

Impact of Pesticides Use on Farmers' Health: Evidence from Bangladesh

M. Alam¹, S. Kleisinger², E. Sehsah³

Abstract

A research was undertaken to find the impact of pesticides use on farmers' health. A survey was conducted with structural questionnaires to collect information on pesticides use, practices, risk perceptions, precaution and health effect from 165 farmers of five districts in Bangladesh. The data were analysed using different software in the University of Hohenheim. It was found that a number of villagers poisoned by pesticides and the mortality rate were 10%. The main causes of poisoning were accidental ingestion. The poisoning in children are also remarkable with 24% of total reported cases. The poisoning occurred from different pesticides but the villagers could not remember the name of brand. There was no record available in hospital or health centre on poisoning from pesticides. The general linear model produced in SAS software was made for analysing the variance and finding the effect of pesticides on operators' health. The analysis indicated that the amount of pesticides applied, training, using protection measures and number of exposures were significantly associated with the probability of farmers' health impairment from pesticides use. However, the other variables such as active ingredient, categories of hazards, education, training on IPM, body index, age and income had no statistically significance on the mutilation on farmers' health. The research concluded that poisoning from pesticides could be reduced significantly by trained the farmers/operators for using correct dose, taking proper protective measures and averting behaviour in handling pesticides.

Keywords: Pesticides, Health

1. Introduction

Pesticides are a significant and growing component of the modern rice technology that has been widely adopted across in the Asia including Bangladesh since 1960. However, this is a hazardous technology and cannot guarantee of safety in any condition. Therefore, it effect on the quality of human health, damage the environment, and destruction of ecosystems. In developing countries, these problems are compounded by rural poverty and inequalities in distribution of land ownership. WHO (1990), Kishi et al. (1995), Pimental et al. (1992), and Rosenstock et al. (1991) reported that workers dying from pesticides poisoning and the majority in developing countries. Therefore, a number of pesticides have been banned and restricted to use. However, some of those are still using in the developing countries (Poapongsakorn et al., 1999). The effect of pesticides on human health could be i) moderate, ii) sever and iii) long run. Table 1 shows the effect of pesticides on human health and Table 2 shows the selected pesticides of special toxicological concern.

Farm workers are at much greater risk of toxicity due to exposure to pesticides. According to the United States Environmental Protection Agency (EPA) approximately 4 million U.S. farm workers

are at high risk of pesticide exposure and about 10,000 to 20,000 pesticide-poisoned farm workers are treated every year. Risk of birth defects is reported with certain pesticides, particularly, the herbicide 2,4-D used in farmland (Garry et al., 1996). Pingali et al. (1994) found a greater probability of eye and skin problems associated with on-site use of pesticides among rice producers in the Philippines. Crissman et al. (1994) found a link between pesticide use and incidence of chronic dermatitis among Ecuadorian potato producers.

It is difficult for the governments of developing countries to regulate food safety and environmental protection, including pesticide residue levels, because pesticides clearly have assisted in controlling pests and maintaining the availability of low cost and high quality food. This is also incompatible with principles of sustainable development of agricultural based developing countries.

Therefore, 'safe pesticide management' program in the developing countries for a decade have not great success to bring the improvements and reduce risks. Oudejans (1999) reported that the overall pesticide market in Indonesia, Malaysia and Thailand still remain largely unaffected by national and international IPM efforts. However, around

¹Professor, Dept. of Farm Power and Machinery, Bangladesh Agricultural University, Mymensingh-2202,

²Professor, University of Hohenheim, Stuttgart, Federal Republic of Germany

³Researcher, University of Hohenheim, Stuttgart, Federal Republic of Germany

Table 1. Effect of pesticides on human health

Moderate human health hazards	Severe human health hazards	Long run effect
<ul style="list-style-type: none"> • Mild headaches • Flu • Skin rashes • Blurred vision 	<ul style="list-style-type: none"> • Paralysis • Blindness • Death • Reducing the number of white blood cells and disease fighting lymphocytes. 	<ul style="list-style-type: none"> • Cancer • Infertility • Miscarriage • Male sterility • Birth defects • Nervous system

Table 2. Selected pesticides of special toxicological concern

Pesticide	Toxicological concerns
Paraquat herbicides	<ul style="list-style-type: none"> • Skin problems ranging from mild irritation, burns, ulceration, peeling, necrosis (cell death in skin tissue), dermatitis of the hand and blistering on hands, thighs, legs, back and scrotum • Eye injuries including blepharitis (eyelid inflammation), conjunctivitis, ulceration or keratosis (growth like a wart) of the cornea • Severe exposure on hands can lead to nail damage, ranging from localised discoloration to temporary nail loss • Nosebleeds resulting from local irritation of the upper respiratory tract, burning sensation in the nose . • Burns upper digestive tract • Multi-organ failure, including the lungs, liver, and kidneys • Less frequently failure of the central nervous system, heart, suprarenal glands and muscles. • In fatal cases death is due to respiratory failure from pulmonary oedema or pulmonary fibrosis up to over a month after the event.
Systematic paraquat herbicides	<p>Cancer, toxicity for the thyroid gland, dermatitis, neurotoxicity</p> <p>Fatal occupational poisonings</p> <p>Acute poisonings, delayed peripheral neurotoxicity</p>
Mancozeb	Acute poisonings, neurotoxicity
Terbufos (WHO Ia)	Acute poisonings, suicides
Methamidophos (WHO Ib)	Acute poisonings
Methyl bromide (WHO Ib)	Acute poisonings
Aluminum phosphide	Acute poisonings
Carbofuran (WHO Ib)	Acute poisonings
Methyl-parathion (WHO Ia)	Cancer
Copper arsenate	Acute poisonings, immunotoxicity
Aldicarb (WHO Ia)	Diseases
Pesticides	Blood cholinesterase
Oorganophosphate exposure	Risk of birth defects
Herbicide 2,4-D	Over-stimulate the nervous system causing nausea, lung congestion, chest pain, and dizziness.
Chlorpyrifos	At high exposure levels -respiratory paralysis and death It is highly toxic to fish, crab, shrimp, birds and other wildlife.
Trifluralin	Allergic dermatitis
Carbaryl	Irritant and direct contact may cause burns
Dichlorvos	Human carcinogen
Rotenone	Respiratory paralysis
Formalin	<ul style="list-style-type: none"> • Severely irritating to the eyes, skin and respiratory tract • Repeated or prolonged contact may cause skin sensitisation <p>Prolonged inhalation may cause asthma-like symptoms, and it may also be carcinogenic to humans</p>

30% of the pesticides marketed in the developing countries do not meet the international standards (WHO 2001). Lack of administrative regulatory capacity and agricultural development programs partially cause the unsafe use of pesticides in the developing countries (Paarlberg 1992). The use of pesticides in Bangladesh has also increased. The trend of pesticides is shown in Fig.1

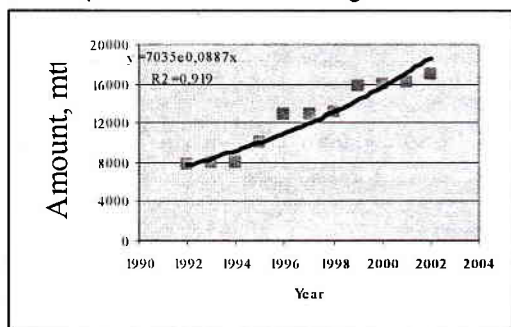


Fig. 1. The trend of pesticides used in Bangladesh

The farmers of Bangladesh used 161 formulations using 50 different active ingredients. Among them, 19% are extremely hazardous (WHO class I), and 51% very hazardous (WHO class II), Dasgupta et al. (2005). Meisner (2004), NOVIB (1993) and SOS (2004) also reported that many pesticides used in Bangladesh were banned or restricted under international agreements. Therefore, a research was carried out to find the impact of pesticides use on farmers' health in Bangladesh.

2. Methodology

A survey was conducted in selected areas (Jamalpur, Mymensingh, Gazipur, Netrokona and Sherpur) of Bangladesh by using a structured questionnaire to collect information on pesticides use, practices, and their problems/sickness. The questionnaire was pre-tested by 10 different farmers from different locations and it was changed as required. For the actual study, 152 farmers were selected randomly from a list of the local agricultural extension officer, member and chairman of union council. The poisoning from pesticides records were collected from villagers and local hospitals. The information on the use of protective measures/clothes, active ingredient of the pesticides, age, bodyweight, height, education level, income, numbers of exposure per season, over used of pesticides then recommended dose, training on IPM, training on pesticides application and handling, WHO categories of used pesticides were also collected. Farmers were asked about

their diseases which were related to pesticides as their opinion. There was no provision in the project to medical check up of their disease. However, these information were used to determine the effect of pesticides on farmers' health. A tape recorder was used during the interview to clarify any confusion or missing answers. After completing the survey, the answers of farmers were coded and entered in Microsoft Excel spreadsheet for data analysis. The effect of pesticides were determine on the basis of following function;

$$\text{Effect on health} = f(AI, WC, PU, ED, TP, TI, A, I, OU, NE, BI)$$

Where

- AI = Active Ingredient in the pesticides
 WC = WHO categories of used pesticides (3 for extremely hazards, 2 for moderately hazards, 1 for least hazards, 0 for no hazards)
 PU = Protective measure/clothes used (5 for one item, 4 for two items, 3 for three items, 2 for four items, 1 for five items, and 0 for full recommended protection)
 Ed = Education (4 for can not read/write, 3 for schooling for 1- 5 years, 2 for schooling for 6- 10 years, 1 for schooling for 10- 12 years, 0 for schooling for over 12 years)
 TP = Training on pesticides application and handling (0 for yes, 1 for No)
 TI = Training on IPM (0 for yes, 1 for No)
 BI = Body Index (0 for satisfactory, 1 for unsatisfactory)
 A = Age (3 for age < 12 years and > 50 years, 2 for age between 13-30 years, 1 for age between 31 to 49 years)
 I = Income in Taka (3 for less than Tk.1000, 2 for income between Tk.1001 to Tk.5000, 1 for income between Tk.5001 to Tk.10000, 0 for income over Tk.10000)
 OU = Over used of pesticides then recommended dose (1 for yes, 0 for No)
 NE = No. of exposure per season (1 for 1 operation, 2 for 2 operations,..... and n for n operations)

The general linear model procedure in SAS software was used for analysing the variance and finding the affect of different factors (farmer's age, education level, training, and IPM knowledge etc.) on impact of health for using pesticides.

3. Results and Discussions

The survey result showed that a number of villagers were poisoning from pesticides. Table 3 shows the poisoning in different categories (age, gender and causes). It was observed that 10% of poisoned persons were dead. Farmers worked with pesticides but 38% females were poisoned.

Table 3. Poisoning from pesticides distributed as age, gender and causes from 1995 to 2005

Category	Respondents	
	No.	%
Total cases reported	165	100
Deaths	17	10
Gender:		
Males poisoned	103	62
Females poisoned	62	38
Age group:		
0-15 years	39	24
16-45 years	122	74
> 45 years	4	2
Causes:		
Consumption of contaminated food	44	27
Working in a storeroom	24	15
Working in the field	31	19
Accidental ingestion	53	32
Attempted suicides	13	8

The main causes of females poisoning were accidental ingestion, working in the store room and attempted to suicides. Accidental consumption resulted from drinking water stored in empty pesticide containers, or use of empty containers for drinking; confusion of a pesticide mixture with a drink etc. Many villagers believe that washing the pesticides container with water is enough to clear any pesticide residues. Cases of suicide often involve young girls forced into marriage or carrying a child by an unnamed father. It is also enhanced due to readily accessible of pesticides for those suffering humiliation or depression young girls. The poisoning of children, below 15 years of old, from pesticides is also remarkable. It was 24% of total cases reported. Children were poisoned from pesticides due to accidental ingestion and

pesticides mixed in front of the children or they play around the pesticides mixing operation. The farmers of Bangladesh mainly used insecticides, herbicides, fungicides and rodenticides in agricultural field. Most of the poisoning occurred from insecticides, Table 4. The farmers of Bangladesh used mainly two types (granular and liquid) of pesticides. It was observed that 29% of poisoning occurred from liquid pesticides, Table 5. It was due to its easily split out on the body and easy to take in case of attempting suicide.

Table 4. Poisoning from different type of pesticides

Type	No.	%
Fungicides	13	8
Herbicides	2	1
Insecticides	40	24
Rodenticides	9	6
Can't remember	101	61
	165	100

Table 5. Poisoning from pesticides distributed as their states

State	No.	%
liquide	35	29
solid	29	10
Can't remember or confused	101	61
Total	165	100

The farmers of Bangladesh use different groups of pesticides. It was found that maximum poisoning occurred from the Chlorpyrifos, Cypermethrin, Diazinon, Edifenphos, Zinc Phosphite group of pesticides. However, the farmers could not remember the name or brand of 61 % of total cases poisoning from pesticides. The record of poisoning were also not found in hospitals or health centre. It is indicated that the pesticide poisoning incidents are poorly recorded in the study area and there is no systematic means of collecting data. The poisoning from different groups of pesticides is summarised in Table 6. Farmers reported number of disease and they believed that they were suffering due to use of pesticides. Table 7 shows the list of diseases which was reported by the farmers. The survey found that 81% of farmers kept pesticides in their bedroom, 9% under the place of grain-storage, 7% in their kitchen and 3% in an isolated place. The practice of storing pesticides in bedrooms or in the house was explained by the farmers' that they were concern to protect their inputs from thieves. But unfortunately,

this is not without risk to their health and that of their family. They also reported that inadequate labelling often contributes to ineffective use, unsafe handling practices, overdosing, and accidents. Twenty percentage of the spray operator in the study area did not take any special protective item during spraying, Table 8. Fig.6 shows that farmers are applying pesticides using a LOK sprayer in the rice field without wearing any protective items/cloths. Most of the operators (32%) used two protective cloths such as long sleeve shirt and "gamcha" (a piece of cloth over head). No one took full protective measures.

Table 6. Poisoning from different pesticides

Pesticides group	Respondents (N=150)	
	No.	%
Bromadiolon	4	2.42
Butachlor	1	0.61
Carbendazim	1	0.61
Carbofuran	4	2.42
Carbosulfan	3	1.82
Cartap	1	0.61
Chlorpyrifos	7	4.24
Cypermethrin	6	3.64
Diamethoate	2	1.21
Diazinon	5	3.03
Di-chlorvos	1	0.61
Edifenphos	6	3.64
Fanitrathion	2	1.21
Fenthoit	1	0.61
Fenvelarate	3	1.82
Malathion	3	1.82
Mancozeb	2	1.21
Metalaxil	1	0.61
Oxadiazon	1	0.61
Phenthoate	1	0.61
Rotenon	2	1.21
Sulpher	1	0.61
Trichlorphon	1	0.61
Zinc Phosphite	5	3.03
Can't remember	101	61.21
Total	165	100.00

Table 7. Impact on health for using pesticides groups of in selected area of Bangladesh

Pesticides group	Respondents (N=150)	
	No.	%
Blurred vision	21	14
Chest pain	5	3
Difficulty breathing	7	5
Digestive system problems	15	10
Dizziness	7	5
Dry throat	15	10
Fatigue	18	12
Fever	17	11
Flushed face	56	37
Headache	35	23
Insomnia	17	11
Itching of skin, eyes and nose	57	38
Mental/physical disability	3	2
Muscle stiffness	19	13
Muscle weakness	9	6
Nausea during application	75	50
Pain in joint	12	8
Sensory organ problems	7	5
Reproductive effects	3	2

It is also observed that the poor working conditions of the farmers are also lead to multiple exposures to a range of products resulting in serious health problems, with a wide variety of symptoms, which jeopardise the diagnosis of poisoning. It was also found that farmers who worked with 5 protective clothes/items they reported less symptoms of suffering then who sprayed without any special clothes/items. The general linear model produced in SAS software was made for analysing the variance and finding the effect of pesticides on operators' health. The probability of different variables and their significance is shown in Table 9.

Table 8. Frequency of use of different protective measures used during spraying

Name of the items or clothes with usual dress	%	% of all
Single item		2
Long sleeve shirt	2	
Two items		36
Long sleeve shirt and gamcha (a piece of cloth over head)	32	
Long sleeve shirt and cloth over mouth and nose	4	
Three items		22
Long sleeve shirt, gamcha, and cloth over mouth and nose	22	
Four items		14
Long sleeve shirt, gamcha, cloth over mouth and nose, and eye glass	14	
Five items		6
Long sleeve shirt, long trousers, eye glass, cloth over mouth-nose, and hat	4	
Long sleeve shirt, gloves, eye glass, cloth over mouth-nose and gamcha	2	
Did not take any special cloth or item	20	20
	Total 100	100

Table 9. Probability of different variables and their significance

Variables	Probability	Significance [^]
Active Ingredient in the pesticides	0.21	NS
Age	-0.003	NS
Body Index	0.152	NS
Education	0.08	NS
Income in Taka	-0.007	NS
No. of exposure per season	0.001	**
Over used of pesticides then recommended dose	0.0005	*
Protective measure/clothes used	0.0005	***
Training on IPM	-2.035	NS
Training on pesticides application and handling	0.003	***
WHO categories of used pesticides	0.153	NS

[^] *** = Significance at the 1% level

** = Significance at the 5% level

* = Significance at the 10% level

NS = Not significant



Fig.6. Lever operated Knapsack sprayer is being used in the rice field

The analysis indicated that training, using protection measures, over used of pesticides and number of exposures were significantly associated with the probability of farmers' health impairment from pesticides use. However, the other variables such as AI, categories of hazards, education, training on IPM, body index, age and income had no statistically significance on the impact on health.

4. Conclusion

Pesticides applied in unsafe conditions, putting in peril the life of women, men and children in farming communities, as well as insects, fish, amphibians, reptiles, birds and mammals. Education and awareness-raising can reduce the worst cases of unsafe use of pesticides, and help to prevent accidents. The international community, and particularly rural development organisations, must increase their efforts to encourage a safer and more sustainable agriculture. Therefore, the study recommended that following measures should be adopted to help prevent pesticide poisoning.

- Farmers who are working with pesticides should be trained in essential precautions, including protective clothing and other elements, in order to reduce associated risks.
- A precautionary approach should be adopted and the most dangerous (WHO Class Ia and Ib) chemicals should be prohibited

immediately. Pesticide control should be a strengthening.

- More control is needed over pesticide sales and outlets and direct promotion of pesticides to farmers and agricultural workers by company representatives.
- The farm workers should be regularly reminded of the hazardous nature of chemicals.
- The health of the workers should be monitored regularly.

Acknowledgement

Authors are grateful to Deutscher Akademischer Austauschdienst Dienst (DAAD), Federal Republic of Germany, for financing to complete the research.

References

- Crissman C C, Cole D C, Carpio F (1994). Pesticide Use and Farm Worker Health in Ecuadorian Potato Production. *American Journal of Agricultural Economics*, 76, 593-597.
- Dasgupta S, Meisner C, Huq M (2005). Health effects and pesticides perception as determinants of pesticide use: Evidence from Bangladesh. *World Bank policy research working paper 3776*, Nov 2005.
- Dinham B (2003). The perils of paraquat Sales targeted at developing countries. *Pesticides News No. 60*, June 2003, pages 4-7
- Garry V F, Schreinemachers D, Harkins M E, others (1996). Pesticide Applicators, Biocides, and Birth Defects in Rural Minnesota. *Environmental Health Perspectives*, 104, 394-399.
- Kishi M, Hirschhorn N, Qjajadisastra M, satterlee L N, Strowman S, Dilts R (1995). Relationship of pesticides to sing and symptoms in Indonesian farmers. *Scandinavian J. of work and Environmental health* 21, 124-133
- Meisner C (2004). Report of pesticide hotspots in Bangladesh. Report on the Canadian Int. Dev. Agency (CIDA). Mimeo. World Bank, Washington DC.
- NOVIB (1993). Pesticides misuse in Bangladesh. *The pesticides News*, No.22, Dec. 1993. The pesticides trust. London: UK.
- Oudejans J (1999). Studies on IPM Policy in SE Asia: Two centuries of plant protection in Indonesia, Malaysia and Thailand, Wageningen Agricultural University Papers, Backhuys Publishers, PO Box 321, 2300 AH Leiden, the Netherlands.

- Paarlberg R L (1992). Managing Pesticide Use In Developing Countries, from Levy, M. A., Robert O. Keohane, and Peter M. Haas (1992). Institutions for the earth: Promoting international environmental protection. Environment 34(4), 12-17, 29-36.
- Pimental D, Acquay H, Biltonen M (1992). Environmental and economics costs of pesticides use. Biosciences 42, 750-760.
- Pingali P L, Marquez C B, Palis F G (1994). Pesticides and Philippine Rice Farmer Health: A Medical and Economic Analysis. American Journal of Agricultural Economics, 76, 587-592.
- Poapongsakorn N, Meenakanit L, Waibel H, Jungbluth F (1999). Approaches to Pesticide Policy Reform-Building Consensus for Future Action. A Publication of the Pesticide Policy Project, Hannover, April, 1999, Publication Series No. 7.
- Rosenstock L, Keifer M, Daniell W E, McConnel, R, Claypoole K (1991). Chronic central nervous system effects of acute organophosphate pesticides intoxication. Lancet 338, 223-227.
- SOS-arsenic.net (2004). Agrochemicals: Imported pollutants in Bangladesh. <http://www.sos-arsenic.net/index.html>.
- WHO (1990). Public health Impact of pesticides used in agriculture, 1990. WHO:New York, USA.
- WHO (2001). "FAO/WHO: Amount Of Poor-Quality Pesticides Sold In Developing Countries Alarmingly High" Press Release WHO-04, February 1, 2001, Geneva. <http://www.who.int/inf-pr-2001/en/pr2001-04.html>