Asian Journal of Agricultural and Horticultural Research

7(2): 35-47, 2020; Article no.AJAHR.63301
ISSN: 2581-4478

Perception Practice and Existing Knowledge Level of Farmers towards Agrochemical Use in Sitakunda Upazilla of Bangladesh

Suravi Rahman Ratna[1], Kishwar Jahan Chowdhury[2*], Sanjoy Das[3], Md. Emdadul Hoque[3] and M. M. Abdullah Al Mamun[1]

[1]Institute of Forestry and Environmental Sciences, University of Chittagong, Chittagong 4331, Bangladesh.
[2]Department of Environmental Science and Disaster Management, Noakhali Science and Technology University, Noakhali 3814, Bangladesh.
[3]Bangladesh Forest Research Institute, Chittagong-4000, Bangladesh.

Authors' contributions

This work was carried out in collaboration among all authors. Author SRR designed the study, performed the data collection, data analysis, and wrote the first draft of the manuscript. Author KJC performed data compilation, statistical analysis, edited the first draft of the manuscript to finalize it, and reviewed the manuscript. Authors SD and MEH had managed literature searches and reviewed the manuscript. Author MMAAM has done the commenting, editing, and overall supervision of the study. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAHR/2020/v7i230093
Editor(s):
(1) Dr. Paola A. Deligios, University of Sassari, Italy.
Reviewers:
(1) Ayanaba Gladstone Benibo, Federal University of Agriculture Makurdi, Nigeria.
(2) Abbas Bleady, Qassim University, Saudi Arabia.
Complete Peer review History: http://www.sdiarticle4.com/review-history/63301

Original Research Article

Received 22 September 2020
Accepted 28 November 2020
Published 28 November 2020

ABSTRACT

Aims: This study aimed to know the knowledge level and perception of the farmers regarding the use and impact of agrochemical and to find out the correlation of knowledge level and pesticide use with their age, education, farm size, number of pesticide use.
Place and Duration of Study: The study was carried out in the Chittagong District of Bangladesh in four different unions of Sitakunda Upazilla between May 2018 and June 2018.

**Corresponding author: Email: kishwar77kjc@gmail.com;*

Methodology: We surveyed 142 farmer households from nine villages of three unions, selected through multistage purposive random sampling. They were interviewed through a semi-structured questionnaire. A key informant survey was done by interviewing Upazila agriculture officers and agrochemical retailers.
Results: No overuse of fertilizer and pesticide were found. Findings showed that 66.2% of farmers were medium knowledgeable, with 14.79% low and 19.01% high knowledgeable. Applications of obsolete pesticides were found to be used. Farmers' knowledge level is significantly correlated with the education level and the number of pesticide uses.
Conclusion: There was a gap between amounts of fertilizer applied than the recommended level except for gypsum. Most of them did not know the standard application rate of fertilizer and pesticide. Farmers' knowledge level should be improved and the adoption of rational use of agrochemicals is needed through extension activity to get proper yield and to inform them of precautionary measures.

Keywords: Agrochemical; perception; knowledge level; environmental impact; organic fertilizer; crop production; awareness program; soil test.

ABBREVIATIONS

DAE = Department of Agricultural Extension
HYV= Highly Yielding Variety

1. INTRODUCTION

Pesticides and fertilizers are used to increase productivity and to protect yield from pests and diseases [1]. Agrochemicals increase crop yield, protect plants from pests, diseases, and different harmful micro-organisms [2]. In the case of farming staple crops, farmers are dependent on more weedicide due to the increased opportunity cost of labor [3]. Another reason for using more insecticides and fungicides is the increased market value of fruits and vegetables [4].

Bangladesh is an agrarian country with a dense population where agriculture governs the livelihood of more than 80% of people [5]. Around 25.7 million people are engaged in agriculture, forestry, and fisheries [6]. Among 28,695,763 families of Bangladesh, 15,183,183 are farmer families [7]. Agriculture contributes 16.33% of the Gross Domestic Product (including fisheries). The total cultivatable land area is 8,505,278.14 ha whereas 204,366.24% remains as fallow land [8].

Agriculture is aimed at providing food security [9]. Fertilizers and pesticides are a crucial input to provide food production and farm profit [1]. Farmers use more agrochemicals to augment the product without considering the environmental and health bearing of it [10]. A present-day industrialized agricultural system encourages more use of synthetic agrochemicals [11]. Most of the developing countries show an exponential increment in agrochemicals use [11,10,12,2]. Government focuses on using agrochemicals to get augmented crop production and to prevent pest infestation from planting to preserving stage of crop cultivation [13].

In Bangladesh, fertilizer, and pesticide use rates were found beyond the limit from a half-century ago [14]. It was found that with the increase of population in every year amount of cultivated area and also the amount of fertilizer and pesticide consumption is increasing [15]. It was revealed that [16], along with the cropping intensity, HYV (Highly Yielding Varieties) rice and vegetable cultivation was also increasing for the last few years (2001 – 2011) which are more fertilizer responsive.

Increased pesticide use contributes to the rapid growth of some weed, virus, and pests and also make them resistant to pesticides Environmental and ecological adverse impact of agrochemicals is proved from far decades [17,18,19]. Deterioration of environment, damage to flora, and fauna including fishery are drawbacks of using pesticides [20]. An investigation about sustainability analysis of conventional cultivation in Bangladesh shows that in the conventional method of farming farmers use fertilizers more than the recommended dose [21]. A major externality incurred by pesticide use which makes agriculture unsustainable is the growing resistance of pests to pesticides [22]. By 2030, agricultural nitrogen dioxide emission will increase 35-60% [23]. The economic costs that arrived from unsustainable agriculture, health hazard, agrochemical price, damage to the ecosystem are immense [20].

Agrochemicals have many toxic effects on human health, food quality, soil, air, water, and non-target plants and organisms [1]. Environmental pollution from agrochemical use is a matter of concern especially for overpopulated countries such as Bangladesh, India, China, etc. [24,2]. Morbidity from pesticide poisoning from consuming fruits and vegetables is detected [2]. Farmers, as well as other local peoples, suffered various health implications such as allergy, eye irritation, respiratory problem, abdominal pain, dizziness, fever, headache, senselessness, etc. from exposure to fertilizer and pesticide due to lack of adopting health precaution [25,26,17]. Reported cases of pesticide poisoning and resulted in death in different countries such as Thailand, Sri Lanka were found high in number [25]. Surface and groundwater pollution from agrochemical use is widespread now [11,27,11]. Eutrophication, algal bloom, reduced oxygen level, fish kill, etc. in rivers and streams from fertilizer residue and pesticide poisoning is occurring in many parts of the world [11,27,28]. Bangladesh needs to import a huge amount of TSP(Triple Super Phosphate) every year [27]. From 2000 to 2006, an average of 371 thousand tons of TSP was imported which is more than five times of TSP production [7]. In Bangladesh, farmers' perception regarding pesticide issues was found blurred [29,30] which is vital in deciding pesticide management. Farmers who suffered health problems from pesticide use don't change the pest management process [26]. Research on farmers' perceptions of pesticide management is scarce [31]. Present practices of agrochemical application and management need to assess hereby [16]. It was concluded that [4],research work on agrochemical use pattern,knowledge level, and perception can be a way of documentation of such information. As such, this study was conducted to know the overall farming process and pesticide management practices of Sitakunda Upazila along with documentation of their knowledge level.

The overall objective of this study was to know the agricultural practices and knowledge level of farmers on fertilizer and pesticide management systems. We have also tried to determine the perception of farmers regarding the use and impacts of agrochemicals on the crop, human health, and environment. Furthermore, the determination of the relationship of farmers' knowledge level and pesticide use with socio-economic characteristics was also an objective of the study.

2. EXPERIMENTAL DETAILS

2.1 Description of the Study Area

Sitakunda is an Upazila of Chittagong covering an area of 483.97 sq. km situated on the North West side of the Chittagong division. It is located between 22°22′ and 22°42′ north latitudes and in between 91°34′ and 91°88′ east longitudes. Bounded by the Bay of Bengal in west and south-west and hills on the other side. The total population of Sitakunda Upazila is 335,178 among which 182,223 are male and 152,955 are female. 36,650 peoples are rural among the total population. This municipality is comprised of nine unions and 59 villages. Population density is 693 per sq. kilometer. Average literacy rate is 54.6%, (59.4%). Main source of income are agriculture (24.12%), non-agricultural laborer (4.27%), industry (2.82%), commerce (15.43%) etc. [8]. In terms of the agro-ecological zone of Bangladesh, Sitakunda Upazila is situated in Chittagong Coastal Plain [32]. This zone is characterized by non-calcareous gray floodplain soils, non-calcareous alluvium, and acid sulfate soils. The soil of this zone is generally medium in terms of fertility with moderate organic content [6].

2.2 Methods of Data Collection and Sampling

A socio-environmental survey was conducted to collect information from farmers about their agricultural practices, agrochemical management process, and knowledge level. A semi-structured questionnaire was used to interview them. Data were collected from May to June of 2018. Three Unions of Sitakuda Upazila named Sayedpur, Muradpur, and Bashbaria with sample sizes 75, 41, and 26 respectively were selected so that these represent the whole Upazila. Then three villages from each Union were selected to get farmers as these villages have more farmer families. Finally, a total of 142 farmers were selected randomly from these nine villages. Sample distribution and name of villages were as follows: Study area is shown below (Fig. 1).

Primary data were collected through face-to-face interviews of farmers through a semi-structured questionnaire. Before finalizing the questionnaire a field test was executed to make it consistent and comprehensive. They were asked about age, income, land size, crops they cultivate, production, fertilizer, and pesticide they are using, amount of fertilizer and pesticide

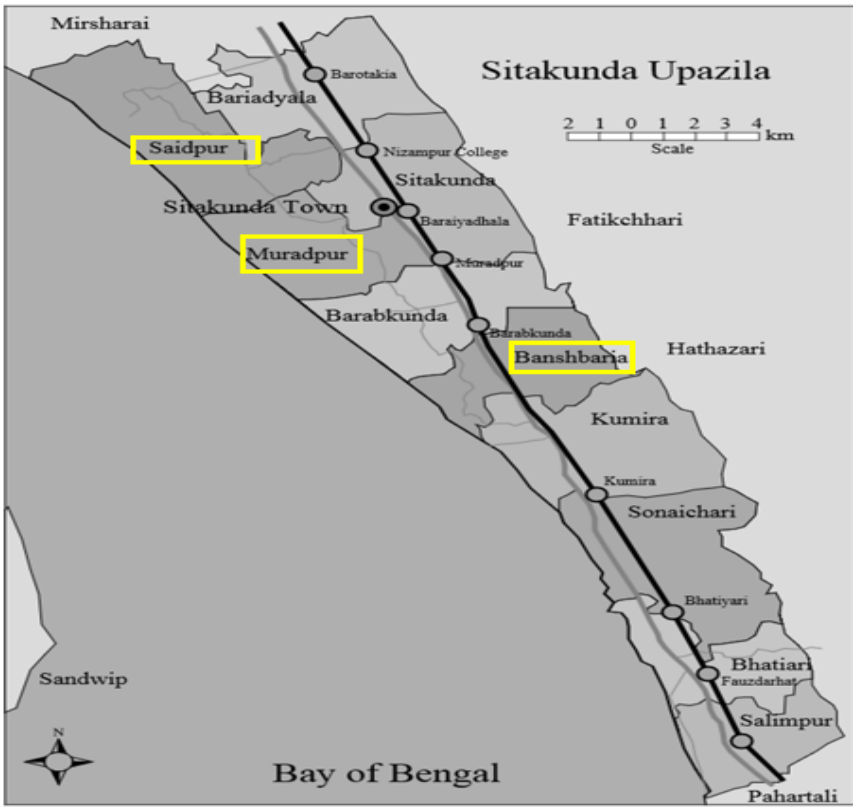

Fig. 1. Sample areas of Sitakunda Upazilla (marked through the yellow box)

application, impacts of agrochemicals on health; environment and crops, etc. included in the questionnaire. A set of yes/no question was asked to identify their perception and knowledge. A key informant survey was done by interviewing Upazila agriculture officers and agrochemical retailers. Secondary data were collected from published journals, books, different census reports, webpages, and websites. Relevant data were collected from the DAE (Department of Agricultural Extension) office of Sitakunda Upazila. The average knowledge level of farmers was determined from their responses to 15 questions regarding agrochemical management, taking the right answer as scored one. Thus the knowledge level is categorized as a low, medium, and high level having a score of 1 – 5, 6 – 10, and 11 – 15 respectively. Different socio-economic characteristics of farmers such as age, schooling year, income, family size, land size were the independent variables of this study. All of these were continuous variables. The relationship of the knowledge level of farmers and the number of fertilizer use with the socio-economic variables were determined from Pearson's correlation analysis.

3. RESULTS AND DISCUSSION

3.1 Demography and Socio-economic Status

Table 1 shows that half of the farmers are middle-aged and the engagement of young people of 20 to 40 years is 27%. 21% of the farmer were of 61 to 80 years. Male-female ratio analysis reveals that most of the families (48%) had more female members. More than half (53%) households were comprised of 6 – 10 members i. e. they are the medium size family. 39% of households have 3 – 5 family members and a very small number (8%) of households have 11 – 15 members. The average family size was found as 6.56. In 2013, the average size of the household of Bangladesh was 3.13, in Chittagong district, it was 3.49 and 2.68 in the rural area of Bangladesh which was found to be increased in both 2003 and 2001 [6]. 77% of the farmers were literate. Among literate farmers 42% are educated up to primary level, 28% up to secondary level and 8% were at the college level and above. All respondents were found to be within the small group (0.04 ha to 1.96 ha farm holding) of farmers

among three groups of farmers based on farm holding [6]. From the table, it can be demonstrated that 40% of farmers had 0.173 ha to 0.315 ha land and around 27% have up to 0.157 ha. In Bangladesh, 84.27% are small farmers in terms of farm holding [6]. A wide range of income was found starting from 5,000 takas to the highest 3, 00,000 takas per month. Most (76) of the household earns 3,000 to 18,000 taka monthly. 57 households earn 19,000 to 3,400 taka per month. 69% of farmers cultivated on their land. 20% of people have no land and hence, did farming on leased land. 11% of farmers provided leases to others as they had some land spare after cultivation. Again, profession shifting from farming to other professions was found due to the low price of rice in the market and higher labor costs in recent years. Besides farming 62% of people engaged in other types of income-generating activities among which day laborer and business were the most frequent (both are 28%). As farming needs enough labor and time farmers can not engage in other works rather part-time laborers and business.

Table 1. Distribution of respondents by socio-economic characteristics (n=142)

Variables	Frequency	Percentage
Age(Years)		
20 - 40	39	27.46
41 - 60	72	50.70
61 - 80	30	21.13
81 - 100	1	0.70
Male Female ratio		
Equal	38	26.76
More than one	36	25.35
Less than one	68	47.89
Family Size		
3-5	56	39.44
6-10	11	7.75
11-14	75	52.82
Education		
Illiterate	31	21.83
Primary	60	42.25
Secondary	40	28.17
College and above	11	7.75
Farm size (Hectare)		
0.016 - 0.157	39	27.47
0.173 - 0.315	60	42.25
0.331 - 0.472	24	16.9
0.488 - 0.630	11	7.75
>0.630	8	5.63
Income Level (Thousand/month)		
Less than 7	1	0.70
7 - 10	50	35.21
14- 20	46	32.39
21- 27	21	14.79
28- 34	14	9.86
35 - 41	5	3.52
above 41	5	3.52
Land Ownership		
Cultivating own land	98	69
Lease has taken	28	20
Lease has given	16	11
Associated profession besides farming		
Day laborer	40	28.17
Business	9	6.34
Job	39	27.46
None	54	38.03

3.2 Amount of Fertilizer Used

All of the commonly used fertilizers in the study area were found less than the standard amount given by the DAE except for gypsum (Fig. 2), which is similar to the findings of [14]- shows the percentage gap of major fertilizer from the recommended amount. This is due to the lack of proper knowledge about fertilizer and nutrients requirements. Many of them opined that their area was fertile and needed no more fertilizer. No unique recommended level of application for mixed fertilizers and organic compost was found.

3.3 Amount of Pesticide Used

Endrin (insecticide 1) and Bashudin (insecticide 2) are two widely used pesticides and the most primitive (Fig. 3). Among fungicides Amcogim 50 WP, Noin 50 WP, Captan 50 WP were found to use. But no excess application was found. Both of these are obsolete pesticides in Bangladesh according to the list of DAE. The application dose of Bashudin 25 EC, Diazinon 10 G, Diazinon 60 EC and Amcozinon 10G for rice is 16.80 kg/ha [32].

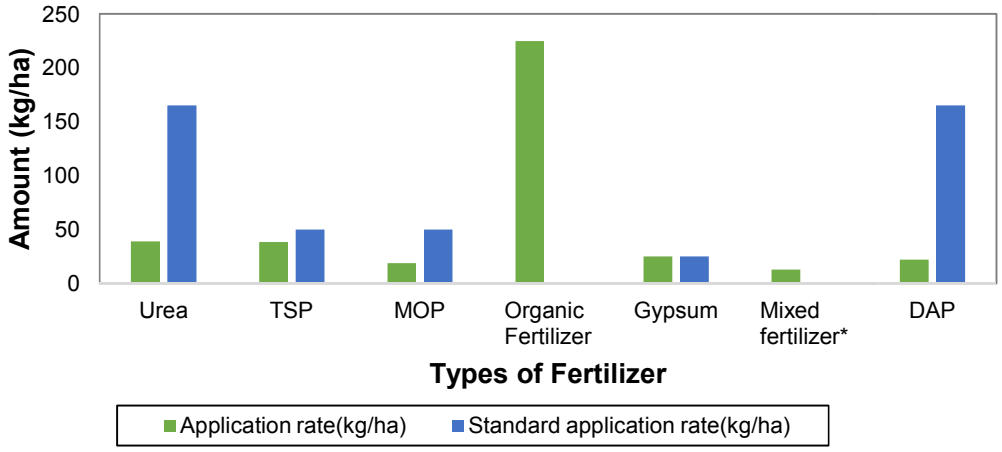

Fig. 2. Application Rate of different fertilizers compared to the respective standard rate of application

*(*Mixed fertilizer is a composition of Calcium, Magnesium, Boron, and Zinc sold as powder or liquid. No Standard Limit of Organic fertilizer was found.)*

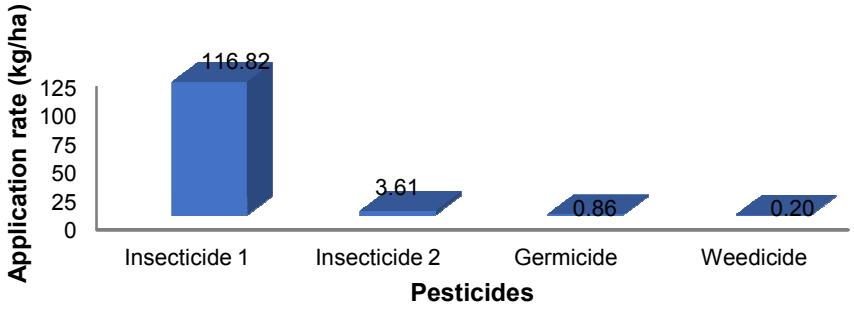

Fig. 3. Pesticide application amount of Sitakunda Upazila

The application of insecticide at a rate of 1 to 10 kg of active ingredients per hectare in Bangladesh has also been shown [29]. None of them was found to able to identify the chemical group of pesticides.

3.4 Perception about Impacts of Agrochemicals

Fig. 4 depicts that most of the respondents know about the environmental impacts of fertilizer and pesticides more than the impact on their health and crop. This is because impacts on the environment are more visible and quick-acting rather than impacts on health and crop. They perceive the least impact regarding health as they don't care so much about it and concentrate on manifold production.

3.5 Perception of Environmental Impacts

More than 80% of farmers stated about water pollution as an environmental impact (Fig. 5). Farmers can easily understand this from changing water color, algal bloom, water hyacinth, etc. Research [28] found residue of pesticide in pond water of Bangladesh. After water pollution, fish-killing in the adjacent areas is frequent (60%) which can be traced easily. Soil fertility, an important prerequisite of better yield, which is also an important component of the environment, was opined by more than half of respondents.

The killing of non-target weeds and pests, which is preached by around 55% of farmers - is a great threat to biodiversity. They said about the killing of different types of pests for which they don't apply pesticides. The development of resistance to different pests and weeds was also opined by some farmers.

3.6 Perception Regarding Pesticides' Impact on Crop

Farmers were found to be known about pesticides' adverse impact on crops and vegetables. The most frequently accounted impacts were about health implications and reduction of production (Fig. 6). The health impacts of pesticide use from residue in crops and vegetables are supported by different studies [33,26,17]. Probably they got informed about these from mass media as these can't be understood in a short period. Many of them identified the taste of vegetables as decreasing. This was assumed to be due to the wide cultivation of HYV vegetables.

More than 15% of respondents stated that the application of pesticides and fertilizer sometimes makes the plant scanty or light. Some of the respondents (10%) said that pesticide residue could remain in crops and vegetables. It was shown that [17] different diseases of human beings caused by pesticide residue.

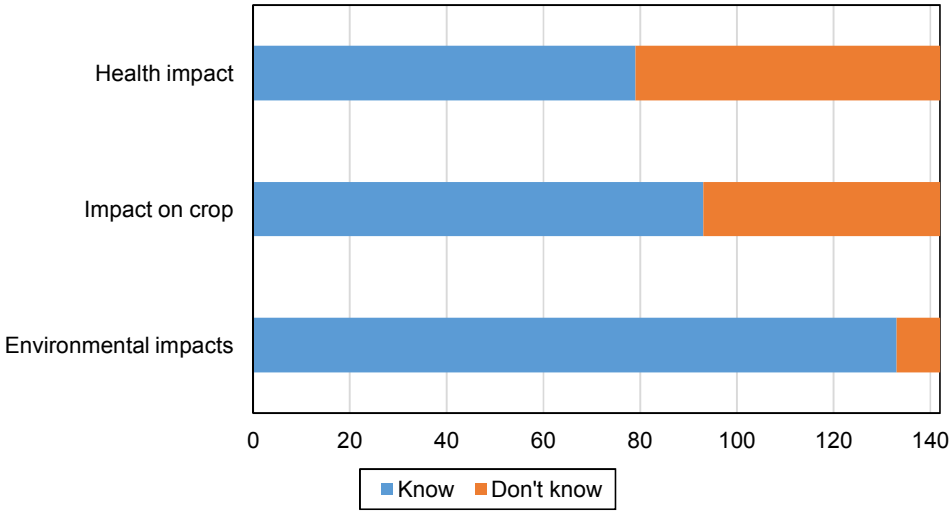

Fig. 4. Perception of farmers' about impacts of agrochemical on health, crop and environment (N=142)

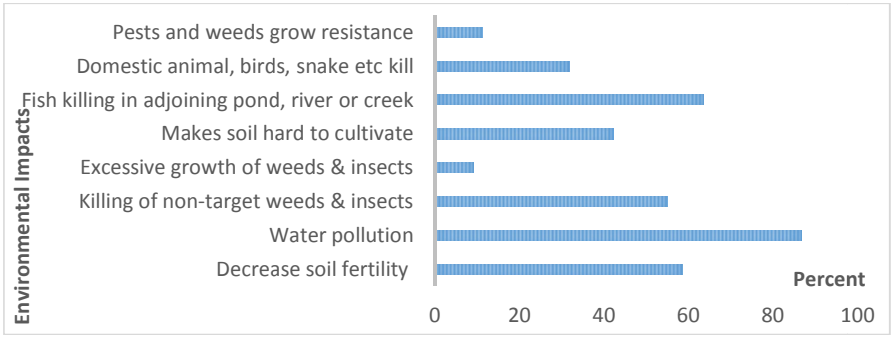

Fig. 5. Perception of respondents regarding the Environmental Impacts of Pesticides (%)
**Some respondents identified more than one impact, the percentage is calculated against each impact*

3.7 Adoption of Precaution

Fig. 7 shows most of the farmers (more than 70%) responded positively about the adoption of health and field precautions. A study [16] found the same findings.

3.8 Precautions Taken by Farmers

Though most of the farmers were found to adopt personal health precautions (Fig. 8) such as using face cover (40%) and wearing cloth (45%) at the time of applying agrochemicals, these precautions are not sufficient. This is because a small portion of them use hand covering cloth (2.82%) and consider wind direction (5.63%). Fertilizers contain active ingredients. None of them considered the timing of the application that is very important. A related study [29] found that precaution taken by the majority of farmers is not enough to protect them.

3.9 Perception Regarding Use of Organic Fertilizer

On the question of whether organic compost was better or not, more than 85% of answers were found as positive (Fig. 9). From Fig. 10, it can be understood that around 50% of the farmer perceive that organic fertilizer increases the fertility of the land.

They also perceive it was natural, provided more production, had no harmful impact, and offered a higher quality yield. 12.68% of respondents agreed that organic fertilizer was better but could not identify the reason (Fig. 10). Respondents who perceived that organic fertilizer was not better, assigned increasing soil acidity as the reason behind it. It could be the effect of applying overdose.

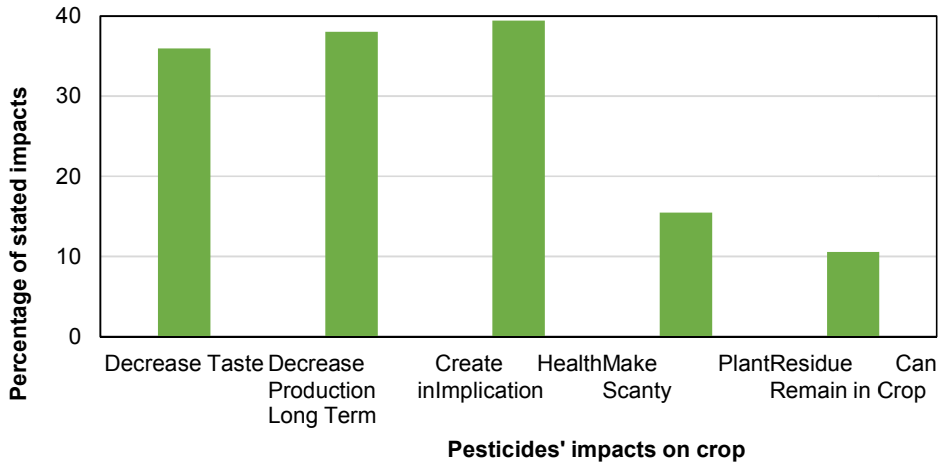

Fig. 6. Farmers' perception regarding the impacts of pesticides on crop

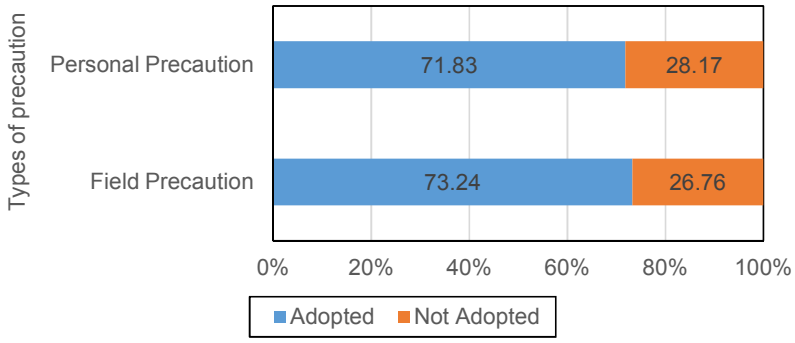

Fig. 7. Status of farmers in adopting personal precaution and field precaution at the time of agrochemical application

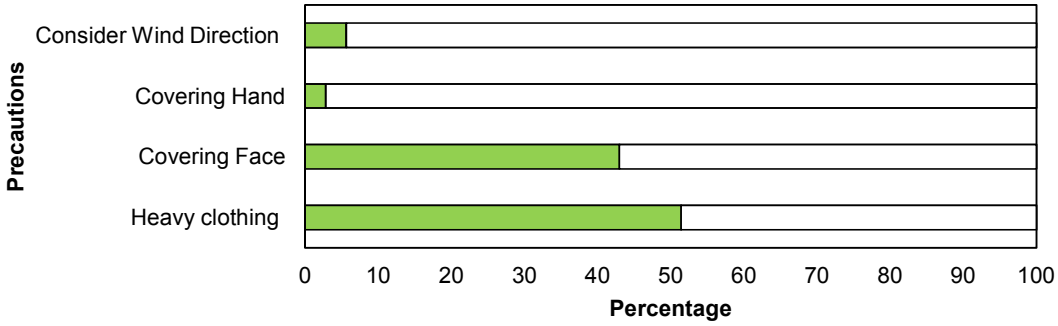

Fig. 8. Personal Precautions Taken by Farmer at the time of applying agrochemical

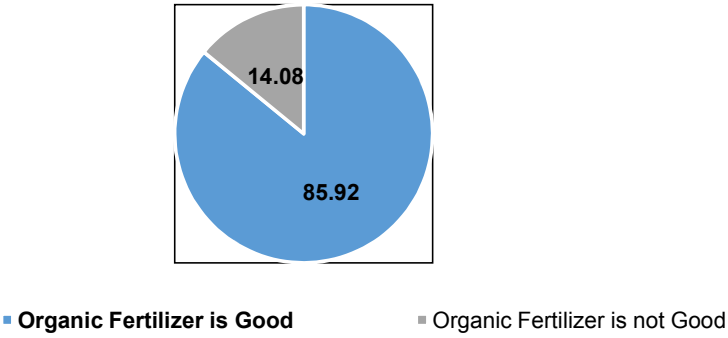

Fig. 9. Perception of organic fertilizer

3.10 Cleaning Method of Agrochemicals' Container

In the case of pesticide management cleaning of the container is an important parameter that also reflects farmers' perception and knowledge level regarding pesticide use [34]. More than 80% of farmers clean the packets and containers used for carrying them in the field (Fig. 11). But inadequate cleaning creates health risks to them as they reuse packets [16].

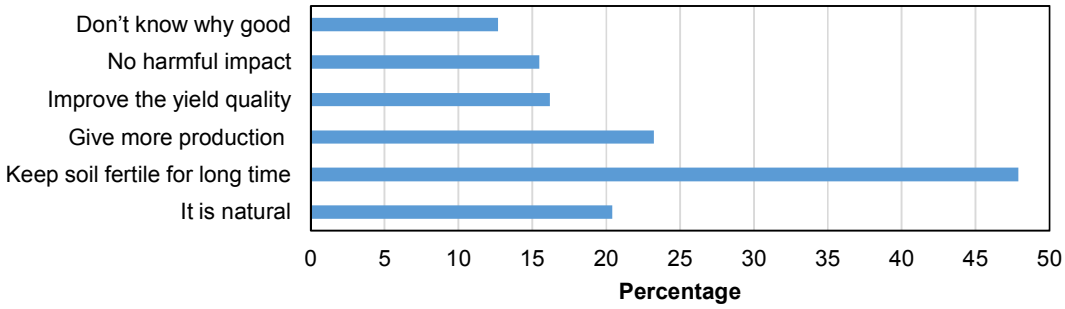

Fig. 10. Reasons for perceiving organic fertilizer is good

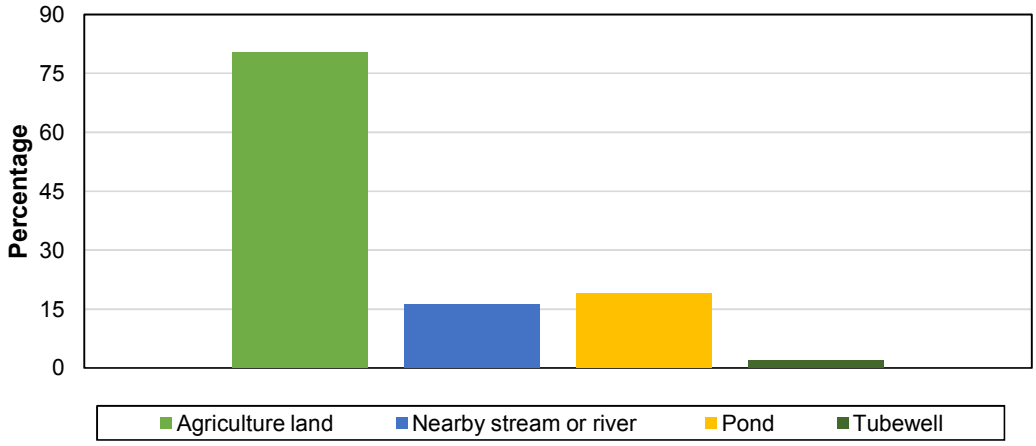

Fig. 11. Cleaning method of agrochemicals' container

And then, washing in a nearby flowing river or stream is frequent. Another risky practice is washing in the ponds as they use the water for cooking. Pond water is used for drinking purposes by 2.23% of people of this Upazila [8].

3.11 Response about the Occurrence of the Awareness Program in the Study Area

In their responses about awareness of the program, farmers were found indifferent and 17% of respondents didn't know if such a program was available (Fig.12). More than half of them reported the occurrence of such a program.

3.12 Average Knowledge Level of Farmers

Most of the farmers (around 60%) had a medium level of knowledge regarding agrochemical management. Many of them were found to have a high level of knowledge and around 15% are low knowledgeable (Fig. 13).

3.13 Relationship of Knowledge Level and Pesticide use with Socio-economic Characteristics

For calculating the appropriate relationship of knowledge level and pesticide use with socio-economic characteristics, descriptive analyses such as curvilinearity, skewness, and normal distribution were checked first. Pearson's correlation analysis revealed that there is a low negative relationship ($r = -0.184$) between knowledge level ($M= 8.23$, $SD=2.32$) and the number of pesticide use ($M=4$, $SD=3.12$) at 99% confidence level i. e. more knowledgeable farmers apply less number of pesticides. A low positive relationship ($r=0.269$) was found between knowledge level and farmers schooling year ($M=5.68$, $SD=5.28$) at 95% confidence level, which means that farmers having more education are more knowledgeable.

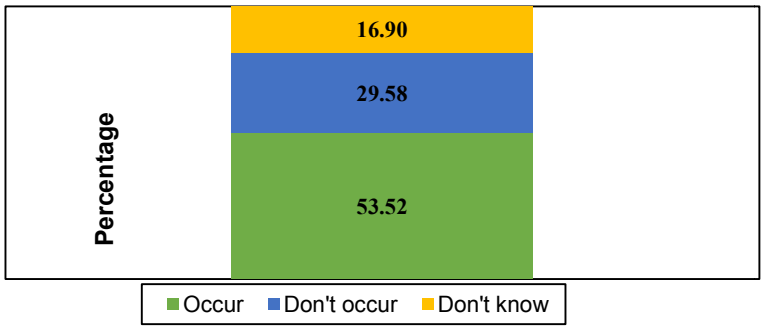

Fig. 12. The occurrence of an awareness program in respondents' locality

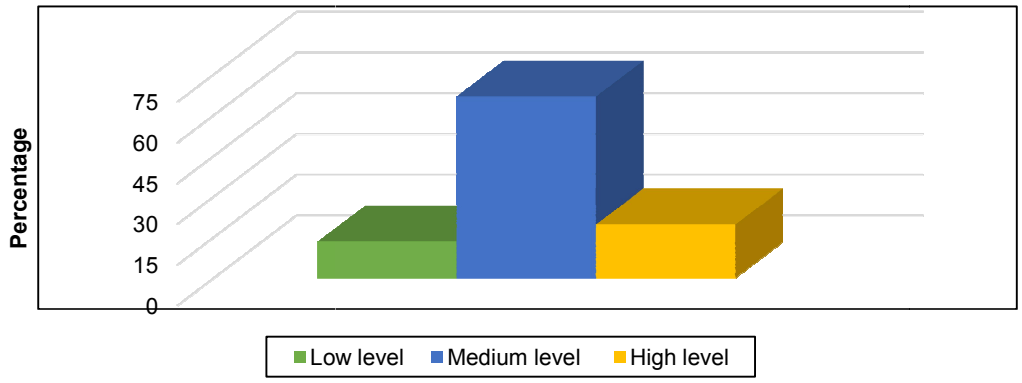

Fig. 13. Average knowledge level of farmers expressed in percentage

Table 2. Correlations of Knowledge level, NO. of pesticide use, schooling year, age, monthly income, farm size, and family member

		Knowledge level	NO. of pesticide use	Schooling year	Age	Monthly income	Farm size	Family member
Knowledge level	Correlation	1	-.184*	.269**	-.157	.069	-.125	-.064
	Significance		.029	.001	.061	.417	.137	.452
NO. of pesticide use	Correlation	-.184*	1	-.128	.058	.064	.240**	.097
	Significance	.029		.128	.495	.449	.004	.249
Schooling year	Correlation	.269**	-.128	1	.030	.135	-.089	.021
	Significance	.001	.128		.727	.110	.292	.806
Age	Correlation	-.157	.058	.030	1	-.011	-.112	-.136
	Significance	.061	.495	.727		.899	.183	.108
Monthly income	Correlation	.069	.064	.135	-.011	1	.232**	.379**
	Significance	.417	.449	.110	.899		.005	.000
Farm size	Correlation	-.125	.240**	-.089	-.112	.232**	1	.187*
	Significance	.137	.004	.292	.183	.005		.026
Family member	Correlation	-.064	.097	.021	-.136	.379**	.187*	1
	Significance	.452	.249	.806	.108	.000	.026	

**. Correlation is significant at the 0.05 level.*
***. Correlation Is Significant At The 0.01 Level*

A positive low relationship (r=0.24) was found with the number of pesticide use and farm size (M=0.32, SD=0.2) at a 95% confidence level meaning farmers who cultivate more farmland, use more number of pesticides. No significant relationship of age, income, and the family member was found with knowledge level which is similar to the result of [15]. Also, no significant relationship of age, income, schooling year and family member with the number of pesticides used was found.

4. CONCLUSION

Farmers of Sitakunda Upazilla used a lower amount of both fertilizer and pesticide than the recommended level. The use of obsolete pesticides was found in use. Most of the farmers did not know the standard level of agrochemical use. However, many of them know about the environmental and health impacts of agrochemical use and took precautionary measures. Most of them cleaned the packet of agrochemicals on the water of cultivated land. Most perceived that organic fertilizer is good. Most of the farmers of Sitakunda Upazila had a medium level of knowledge. More than half of them said about the occurrence of the DAE awareness program. This study suggests that farmers' knowledge level should be increased to ensure proper use of agrochemicals and to secure them from the impacts of agrochemicals.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Aktar W, Sengupta D, Chowdhury A. Impact of pesticides use in agriculture: their benefits and hazards. Interdiscip Toxicol. 2009;2(1):1–12.
2. Rajendran DS. Environment and health aspects of pesticides use in Indian agriculture. In: Bunch MJ, Suresh VM, Kumaran TV, editors. Chennai, India: Department of Geography, University of Madras and Faculty of Environmental Studies, York University. 2003;353–373. Available:http://eprints.unimysore.ac.in/15940/
3. Okoedo-Okojie DU, Aphunu A. Assessment of farmers' attitude towards the use of chemical fertilizers in Northern agricultural Zone of Delta state, Nigeria. Arch Appl Sci Res. 2011;3(1):363–369.
4. Pingali PL. Environmental consequences of agricultural commercialization in Asia. Environ Dev Econ. 2001;6(04):483–502.
5. Rahman S. Farm-level pesticide use in Bangladesh: Determinants and awareness. Agric Ecosyst Environ. 2003;95:241–52.
6. BBS, BB of statistics. Statistical Yearbook of Bangladesh 2011. 31st edition. Bangladesh Bureau of Statistics. 2012; 558.
7. MOA. Ministry of Agriculture; 2016.
8. Bageheri A, Fami HS, Rezvanfar A, Asadi A, Yazdani S. Perceptions of paddy farmers towards sustainable agricultural technologies: Case of Haraz catchments area in Mazandaran province of Iran. Am J Appl Sci. 2008;5(10):1384–91.
9. McLay CDA, Dragten R, Sparling G, Selvarajah N. Predicting groundwater nitrate concentrations in a region of mixed agricultural land use: A comparison of three approaches. Environ Pollut. 2001; 115(2):191–204.
10. Bashour I, Tolba M, Saab N. Pesticides, fertilizers and food safety. In: Arab Environment: Future Challenges Tolba, M, and Saab, N(Ed), Report of the Arab Forum for Environment and Development (AFED) and Technical Publications, Beirut, Lebanon [Internet]. 2008;137–145. Available:http://www.academia.edu/download/30719704/arab_environment_AFED2008.pdf#page=158
11. Greenpeace. Agrochemicals unmasked: fertilizer and pesticide use in Thailand and its consequences to the environment [Internet]. Greenpeace Thailand. 2016. Available:http://www.greenpeace.org/seasia/th/press/reports/agrochemicals-in-thailand-eng/
12. Tirado R, Bedoya D, Novotny V. Agrochemical use in the Philippines and its consequences to the environment. Greenpeace Southeast Asia. 2007;9.
13. Rahman S. Pesticide consumption and productivity and the potential of IPM in Bangladesh. Sci Total Environ. 2013;445: 48–56.
14. Shah AL, Rahman MS, Aziz MA. Outlook for fertilizer consumption and food production in Bangladesh. Bangladesh J Agric Env Spec. 2008;4:9–26.

15. Zhou Y, Yang H, Mosler HJ, Abbaspour KC. Factors affecting farmers' decisions on fertilizer use: A case study for the Chaobai watershed in Northern China. Consilience. 2010;4:80–102.
16. Khai HV. Farmer Perceptions and demand for pesticide use: A Case study of rice production in the Mekong Delta, Vietnam. J Econ Behav Stud. 2014;6(11): 868–873.
17. Kumari KA, Kumar KNR, Rao CN. Adverse effects of chemical fertilizers and pesticides on human health and environment. In Journal of Chemical and Pharmaceutical Sciences. 2014;150–1. Available:http://www.jchps.com/
18. Rohr JR, Schotthoefer AM, Raffel TR, Carrick HJ, Halstead N, Hoverman JT, et al. Agrochemicals increase trematode infections in a declining amphibian species. Nature. 2008;455(7217):1235–1239.
19. Zacharia JT. Ecological effects of pesticides [Internet]. INTECH Open Access Publisher; 2011. Available:http://www.intechopen.com/source/pdfs/21176/InTechEcological_effects_of_pesticides.pdf
20. Wilson C, Tisdell C. Why farmers continue to use pesticides despite environmental, health and sustainability costs. Australia: School of Economics, University of Queensland. (Economics, geology and the environment). 2000;53.
21. Rasul G, Thapa GB. Sustainability of ecological and conventional agricultural systems in Bangladesh: An assessment based on environmental, economic and social perspectives. Agric Syst. 2004; 79(3):327–351.
22. Cavane E. Farmers' attitude and adoption of improved maize varieties and chemical fertilizers in Mozambique. Indian Res J Ext Educ. 2016;11(21):1–6.
23. Bruinsma J, editor. World agriculture: towards 2015/2030 : An FAO perspective. Earthscan Publishers Limited, 120, Pontonville Road, London, UK; 2003.
24. Eddleston M, Karalliedde L, Buckley N, Fernando R, Hutchinson G, Isbister G, et al. Pesticide poisoning in the developing world—a minimum pesticides list. The Lancet. 2002;360(9340):1163–1167.
25. Tirado R, Englande AJ, Promakasikorn L, Novotny V. Use of agrochemicals in Thailand and its consequences for the environment. Corn Green Res Lab [Internet]; 2008 Available:http://greenpeace.to/publications/GPSEA_agrochemical-use-in-thailand.pdf
26. Khan M. Using the health belief model to understand pesticide use decisions. Pak Dev Rev. 2010;941–956.
27. Killebrew K, Wolff H. Environmental impacts of agricultural technologies [Internet]; 2010. Available:https://ideas.repec.org/p/udb/wpaper/uwec-2011-01.html
28. Uddin MA, Saha M, Chowdhury MAZ, Rahman MA. Pesticide residues in some selected pond water samples of Meherpur region of Bangladesh. J Asiat Soc Bangladesh Sci. 2013;39(1):77–82.
29. Parveen S, Nakagoshi N. An analysis of pesticide use for rice pest management in Bangladesh. J Int Dev Coop. 2001;8(1): 107–126.
30. Kabir MH, Rainis R. Farmers' perception on the adverse effects of pesticides on environment: The case of Bangladesh. Int J Sustain Agric. 2012;4(2):25–32.
31. Banglapedia. Banglapedia : National Encyclopedia of Bangladesh [Internet]. Banglapedia : National Encyclopedia of Bangladesh; 2016 Available:http://en.banglapedia.org/index.php?title=Sitakunda_Upazila
32. BCPA. Bangladesh Corp Protection Association [Internet]; 2016. Available from: http://www.bcpabd.com/list-of-pesticide.php
33. Lutap L, Atis M. Pest management in vegetable production: The case of the rainfed lowlands in Ilocos Norte. Reg Res Dev Pap Ilocos Norte. 2002;3:87–107.
34. Bhandari G. An overview of agrochemicals and their effects on environment in Nepal. Appl Ecol Environ Sci. 2014;2(2):66–73.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/63301