Attitude of Farmers towards the Use of Chemical Pesticides for Vegetable Cultivation

Abstract

The main purpose of the study was to determine farmers' attitude towards the use of chemical pesticides for vegetable cultivation in the selected areas of Mymensingh district and to explore the relationships between nine selected characteristics of farmers and their attitude towards towards the use of chemical pesticides for vegetable cultivation. A total of 100 farmers were selected from Baira and Sutiakhali unions of Mymensingh Sadar upazila following simple random sampling technique. Data were collected during 10 April to 08 May, 2019 using a structured interview schedule through face-to-face interview method by the principal author himself. Data were analyzed with a combination of descriptive statistics and inferential statistical technique. Nine selected characteristics of the farmers namely; age, education, family size, farm size, annual income, extension media contact, general knowledge, training received and problem confrontation score were considered to show relationships with their attitude towards NATP (phase-I) interventions. The majority (34 percent) of the farmers had moderately favourable attitude towards the use of chemical pesticides for vegetable cultivation compared to 24 percent of the respondents had neutral attitude and 19 percent of the respondents had highly favourable attitude towards the use of chemical pesticides for vegetable cultivation. Correlation analyses indicated that annual income and extension media contact had significant positive relationships with respondents attitude towards the use of chemical pesticides for vegetable cultivation. So, these two characteristics had significant contributions on the attitude of farmers. Age, education, family size, farm size, general knowledge, training received and problem confrontation score had no significant relationship with respondents attitude towards the use of chemical pesticides for vegetable cultivation. So, these characteristics had no significant contributions on the attitude of farmers. Overall the farmers were very keen to use chemical pesticides for vegetable cultivation as they got immediate economic return after using chemical pesticides.

Keywords: Attitude, chemical pesticides, economic return

Introduction

Vegetables substantially contribute to healthy and balanced diet of human being (Zoundji et al., 2018). These crops are inevitable for human health due to its nutrient contents such as dietary fiber, vitamins and minerals (Ulger et al., 2018). Vegetables are the major crops grown in an area of 37.22 million hectares with annual production of 630.75 MT in Asia In Bangladesh, around 40.37 percent of cultivable land is under vegetable cultivation (BBS, 2010).. These crops play significant role in improving the poor nutritional status of human being in Bangladesh.

Vegetables due to its nature are susceptible to insect, pest and diseases attack (Adeniji, 2008). Farmers use a wide range of pesticides to prevent crop loss from pest attack; and it is reported that pesticides contributed substantially to reduce pest attack and to increase production (Mahantesh and Singh, 2009). Pesticides have direct relation with increasing crop production significantly (Latif et al., 2011). However, there is a growing concern that indiscriminate use of chemical pesticides has long-term hazardous effects on human and environment (Jallow et al., 2017). But the reality is, most of the farmers in Bangladesh are not aware of the negative effects of chemical pesticides. According to Rahman (2003), around 77 percent of Bangladeshi farmers use pesticide at least once in a given agricultural season.

Although use of pesticides as well as crop loss due to pests are increasing globally, a marginal increase in pesticide use still appears to be profitable to farmers (Yudelman et al., 1998). Emergence of pest resistance to pesticides is one of the major negative aspects of pesticide use, compounded by a widespread claim that chemicals are harmful to human health and the environment (Pingali, 1995; Antle and Pingali, 1994; Rola and Pingali, 1993). There is widespread acceptance that expansion of modern agricultural technologies led to sharp increase in pesticide use (Roger and Bhuiyan, 1995; Pingali and Rola, 1995). Therefore, with the increased diffusion of 'green revolution' technology in regions of Asia, Latin America and Africa, pesticides became and will continue to be a major component of modern day agriculture. Pesticide use in Bangladesh, negligible until the 1970s, has recorded a dramatic rise in recent years. Pesticide use levels increased from 2200 metric tons in 1980–1982 to 6500 metric tons in 1992–1994 and modern rice cultivation increased from 20.3% of total rice area to 49.0% during the same period (Rahman and Thapa, 1999). Studies on factors determining demand for major inputs, such as labor, fertilizer and irrigation for crop production owing to the 'green revolution' in Bangladesh are numerous (Rahman, 2000; Rahman and Routray, 1998; Ahmed and Sampath, 1992; Ahmed and Hossain, 1990; Alauddin and Tisdell, 1991; Hossain, 1989; Hossain et al., 1990). However, similar

information on pesticide use, which has become an essential input in crop production, is not available. The present study, therefore, attempts to contribute to the existing body of literature by explicitly examining the factors determining the use of pesticides and farmers' awareness of beneficial and harmful effects of pesticides. Farmers in low income countries are overly reliant on synthetic pesticides to manage crop pests and diseases (Schreinemachers et al., 2017; Pretty, 2005; Ecobichon, 2001). Bangladesh has experienced a fivefold increase in agricultural pesticide use (insecticides, fungicides and herbicides) between 1990 and 2010 (Pretty and Bharucha, 2015). The use of pesticides in Bangladesh is particularly high on vegetables. Bentley (2009) and Rashid et al. (2003) reported that farmers producing eggplant sprayed nearly every day. Health and environmental risks associated with high levels of synthetic pesticide use in Bangladesh have been well-documented (e.g. Dasgupta et al., 2005; 2007; Rahman and Alam, 1997). Pesticide problems have also led other countries to consider restricting vegetable imports from Bangladesh (Rahman, 2016).

It is therefore of utmost importance to Bangladesh to reduce pesticide use in vegetables. Bangladesh has successfully introduced IPM farmer field schools in rice and later expanded these to vegetables. The country has worked intensively with international organizations such as World Bank, FAO and World Vegetable Center to reduce pesticide use and promote IPM in vegetables and other crops. In 2002, the government approved a national IPM policy and in 2010 it opened a new registration system for biocontrol products, which has increased the availability of a wider range of biocontrol products (Srinivasan, 2012). Still there is only limited evidence for the impact of IPM on reduced pesticide use in Bangladesh and neighboring countries. A study on IPM training in cauliflower, cabbage and okra in India didn't find a significant adoption of non-chemical practices other than pheromone traps used by okra growers (Sharma and Peshin, 2016). Van den Berg (2004) and Rashid et al. (2003) reported that eggplant IPM in Bangladesh reduced spraying frequency and pesticide expenditure and increased yield and income. However, Ahsanuzzaman (2015) found that IPM neither increased crop yield nor reduced input expenditures in sweet gourd production. This study therefore contributes to strengthening the evidence basis for the impact of IPM in Bangladesh and elsewhere.

Vegetables are the most important component of human diets for the safeguard of fitness and hindrance of diseases, it is also very important group of crops and they constitute a major part of the diet contributing nutrients and vitamins. The cereal consumption of the country is the highest position whereas vegetable consumption is in the lowest position but it provides more

return than other field crops, so itself here vegetable gives 350% higher monthly net return than rice (Hasan, 2005). Profound malnutrition, as well as less disease protecting the capacity of the human body, is prevailing among the rural people in Bangladesh. Being a poor nation, it is difficult to defeat such a big malnutrition problem by eating fish, meat, egg, butter, ghee etc. Hence, vegetable production is a vital area of agriculture. However, vegetables can play a very significant role to improve the nutritional level of the rural people in the country that is almost unnoticed. Insects, pests and diseases pose serious threat to vegetable production and these problems have been the major to the goal of our realization of self-sufficiency vegetable production (Adeniji, 2008). Vegetables play a vital role in our body because of its high nutrient balanced status. However, most of our people do not have enough vegetable for their everyday consumption. So, vegetable cultivation area needs to be increased for increasing average per capita consumption. Due to lack of adequate knowledge on nutrient status of vegetables and unfavorable adoption towards vegetable cultivation, there is less vegetable production in the locality. Most of the farmers do not know how pesticide should be used in their vegetables field. For more vegetable production, farmers are indiscriminately using pesticides. Improper and nonjudicious application of these pesticides could be harmful for vegetable production. Pesticides are toxic in nature and do not differentiate between target and non-target species of plants and animals, and hence should essentially be subject to safe and judicious use. Due to noncompliant and indiscriminate use of pesticides, many accidents have occurred in different parts of the world, and presence of pesticides in foods, fruits, vegetables, and environment and even in mother's milk is a matter of great concern (FAO, 2005). There is a dearth of investigation to find out if farmers maintain safety measures awareness while spraying pesticide in their vegetable field. Hence, the present study dealt with the practices of pesticide use. The present study was undertaken to know the socioeconomic characteristic of the farmers, problems facing in vegetable production, if farmers use correct pesticide to save their vegetable and safety measures taken by the farmers while spraying pesticides. It was assumed that an assessment on practices of pesticide use in the vegetables field by the respondents could be helpful to formulate policy and program for the augmentation of sustainable vegetable production. However, uses of pesticides must be controlled and users should be aware of possible undesirable effects on human health and the natural environment. Many study revealed that improper and indiscriminate application of pesticides reduces agricultural sustainability, create environmental problems and causes harmful effects on human health of both farmers and consumers. Now a day, using a small land area, yield can double or even triple with the combination of pesticide use, improved

planting methods, using advance machineries and others. Therefore, promoting sustainability in agricultural production requires critical consideration of agricultural technologies and identification of best practices. Keeping the above facts in view, the investigators undertake the study to determine the pesticide control measures practiced by the farmers and to explore the relationship between the selected characteristics of the farmers and their practices on pesticide use. Vegetables can play a significant role in human nutrition. They are a rich source of minerals, vitamins, and fibre. They contain a moderate amount of protein and are often low in carbohydrates. In Vietnam, principal vegetables include tomato (*Solanum lycopersicum*), chili (*Capsicum annum*), cucumber (*Cucumis sativus*), watermelon (*Citrullus lanatus*), bitter gourd (*Momordica charantia*), pea (*Pisum sativum*), French bean (*Phaseolus vulgaris*), yardlong bean (*Vigna unguiculata* subsp. *sesquipedalis*), various brassicas, and Allium species. Vegetable crops have been promoted to improve food security, meet local market demands, and serve the export market (Johnson et al. 2008). However, pesticide-free cultivation has not been attractive to farmers due to the challenges of controlling pests. According to Hoi et al. (2013), vegetable farmers apply pesticides intensively, and often at higher rates than permitted by the label. More than 7000 incidents of pesticide residue poisoning were reported in 2002 (Nguyen 2003). Besides acute poisoning due to direct and indirect exposure to pesticides, chronic pesticide poisoning is of concern, especially for Vietnamese farmers. There have been numerous studies examining pesticide use on vegetables and risk exposure in developing countries in Asia (Rahman 2003; Jeyanthi & Kombairaju 2005; Atreya 2007; Xu et al. 2008; Weinberger & Srinivasan 2009; Zhou & Jin 2009; Srinivasan 2012).

Chemical pesticides may not be harmful for human health if farmers know the residual time of a pesticide after they use. According to Bangladesh Crop protection Association (BCPA), less than 1% farmers have the skills of pesticides application and crop harvest. Food safety and pesticides have become serious human health concern and synthetic pesticides are an environmental contaminant. Despite the harmful effects of synthetic pesticides to human health, environment and other living beings, we cannot replace the chemical pesticides over night by bio-pesticides, IPM and organic agriculture. Attempts to educate farmers to use pesticides more safely and effectively and raising their awareness concerning health and environmental hazards are important.

So, the present study was formulated with the following specific objectives:

- To assess the attitude of the vegetable growing farmers towards the use of chemical pesticides for vegetable cultivation
- To measure the relationships between the selected characteristics of the vegetable growing farmers and their attitude towards the use of chemical pesticides for vegetable cultivation.

Methodology

Study area, population and sample

The study was conducted in two unions such as Baira and Sutiakhali of Mymensingh Sadar Upazila under Mymensingh District. The study area was selected purposively for investigation because the area was suitable for vegetable cultivation. Different kinds of vegetables namely brinjal, lady's finger, bottle gourd, cucumber, chili, pointed gourd etc. grown well in the study area. Due to increasing rate of vegetable production, good communication facilities and researcher's perception about better cooperation from the vegetable growers motivated the researcher to select the study area. Vegetable growers of this study area were the population of the study. The total numbers of vegetables growers were 500 in the study area, among them 100 (20 percent) were selected randomly as the sample.

Measuring attitude of the farmers

For measuring the attitude of the respondents a Likert scale (as developed by Likert, 1932) was used. A total of 15 relevant statements were adapted to the interview schedule to assess attitude of farmers towards the use of chemical pesticides for vegetable cultivation. The statements were asked to the farmers against the possible responses such as strongly agree, agree, undecided, disagree and strongly disagree with corresponding score of 5, 4, 3, 2, and 1, respectively. Ullah et al. (2011) and Ghosh and Hasan (2013) also used Likert scale in their respective studies. The attitude score of individual respondent was computed by summing the scores for responses to all the statements. Thus, the scale score ranged from 15 to 75, where 15 indicates unfavourable attitude and 75 indicates highly favourable attitude towards pesticide use in vegetable cultivation.

Vegetable growers faced different problems during vegetable cultivation. To find out the problem confrontation by the vegetable growers nine statements were used to collect data from the vegetable growers. A four point rating scale as 'high', 'moderate', 'low' and 'not at

all' while weights were assigned to these responses as 3, 2,1 and 0 respectively to collect data on problem faced by the vegetable growers on selected nine statements.

So, Problem Confrontation Score (PCS) = 3xHP+2xMP+1xLP+0xNA

Where,

HP= Total number of respondents expressing their problem as 'high' for the statement

MP= Total number of respondents expressing their problem as 'moderate' for the statement

LP= Total number of respondents expressing their problem as 'low' for the statement

NA= Total number of respondents expressing their problem as 'not at all' for the statement

Thus, the possible problem confrontation score of the respondents could range from 0 to 27. In all cases 0 indicates no problem and 27 indicates high problem on vegetable cultivation.

Data collection and analysis

Data were collected through personal interview during 10 April to 8 May, 2019. Before collecting final data, pre-testing of the interview schedule was made to locate any defects regarding the questions and statements. Attitude of vegetable growing farmers towards the use of chemical pesticides for vegetable cultivation was the focus variable and ten characteristics of the vegetable growers were selected as explanatory variables. The collected data were properly edited and coded before final analysis. All inconsistent data was avoided to eliminate the errors and fault. The Statistical Package for Social Sciences (SPSS) was used for the data management. Descriptive statistics such as percentage, frequency, mean, standard deviation and inferential statistics such as correlation analysis were employed to find out the findings of the study.

Results and Discussion

Selected characteristics of farmers

The selected characteristics of the farmers have been presented in Table 1. The findings show that highest proportion of the respondents (43%) was in middle aged category followed by old respondents (30%) and young (27%). Most of the respondents (43%) had no schooling followed by secondary level of education (33%) and 20% of the respondents had primary

level of education while 4% of the respondents had higher secondary level of education. It is expected that education is one of the important factors in determining respondents' attitude. It helps them to broaden their outlook and expands their horizon of knowledge. The household size of the respondents ranged from 2 to 14 with a mean of 7.05 was higher than that of the national average of 4.48 (BBS, 2015) and standard deviation 3.19. The average family size (7.05) was higher than the national average of 4.48 (BBS, 2015). The highest proportion of the respondents (36%) had small size farm followed by 27% of the respondents had marginal size farm while 24% of the respondents had medium size farm and 13% of the respondents had large size farm. Data presented in Table 1 show that the highest proportion of the respondents (44%) had medium income followed by high income (39%) while only 17% of the respondents had low income. Data indicate that the highest proportion of the respondents (68%) had low extension media contact followed by 28% had low extension media contact while only 4% of the respondents had high extension media contact.

Table 1. Distribution of the respondents according to their selected characteristics (n=100)

Characteristics (Measuring unit)	Categories	Respondents		Mean	Standard Deviation
		No.	Percent		
Age (Actual years)	Young (18-35)	27	27	46.83	13.63
	Middle Aged (36-50)	43	43		
	Old (>50)	30	30		
Education (Year of schooling)	No schooling (0)	43	43	4.1	3.98
	Primary (1-5)	20	20		
	Secondary (6-10)	33	33		
	Higher secondary (>10)	4	4		
Household Size (No. of members)	Small (up to 4)	12	12	7.05	3.19
	Medium (5-6)	43	43		
	Large (above 6)	45	45		
Farm size (Hectares)	Marginal (0.02-.2)	27	27	1.01	1.25
	Small (0.21-1)	36	36		
	Medium (1.01-3.0)	24	24		
	Large (>3.0)	13	13		
Annual Income ('000'Tk)	Low (up to 60)	17	17	153.90	115.73
	Medium (61-150)	44	44		
	High (> 150)	39	39		
Extension media contact (Scale scores)	Low (up to13)	68	68	11.81	7.64
	Medium (14-26)	28	28		
	High (>26)	4	4		
Training received	Not received (0)	70	70	0.80	1.72

(Days)	Short duration (1-2)	18	18		
	Medium duration (3-4)	9	9		
	Long duration (>4)	3	3		
Knowledge on vegetable cultivation (Scale scores)	Low (up to 11)	37	37	16	7.71
	Medium (12-22)	40	40		
	High (>22)	23	23		
Problem confrontation score (Scale scores)	Low (0-9)	15	15	13.50	4.41
	Medium (10-18)	71	71		
	High (>18)	14	14		

The highest proportion of the respondents (70%) did not receive any training while 18% of the respondents received medium duration training and only 9% of the respondents received long duration training. Data furnished in Table 1 indicate that most of the respondents (40%) had medium knowledge on vegetable cultivation followed by low (37%) knowledge, and only 23% of the respondents had high knowledge on vegetable cultivation. The problem confrontation score of the respondents ranged from 4 to 25 against the possible range of 0 to 27 with a mean of 13.50 and standard deviation 4.41. Most of the respondents (71%) had medium problem confrontation score followed by low (15%) problem confrontation score and 14% of the respondents had high problem confrontation score.

Farmers' Attitude towards the Use of Chemical Pesticides for Vegetable Cultivation

Farmers' attitude towards the use of chemical pesticides for vegetable cultivation was the main focus of the study. Attitude score of farmers varied from 16 to 56 against the possible range of 15 to 75 with a mean of 38.01 and standard deviation 9.59. Based on the possible attitude scores, the respondents were classified into five categories as shown in Table 2.

Table 2. Distribution of farmers according to their attitude towards the use of chemical pesticides for vegetable cultivation

Categories	Frequency	Percentage	Mean	SD
Highly unfavourable (<15)				
Unfavourable attitude (15-30)	0	0	38.01	9.59
Neutral attitude (30)	24	24		
Favourable attitude (31-45)	23	23		

Highly favourable attitude (>45)	19	19		
Total	100	100		

The majority (34 percent) of the respondents had moderately favourable attitude towards the use of chemical pesticides for vegetable cultivation compared to 24 percent had neutral attitude and 23 percent had slightly favourable attitude and only 19 percent had highly favourable attitude. The findings may be due to that the lack of knowledge and awareness of farmers about the harmful effect of chemical pesticides, lack of training and other facilities, problems faced by the farmers on biological control of pests and diseases etc. As most of the farmers had neutral to moderately favourable attitude towards the use of chemical pesticides for vegetable cultivation it is possible to improve the attitude of the farmers by improving their level of knowledge, by raising awareness through mass media, proper training and demonstration facilities on biological control of pests and diseases etc.

Relationship between respondents selected characteristics and their attitude towards the use of chemical pesticides for vegetable cultivation

The purpose of this section is to explore the relationships between each of the selected characteristics of the respondents and their attitude towards the use of chemical pesticides for vegetable cultivation. Pearson's Product Moment Correlation Co-efficient (r) was employed to find out the relationship between explanatory and focus variable. The output of the correlation analysis is presented in Table 3.

Table 3. Relationship between selected characteristics of farmers and their attitude towards the use of chemical pesticides for vegetable cultivation (n=100)

Farmers' characteristics	Co-efficient of co-relation coefficient (r) with df= 98
Age	0.013
Education	0.165
Family size	-0.042
Farm size	0.003
Annual income	0.368**
Extension media contact	0.366**
Knowledge on vegetable cultivation	0.066
Training received	0.079

*Significant at 0.05 level of probability; **Significant at 0.01 level of probability

The findings show that out of eight explantory variables, two variables such as annual income and extension media contact were significantly associated with their attitude towards pesticide use. Annual income of the respondents showed significant positive relationship (r=0.368**) with their attitude towards the use of chemical pesticides for vegetable cultivation. It indicated that the farmers with relatively higher annual income are relatively earlier in adopting any new technology, idea or practice for their better socio-economic condition. This results in favorable attitude towards the use of chemical pesticides for vegetable cultivation. Ahaduzzaman (2003) found significant positive relationship between annual income and attitude of farmers towards modern T. Aman technologies. Siddique (2002) and Hossain (2002) found that annual income had no significant relationship with attitude of farmers. Extension media contact of the respondents showed significant positive relationship (0.366**) with the attitude of CIG members. The reason behind this might be farmers with high extension media contact take decisions and other activities about farming practices. On the other hand the farmers who had low extension media contact were unable to take decision and other activities about farming practices. Khan (2012) and Zakir (2010) found significant positive relationship between the extension media contact and the attitude of the farmers in their respective studies.

Conclusion

The study concludes that most of the respondents (34 percent) had moderately favourable attitude towards the use of chemical pesticides for vegetable cultivation. Attitude consists of knowledge level, belief and action. Most of the respondents of the study area had low level of education and low socio-economic condition, lack of awareness about harmful impact of chemical pesticides on human health and environment, lack of knowledge about biological control of pests and diseases, lack of technical advices etc. These activities resulted in neutral to slightly favourable towards the use of chemical pesticides for vegetable cultivation. Among the 9 selected characteristics of farmers two characteristics namely annual income and extension media contact seem to have major contributions on farmers' attitude towards the use of chemical pesticides for vegetable cultivation. Considering the findings of the study, some essential policy recommendations have been arisen which are: various extension activities related to pests and diseases management need to be strengthened to give support to farmers for better farm management and improvement of crop productivity.

The overall attitude of farmers was neutral to moderately favourable so, it is possible to improve the attitude of farmers. The knowledge level of farmers should be improved by providing proper training facilities, raising awareness though using various mass media such as newspaper, television, poster and leaflet, proper monitoring on production and marketing of chemical pesticides, demonstration meeting on making and use of biological pesticides etc. to improve the attitude of farmers towards the use of chemical pesticides for vegetable cultivation.

References

Adeniji OB (2008). Pesticide Control in Vegetables production in Kunda State Nigeria. An unpublished Ph. D. Thesis, Department of Agricultural Economics and Extension Technology, Federal University of Technology, Minna.

Ahaduzzaman et al. 2003. Farmers' Attitude towards Modern T. Aman Technologies. *Journal of Agricultural Education and Technology*. Vol. 6 (1&2): 17-20.

Ahmed, A.U., Sampath, R.K., 1992. Effects of irrigation-induced technological change in Bangladesh rice production. Am. J. Agric. Econ. 74, 144–157.

Ahmed, R., Hossain, M., 1990. Developmental impact of rural infrastructure in Bangladesh, Research Report No. 83. International Food Policy Research Institute, Washington, DC.

Ahsanuzzaman, A., 2015. Three Essays on Adoption and Impact of Agricultural Technology in Bangladesh. PhD thesis. Virginia Polytechnic Institute and State University, Blacksburg, Virginia. https://vtechworks.lib.vt.edu/handle/10919/ 53510. Accessed on 08.05.2016.

Alauddin, M., Tisdell, C., 1991. The Green Revolution and Economic Development: The Process and its Impact in Bangladesh. Macmillan, London.

Antle, J.M., Pingali, P.L., 1994. Pesticides, productivity and farmer health: a Philippine case study. Am. J. Agric. Econ. 76, 418– 430.

Atreya K. (2007): Pesticide use and knowledge and practices: a gender differences in Nepal. Environmental Research, 104: 305–311.

BBS, 2010.Statistical Year Book of Bangladesh. Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

BBS. 2015. *Statistical Year Book of Bangladesh*, Bangladesh Bureau of Statistics, Statistical Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

Bentley, J.W., 2009. Impact of IPM extension for smallholder farmers in the tropics. In: Peshin, R., Dhawan, A.K. (Eds.), Integrated Pest Management: Dissemination and Impact. Springer, Berlin, Germany.

Dasgupta, S., Meisner, C., Huq, M., 2005. Health Effects and Pesticide Perception as Determinants of Pesticide Use: Evidence from Bangladesh. World Bank Policy Research Working Paper 3776. World Bank, Washington, DC.

Dasgupta, S., Meisner, C., Huq, M., 2007. A pinch or a pint? Evidence of pesticide overuse in Bangladesh. J. Agric. Econ. 58 (1), 91e114. http://dx.doi.org/10.1111/ j.1477-9552.2007.00083.x.

Ecobichon, D.J., 2001. Pesticide use in developing countries. Toxicology 160 (1-3), 27-33.

FAO (Food and Agricultural Organization) (2005). Food Safety Risk Analysis, Part II, Case Studies, Food and Agricultural Organization of the United Nations (FAO).

Ghosh, M.K. and S. S. Hasan. 2013. Farmer's Attitude towards Sustainable Agricultural Practices. Bangladesh Research Publications Journal, 8 (4): 227-234.

Hasan MR (2005). An Economic Analysis of Contract Farming for Production and Export of High Value Vegetables in Bangladesh, MS Thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

Hoi P.V., Mol A., Oosterveer P. (2013): State governance of pesticide use and trade in Vietnam. NJAS – Wageningen Journal of Life Sciences, 67: 19–26.

Hossain, M., 1989. Green Revolution in Bangladesh: Impact on Growth and Distribution of Income. University Press, Dhaka.

Hossain, M., Quasem, M.A., Akash, M.M., Jabber, M.A., 1990. Differential Impact of Modern Rice Technology: The Bangladesh Case. Bangladesh Institute of Development Studies, Dhaka.

Hossain, M.A., Islam, M.S. and Miah, M.A.M. 2002. Attitude of Island Farmers towards Adoption of Modern Agricultural Technologies. *Bangladesh Journal of Extension Education*. Vol. 14 (1&2): 47-51.

Jeyanthi H., Kombairaju S. (2005): Pesticide use in vegetable crops: frequency, intensity and determinant factors. Agricultural Economics Research Review, 18: 209–221.

Johnson G.I., Weinberger K., Wu M.H. (2008): The Vegetable Industry in Tropical Asia: An overview of production and trade, with a focus on Thailand, Indonesia, the Philippines, Vietnam, and India. Shanhua, Taiwan: AVRDC – The World Vegetable Center.

Khan, M.M.A. 2012. Farmer's Attitude towards Modern Jujube Cultivation (M.S. Thesis), Department of Agricultural Extension Education, Bangladesh agricultural University, Mymensingh.

Likert, R. 1932. A Technique for the Measurement of Attitudes. Archives of Psychology, 140. New York.

Nguyen T.X. (2003): Who will protect green vegetables? Tri Thuc Tre Magazine, 101: 14-16.

Pingali, P.L., 1995. Impact of pesticides on farmer health and the rice environment: an overview of results from a multidisciplinary study in the Philippines. In: Pingali, P.L., Roger, P. (Eds.), Impact of Pesticides on Farmer Health and the Rice Environment. Kluwer Academic Publishers, Boston.

Pingali, P.L., Rola, A.C., 1995. Public regulatory roles in developing markets: the case of Philippines. In: Pingali, P.L., Roger, P. (Eds.), Impact of Pesticides on Farmer Health and the Rice Environment. Kluwer Academic Publishers, Boston.

Pretty, J., 2005. Sustainability in agriculture: recent progress and emergence challenges. Issues Environ. Sci. Technol. 21, 1-15.

Pretty, J., Bharucha, Z.P., 2015. Integrated pest management for sustainable intensification of agriculture in Asia and Africa. Insects 6 (1), 152-182.

Rahman S. (2003): Farm-level pesticide use in Bangladesh: determinants and awareness. Agriculture, Ecosystems and Environment, 95: 241–252.

Rahman, M.H., Alam, M.J.B., 1997. Risk assessment of pesticide use in Bangladesh. J. Civ. Eng. 25, 97-102. http://jce-ieb.org.bd/pdfdown/ce250107.pdf. Accessed 05.05.2017.

Rahman, S., 1998. Socio-economic and environmental impacts of technological change in Bangladesh agriculture. Ph.D. Dissertation. Asian Institute of Technology, Bangkok, Unpublished.

Rahman, S., 1999. Impact of technological change on income distribution and poverty in Bangladesh agriculture: an empirical analysis. J. Int. Dev. 11, 935–955.

Rahman, S., 2000. Women's employment in Bangladesh agriculture: composition, determinants and scope. J. Rural Stud. 16, 497–507.

Rahman, S., Routray, J.K., 1998. Technological change and women's participation in crop production in Bangladesh. Gender Technol. Dev. 2, 243–267.

Rahman, S., Thapa, G.B., 1999. Environmental impact of technological change in Bangladesh agriculture: farmers' perception and empirical evidence. Outlook Agric. 28, 233–238.

Rahman, Z., 2016. Lack of Regulations Affect Vegetable Export. The Financial Express. Published 26 Mar 2016. http://www.thefinancialexpress-bd.com/2016/03/26/23070/asia/print. Accessed 07.08.2017.

Rashid, M.A., Alam, S.N., Rouf, F.M.A., Talekar, N.S., 2003. Socio-economic Parameters of Eggplant Protection in Jessore District of Bangladesh. World Vegetable Center, Shanhua, Taiwan.

Roger, P.A., Bhuiyan, S.I., 1995. Behavior of pesticides in rice-based agro-ecosystems: a review. In: Pingali, P.L., Roger, P. (Eds.), Impact of Pesticides on Farmer Health and the Rice Environment. Kluwer Academic Publishers, Boston.

Rola, A.C., Pingali, P.L., 1993. Pesticides, Rice Productivity and Farmers' Health: An Economic Assessment. International Rice Research Institute, Los Banos and the World Resources Institute, Washington, DC.

Schreinemachers, P., Chen, H.-p., Loc, N.T.T., Buntong, B., Bouapao, L., Guatam, S., Nhu, T.L., Pinn, T., Vilaysone, P., Srinivasan, R., 2017. Too much to handle? Pesticide dependence of smallholder vegetable farmers in Southeast Asia. Sci. Total Environ. 593-594, 470-477

Sharma, R., Peshin, R., 2016. Impact of integrated pest management of vegetables on pesticide use in subtropical Jammu, India. Crop Prot. 84, 105-112. http://dx.doi.org/10.1016/j.cropro.2016.02.014.

Siddique, A.B. (2002). Attitude of the Farmers towards Improved Winter Vegetable Production in a Selected Area of Gafargaon Upazila under Mymensingh District (M.S. Thesis). Department of Agricultural Extension Education, Bangladesh agricultural University, Mymensingh.

Srinivasan R. (2012): Integrating bio-pesticides in pest management strategies for tropical vegetable production. Journal of Bio-pesticides, 5 (Suppl.): 36–45.

Van den Berg, H., 2004. IPM Farmer Field Schools: a Synthesis of 25 Impact Evaluations. Wageningen University, Netherlands.

Weinberger K., Srinivasan R. (2009): Farmers' management of cabbage and cauliflower pests in India and their approaches to crop protection. Journal of Asia-Pacific Entomology, 12: 253–259.

Xu R., Kuang R., Pay E., Dou H., de Snoo G.R. (2008): Factors contributing to overuse of pesticides in Western China. Environmental Science, 5: 235–249.

Yudelman, M., Ratta, A., Nygaard, D., 1998. Pest management and food production: looking to the future. Food, Agriculture, and the Environment Discussion Paper 25. International Food Policy Research Institute, Washington, DC.

Zakir, A. 2010. Attitude of Farmers towards the Effect of Pond Ownership on Fish Production (unpublished master's thesis). Department of Agricultural Extension Education, Bangladesh agricultural University, Mymensingh.

Zhou J., Jin S. (2009): Safety of vegetables and the use of pesticides by farmers in China: evidence from Zhejiang province. Food Control, 20: 1043–1048.