had 36-40 years farming experience (Table 4).

Table 4: Distribution of respondents based on the farming experience with knowledge level of pesticide use

Farming experience (years)	% of knowledge level of pesticide use			Total respondent percentage
	11-15	16-20	21-25	
10-15	26.7%	17.9%	50%	23.3%
16-20	66.7%	57.1%	0%	60%
21-25	0%	14.3%	0%	6.7%
26-30	3.3%	7.1%	50%	6.7%
31-35	0%	0%	0%	0%
36-40	3.3%	3.6%	0%	3.3%

Media exposure is important for receiving up to date farm information. It's related with education. Generally higher educated person more involved with media, but this research work showed that higher educated respondents only 6.3% involved with media and the respondents who had no education involved highest proportion (68.8%) to media (Table 5).

Table 5. Distribution of respondents based on the education with media exposure

Education level	% of media exposure (hours/day)			Total respondent percentage
	Not use	0-03 hours	04-06 hours	
Illiterate	50%	68.8%	45%	51.7%
Primary education	50%	25%	37.5%	35%
Secondary education	0%	0%	17.5%	11.7%
Higher education	0%	6.3%	0%	1.7%

Crop based pesticide frequency in a season: The highest proportion 58.3% respondent had use pesticide 16-20 times in a season for brinjal, while 25% respondents had use pesticide 11-15 times, 8.3% respondents had use pesticide 5-10 times and 21-25 times (Fig. 1a). This research showed that majority of the farmers sprayed insecticides more than 16-20 times in brinjal cultivation. It may be for the regional variation or pest emergence variation. About one third (1/3) respondents had use pesticide 16-20 times in a season for okra, while one fourth (1/4) respondents had use pesticide 21-25 times, one sixth (1/6) respondents had use pesticide 5-10 times and 26-30 times, one twelve (1/12) respondents had use pesticide 11-15 times (Fig. 1b). About two fifth (2/5) of the respondent had use pesticide 16-20 and 21-25 times in a season for bitter gourd, while one twelve (1/12) of the respondents had use pesticide 5-10 and 11-15 times (Fig. 1c). The highest proportion 58.3% respondent had use pesticide 16-20 times in a season for snake gourd, while 16.7% respondents had use pesticide 5-10 times and 21-25

times, 8.3% respondents had use pesticide 11-15 times (Fig. 1d). About 66.7% respondent had use pesticide 16-20 times in a season for cucumber, while 16.7% respondents had use pesticide 21-25 times, 8.3% respondent had use pesticide 5-10 times and 11-15 times (Fig. 1e). In a single season, farmers sprayed pesticides about 20-25 times for okra Harun *et al*. (2006). But this research showed that majority of the farmers sprayed insecticides more than 16-20 times in okra cultivation. It may be for the regional variation or pest emergence variation.

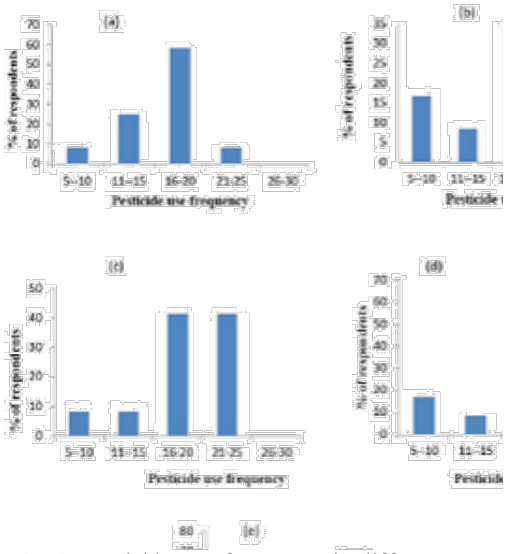

Fig. 1. Pesticide use frequency in different crops (a) Brinjal, (b) Okra, (c) Bitter gourd, (d) Snake gourd, and (e) Cucumber

Environmental impact: The own observation of the researcher to the study area found that, farmers used pesticide to kill pest to their field and by these way pesticides released into the environment. By applying pesticide to the field some of the pesticide may migrate into the air, soil, groundwater and surface waters. Pesticide may also carry out by rain water to the water body. In this way pesticide mix with environment and create environmental pollution. How readily pesticides move off-site from where they are applied depends on the chemical and physical characteristics of the individual pesticide. Pesticides can kill beneficial soil bacteria, earthworms, snails, frogs, birds, fish, honeybees and other valuable species. On observation, researcher found there were no beneficial insect, snails, frogs, birds in the study area. It indicated due to use of pesticide beneficial insects, snails, frogs were died and it create ecological imbalance. A few respondents claimed that pesticide create negative impact on aquatic life.

According to Haq and Ghose (2011), more than 80% of the respondents did not take any safety measures during application and preservation of pesticides. Another study by Ajayi (2005) found that both harmful and beneficial organisms were killed and substances released from chemical reactions contaminate the environment, leading to climate change, pest resistance and biodegradation. Mathews (2006) indicate that farmers use pesticides without full understanding of the impact on human health and the environment.

Bangladesh is an over populated and agro based country. Most of the people live in rural areas and they are illiterate. All out efforts are being made by the people of the country to increase agriculture production for feeding the rapidly increasing population. Use of pesticide in agriculture has been increasing day by day in order to get increasing agriculture production. The farmers of this country are increasingly using these pesticides in their farming without considering its long run effect, either knowingly or unknowingly. For the better living in better environment having knowledge on pesticide use and its impact on environment are very important.

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