International Journal of Development and Sustainability
ISSN: 2168-8662 – www.isdsnet.com/ijds
Volume 3 Number 3 (2014): Pages 493-504
ISDS Article ID: IJDS13031403

Current scenario of pesticide practices among farmers for vegetable production: A case study in Lower Sindh, Pakistan

Asif A. Jamali *, Amber R. Solangi, Najma Memon, Shafi M. Nizamani

National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan

Abstract

The study was aimed at determining the extent of pesticide use and farmers' knowledge of pesticides and their use on the field. In this study, 100 farmers were interviewed concerning pesticides usage patterns among farmers in vegetable production area in Lower Sindh, Pakistan. Information was obtained through personal interviews through structured Questionnaire. Resultantly, 27 various registered pesticides used by the farmers were insecticides. Majority of pesticides which belonged to class-II that WHO recognizes them as hazardous and one of them pesticides with the class-Ib highly hazardous was also found. Majority of insect and pest were found in Okra and tomato crops. Many farmers depended on nicotinoid and organophosphate, groups of pesticides. Numbers of farmers were less educated and did not have the knowledge of pesticides usage, farmers' knowledge of insecticides was dealer's advice. Dealers decided when to spry the crop. During pesticide application and vegetable harvesting 50% farmers did not use safety protection. The research has exposed some of overuse, misuse and abuse of pesticides among farmers. Due to unaware of pesticides hazardous farmers lacked appropriate information on safe handling and use of pesticides, which can be attributed to insufficient agriculture extension services and state of art trainings to the farmers at their root level.

Keywords: Pesticide, Farmers, Vegetable production

Cite this article as: Jamali, A.A., Solangi, A.R., Memon, N. and Nizamani, S.M. (2014), "Current scenario of pesticide practices among farmers for vegetable production: A case study in Lower Sindh, Pakistan", *International Journal of Development and Sustainability*, Vol. 3 No. 3, pp. 493-504.

* Corresponding author. *E-mail address:* jamali_asif_10@yahoo.com

1. Introduction

Sindh province is major chilies and onion producer in the country, while in tomato production Sindh is at number two. The differences of onion, tomato and chilies production clearly indicated that these commodities were traded domestically across the provinces. The average area in thousand hectares and production in thousand tones of onion, tomato and chilies in Sindh has been reported. The average annual production of onion, tomato, chilies was 3.4, 4.55 and 6.53 thousand tons respectively (Government of Pakistan, 2005a). Production of okra, bitter gourd, tomato and cauliflower in Sindh during was 22.1, 37.1, 60.5, 13.3 thousand tones (Government of Pakistan, 2005b). Rural food needs in cities and towns in Pakistan are growing, and increasingly vegetables are grown in rural and peri-urban areas to meet the demand. However, traditional vegetable farming systems (i.e. without any chemical input) are incapable of meeting this challenging demand. Besides, pests and diseases pose big problems in vegetable production which require intensive pest management to control them. Each year these pests destroy almost half of the world's food crops. Thus, the prudent use of crop coupled with appropriate pesticides management may actually improve our diet by decreasing the cost of vegetables and increasing their availability, abundance, quality, and variety as well.

Worldwide usage of pesticide has increased manifold since the 1960s. The use of pesticides helped to considerably reduce crop losses and to get better yield of the crops such as corn, maize, vegetables, potatoes and cotton. On other side, their unfavorable effects on environmental quality and human health have also been reported. The main issue of pesticides mismanagement starts at in the local area but is reflected globally (Huber et al., 2000; Kidd et al., 2001).

Pakistan is the 2nd largest consumer of pesticides among the south Asian countries. About 27 % of the total pesticides consumption is used on Fruits and vegetable crops (Hussain et al., 2002). The Pesticide business started in Pakistan in 1954 with the import of 254 metric tons of formulated product, increasing to 20,648 metric tons in 1986-87 and 44,872 tons in 1998. Use of pesticides is increasing at the rate of 25% a year (USAID, I-LED 2006-2009). Pesticides not only persist in the vegetables but also pollute the soils and water, then enter the food chain, and finally come in blood of humans through foodstuffs and water. In addition, pesticides also contribute to environmental pollution, biodiversity losses and deterioration of natural habitats (Cerejeira et al., 2003). There have been reported instances of pest recovery, development of resistance to pesticides, secondary pest outbreaks and destruction of non-target species. In spite of the fact that pesticides are also applied in other sectors, agriculture can certainly be seen as the most important source of adverse effects (Sattler et al., 2007). Insects and pest rigorously attack the vegetables such as okra, chilies, tomato cauliflower, brinjal, bitter gourd and onions. Organochlorine, orgnophosphate, carbamate, pyrethroid and neo-nicotinoid groups of pesticides are used by farmers for the control of these pests. Keeping in view high demand of quality products, the Asian, African, Center and South American farmers profusely used the pesticides, as it on the one hand ensure yield and on the other it pares the way for self-sufficiency in food related products (Mansour, 2004).

In lower Sindh many formers are not adequately aware about the hazards associated with the chemicals. As a result, farmers use pesticides without full understanding of their impact on human health and the

environment. In lower Sindh one of the biggest problems concerning with vegetable farmers is disease and pests which ravage their crops. While pesticides are usually considered a remedy for farmers' pest concerns, farmers' perceptions and consumption of the chemicals have not received much attention. However, the awareness and perceptions of the farmers regarding pesticide risks to human health are important for number of reasons (Warburton et al., 1995). The decision of pesticide use and his awareness if different from expert opinion must always be narrowed down through appropriate guidance to the farmers in respect of pesticides they use and the methods of protection used against those pesticides.

In lower Sindh there has not been any organized comprehensive study on pesticides usage among farmers. However this research work aims to examine the farmers' pesticide management practices in lower Sindh, to assess the extent of farmers' knowledge of pesticides and their perceptions about the chemicals' effectiveness and potential for harmful effects associated in their indiscriminate use on the field vis-à-vis crops. In this study, the objective and principal focus has been to determine the extent of pesticides use, i.e. the types of chemicals that farmers use, the practices involved and to what extent farmers rely on the chemicals, and the timing of spraying.

2. Material and methods

The survey was conducted from June to December 2010. Study area covered five Districts of lower Sindh province which were Tando Alhyar, Mirpurkhas, Hyderabad, Badin, and Thatta. These are mainly rural areas of province where the population heavily depends on agronomic and horticultural crops specially the vegetables. Majority of these vegetables are sold on the national markets of Hyderabad, Karachi and Islamabad. Good quality vegetables are exported abroad through these markets. Information from 100 farmers (20 from each district) was collected through formal and informal personal interviews about their perception of pesticides usage. Structured Questionnaire was developed in consultation with experts of Agriculture Extension and Plant Protection Departments of Sindh Agriculture University, Tandojam, Pakistan. Questionnaire had four sections namely, Personal information regarding Farmers, Knowledge of Pesticides, Pesticide Usage Pattern and Frequency of pesticide application on vegetables. In first portion literacy rate and age were included. The second portion were included the farmers' knowledge of insecticide/pesticides application and idea about residue effect/persistence. In third portion farmers were asked about the decision and time of pesticides spray, use of protective clothing during spray, knowledge of using mixed pesticides, the recommendation of pesticides, idea of residual effect/persistence and interval between pesticide application and harvest. Last section of Questionnaire consisted of frequency of pesticide application on vegetable in different district, formulation of pesticides, and toxicity level of pesticides. All the data were analyzed by Microsoft excel and frequencies were calculated for each question (Pinyupa et al., 2009; Jadalla et al., 2012).

3. Result and discussion

3.1. Personal information regarding farmers

One hundred small-scale male farmers voluntarily participated in this study. Literacy rate of farmers depicts that 10% were illiterate, 39% had received primary education, 22% middle, secondary 17%, and 12% were university graduates. It means considerable number of farmers had finished primary and 71% of farmers were not having education beyond the middle. Earlier studies in Sindh indicated that 34.7 percent of the farmers interviewed were illiterate (Khuharo, 2008).

The age structure of farmers revealed that 12% were in between 20 to 30 with average age of 24, 22% in between 30 to 40 with average age of 36. The majority (64%) of farmers was 40 to 60 years old with an average age of 48 (Table-1). The average age of farmers was 48 years but majority of farmers of Ghana were the age of 45 years (Ntow et al., 2006).

Table 1. Personal information regarding Farmers

Educational level of farmers	**Number (%)**
No education	10
Primary	39
Middle	22
Secondary	17
Graduation	12
Age of farmers	
Between 20 to 30	12
Between 30 to 40	24
Between 40 to 60	64

3.2. Knowledge of pesticides

The sources of farmers' knowledge of insecticides were diverse such as pesticide labels, dealer's advice, recommendations of agriculture researchers, and agriculture extension. It was observed from the data that the major source of farmers' knowledge of insecticides was the pesticides dealer which constitutes 81% of all sources. In Thailand it was 60% and in Ghana it was 11.9% (Ntow et al., 2006, Pinyupa et al., 2009).The idea about residual effect of pesticides among the farmers is 52%; whereas 48% have no idea about residual effect. The half of the farmers was not aware of residual effect (table-2).

Table 2. Knowledge of Pesticides

Farmers' knowledge of insecticide application	Number (%)
reading label	5
consult dealer	81
reading label/ consult dealer	9
reading label/ Agriculture Research	1
consult dealer/ Agriculture extension	1
consult dealer/ other	2
Agriculture Research/ Agriculture extension	1
Any idea about residue effect/persistence	
Yes	52
No	48

3.3. Pesticide usage pattern

The spray of pesticides depended on cost of vegetable and the farmer's economy and many other factors such as the price of these vegetable in the market, advice from the fellow farmers, pesticide sales representative, etc. The 75% of farmers have their own decision to spray, but 25% have other sources such as Neighbor, Agriculture extension, Agriculture Research and Pesticides agent. Before any type of pesticide usage, the pest attack was confirmed through the diagnosis of crop disease, and then treated it by using accurate insecticide/pesticide, if it is required. Improper dosage and frequency may be ineffective, useless, wastage of time and money if the attack is improperly identified (World Report, 2005). The 80% farmers sprayed themselves and 20% farmers took this work from skilled person. The time of spray was 37% in morning and 63% in the evening time. The morning time of pesticides usage showed the adverse affect on the birds and honey bee and on many animals which take food in morning. The farmers used the protective cloth in winter but in summer they did not use because of high temperature and high moisture in lower Sindh. Approximately half of the farmers didn't use protective clothing. Therefore, the result of affect of pesticides reported in summer was very high (Azmi et al., 2006).

For increasing the effect of pesticides farmers also used the mixed pesticides. It was also suggested by different sources such as Agriculture extension, Pesticides dealer or own decision. About 99% farmers had used the mixed pesticides in their crop in which 86% farmers used pesticides recommended by the dealer. Organophosphates with combination of Pyrethroids pesticide chemicals proved to be the most effective and lethal weapon against Bollworm insect/pest species but the health hazards as a results of such mixtures may be lethal for respondents (Mona et al., 2000). Answers about interval between pesticide application and harvest depended on farmers vegetables not on the kind of the pesticides. It means they have no knowledge of interval between pesticide application and the harvest (Table-3). All respondents in the present survey

sprayed their vegetables with pesticides to control pests and diseases. This fact has been testified by Dinham where it is said that majority of the Gana farmers apply pesticides to get rid of pest and disease that attack on vegetables (Dinham, 2003). In Britain pesticides are used extensively on vegetable farms, small or large (Thomas, 2003).

Table 3. Pesticide Usage Pattern

Who decides when to spray	Number (%)
Own decision	75
Neighbour	2
Agriculture extension	6
Agriculture Research	2
Pesticides agent	2
Own decision/ Agriculture Research	10
Own decision/ Agriculture extension	1
Own decision/ Pesticides agent	2
Who sprays the crop	
your self	80
Skilled worker	20
Time of spray	
Morning	37
Evening	63
Use of Protective clothing during spray	
Yes	46
No	54
Using mixtures	
Yes	99
No	1
If, yes then recommendation	
Agriculture extension	6 (6.06%)
Pesticides dealer	85 (85.85%)
Own	8 (8.08%)
Interval between pesticide application and harvest	
After one day	6
After two days	12
After three days	22
After four days	16
After five days	17
After seven days	10
After eight days	17

3.4. Frequency of pesticide application on vegetable

The usage of pesticides on vegetables grown in different districts showed that Okra and tomato were more affected by the pests/insects so therefore, the frequency of pesticides usage was also very high. District wise data showed that Thatta, Tando Allahyar and Hyderabad had the high frequency of pesticides usage. The increasing order of commonly used pesticides on vegetables grown in lower Sindh was Imidacloprid> acetamiprid> diafenthiuron> emamectin> endosulfan. The majority of farmers rely on nicotinoid, organophosphate, organochlorine, urea and pyrethroid group of pesticides (Table 4).

Table 4. Frequency of usage of pesticides among farmers

Pesticide	Group	Usage Frequency					
		Thatta	Hyd	Mirpur	T. Allahyar	Badin	Total
Imidacloprid	Nicotinoid	9	2	6	9	3	29
Acetamiprid	Nicotinoid	4	2	5	6	2	19
Diafenthiuron	Urea	6	5	2	3	2	18
Emamectin	Avermectins	7	NR		3	5	15
Endosulfan	OC	3	4	1	3	3	14
Metalaxyl	Anilide	1	4	4	1	1	11
Pyridaben	Unclassified	1	6	3	1	NR	11
Mancozeb	Dithiocarbamate	1	4	2	1	2	10
Abamectin	Avermectins	2	1		5	1	9
Profenophos	OP	3	NR	2	1	2	8
Bifenthrin	Pyrethroid	2	NR	1	1	3	7
Cypermethrin	Pyrethroid	1	1	1	3	1	7
Difenoconazole	Conazole	1	2	NR	NR	4	7
Lufenuron	Urea	1	1	NR	2	1	5
Monomehypo	Nereistoxin	1	2	1	1	NR	5
acephate	OP	NR	1	2	1	NR	4
Dimethoate	OP	2	NR	NR	1	1	4
indoxacarb	Oxadiazine I	NR	NR	NR	3	NR	3
Malathion	OP	NR	2	1	NR	NR	3
Copper xychloride	Inorganic	2	NR	NR	NR	NR	2
deltamethrin	Pyrethroid	NR	1		1	NR	2
Carbofuran	Carbamate	NR	NR	NR	NR	1	1
Chlorantraniliprole	Not classified	NR	NR	NR	1	NR	1
Lambda-Cyhalothrin	Pyrethroid	NR	NR	NR	NR	1	1
Sulphur	Inorganic	NR	NR	1	NR	NR	1
Thiamethoxam	Nicotinoid	1	NR	NR	NR	NR	1
Thiophanate methyl	Benzimidazole	NR	NR	NR	NR	1	1
Total		48	38	32	47	34	199

**NR= Not reported*

The results of this survey indicated a wide variety of chemicals were utilized as pesticides in this area. Although 27 different pesticides were reported by farmers which were being used in Lower Sindh, yet but it could be lower than actual number of pesticides in use. The vegetable farmers depended heavily on use of pesticides for control of different pests and diseases and over 27 different formulations were used. This is probably because they believe that the only solution to pest problems is to spray more frequently and using different types of pesticides (Thomas, 2003). The farmers were not receiving agricultural extension services, and relied heavily on pesticide use when dealing with pest problems but were constrained by the lack of appropriate knowledge (Ngowi, 2003).

Majority of pesticides were insecticides and few fungicides were also being used. In Table 5 the classification of these pesticides by the type of pests they control, active ingredient, chemical group and WHO Hazard Category is presented. All the pesticides were registered by agriculture research department of Pakistan. Toxicity class of majority pesticides belonged to Class-II. (WHO Recommended Classification of Pesticides by Hazard). The use of extremely hazardous insecticides, including endosulfan (moderately hazardous) and carbofuran (class-Ib of Carbamate group) were observed. Other less hazardous agents create a health risk to the farmers as well.

The research and study authenticate those pesticide dealers who aim at business profit, shy away the environmental and health risk that are entailed due to excessive use of pesticides. It is in conformity with similar pattern in African countries (Abate et al., 2000).

This situation is also true in many developed countries where the choice of pesticides to be used by farmers is influenced by the suppliers (Epstein and Bassein, 2003; Snoo, et al., 1997). It is because of the pest and disease which badly affect the vegetable yield hence the farmers are compelled to apply and spray pesticides excessively, in order to have better crop. In Pakistan government developed the extension wing for usage of pesticides but it stands farmers relied continuously on dealers. Because of the illiteracy and lack of knowledge farmers do not select the right pesticides and right amount of the dose, in order to avoid the bad effect upon the environment and health. That fact has also been rightly pointed out by Epstein and Bassein (2003), wherein they had observed that farmers prefer the application of pesticides upon their own settled out method of calendar rather keeping in view the effect upon health and environment.

A wide range of pesticides are globally used for crops protection during the cultivation of vegetables due to heavy pest infestation throughout the season crop and food (Agnihotri, 1999; Kalara, 2003), Literature reveals that vegetables contain the residues of pesticides above their respective maximum residue limit MRL (Taneja, 2005) may pose health hazards to consumers (Mukherjee and Gopal, 2003). Monitoring of pesticides is conducted globally to assess the environmental load of their residues. Currently pesticides wide use in the world as an alternative pest control replaying persistent organochlorines (Toan et al., 2007). Because of wide spread use of pesticides, the presence of their toxic residues (Torres, 2004) have been reported in various environmental component/ commodities (Kumari et al., 2006; Kumari and Kathpal, 2008; Wang et al., 2008). These pesticide residues find their way into the human body through food, water, and environment.

Table 5. Frequency with Target of pest and toxicity level of pesticides

Group of pesticides Common name	Chemical family	Toxicity class	Status	Uses	Frequency of pesticides
Imidacloprid	Nicotinoid	II	Reg	Sucking pests	29
Acetamiprid	Nicotinoid	II	Reg	Sucking pests	19
Diafenthiuron	Urea	III	Reg	sucking pests & mites	18
Emamectin	Avermectins	II	Reg	Lepidopterous fruit worms	15
Endosulfan	OC	II	Reg	against lepidopterous larvae	14
Metalaxyl	Anilide	II	Reg	Downy mildew, early blight of tomatoes	11
Pyridaben	Unclassified	II	Reg	sucking pests	11
Mancozeb	Dithiocarbamat e	U	Reg	Downy mildew	10
Abamectin	Avermectins	II	Reg	Against lepidopterous larvae	9
Profenophos	OP	II	Reg	against lepidopterous larvae	8
Bifenthrin	Pyrethroid	II	Reg	against lepidopterous larvae	7
Cypermethrin	Pyrethroid	II	Reg	against lepidopterous larvae	7
Difenoconazole	Conazole	II	Reg	Powdery mildew , early blight of tomato	7
Lufenuron	Urea	II	Reg	against lepidopterous larvae	5
Monomehypo	Nereistoxin	NR	Reg	against lepidopterous larvae	5
Acephate	OP	II	Reg	Chewing & sucking pests	4
Dimethoate	OP	II	Reg	sucking pests	4
Indoxacarb	Oxadiazine I	III	Reg	Chewing & sucking pests	3
Malathion	OP	III	Reg	Chewing & sucking pests	3
Copper Oxychloride	Inorganic	II	Reg	early blight of tomato	2
Deltamethrin	Pyrethroid	II	Reg	Chewing & sucking pests	2
Carbofuran	Carbamate	Ib	Reg	against lepidopterous larvae	1
Chlorantraniliprole		U	Reg	Against lepidopterous larvae	1
Lambda - Cyhalothrin	Pyrethroid	II	Reg	Chewing & sucking pests	1
Sulphur	Inorganic	III	Reg		1
Thiamethoxam	Nicotinoid	III	Reg	Sucking pests	1
Thiophanate methyl	Benzimidazole	U	Reg	Powdery mildew	1

Ia = Extremely hazardous; Ib = Highly hazardous; II = Moderately hazardous III = slightly hazardous; U = Unlikely to present acute hazard in normal use; reg = registered

4. Conclusion

Research findings provide the guidelines to researchers, scientists, health practitioners in Sindh province regarding use of pesticide. The survey has shown some overuse, misuse and abuse of pesticides. The farmers were not aware of pesticide hazards. The farmers lacked knowledge on safe handling and use of pesticides. Improper usage of pesticides may be ineffective, useless, wastage of time and money. Knowledge of pesticide selection, timing of application and harvesting period is very important to avoid health risks. However, the situation on ground is attributed to by almost absence of agriculture services and trainings. Farmers are taking risk of health because they have in-sufficient protection. Without training, farmers are unable to make good decisions of pesticides usage. Additionally, farmers would not be able to identify the active ingredients in pesticides to avoid their use.

5. Research output

Recommendation package will be developed for pesticides usage and results will be extended to the farmers of other provinces of Pakistan. This information can be used to develop a training programmed on pest management especially on pesticide use in agricultural area of Sindh.

Acknowledgement

We thank the Pakistan Science Foundation for the financial support of this work, Institute of Food Sciences & Technology, Sindh Agriculture University, Tando Jam and National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan.

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