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Vegetable Growers Perception of Pesticide Use Practices and Health Effects in the Vavuniya District

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Abstract: As in developing countries like Sri Lanka, the application of pesticides is often not very precise and unintended exposures occur to other organisms in the general area where pesticides are applied. The objectives of this study were to investigate the current pesticide use pattern and practices in vegetable farming compared with recommended standard and study the health impacts caused by agrochemical in Vavuniya district in Sri Lanka. Primary data was collected from 120 randomly selected farmers among vegetable cultivators in Vavuniya district through questionnaire survey. Primary data were socio-demographic characteristics, pesticide management practices and health impacts. Secondary data were collected from Department of Agriculture and RDHS (Regional Directorate of Health Service) in Vavuniya. The collected data were analyzed using the Pearson correlation test, frequency analysis and crosstabs in SPSS (Statistical Package for Social Sciences), version 16. Almost all farmers depended on synthetic pesticides for the management of pest and 51% of the farmers applied the pesticides 10-20% higher than recommended level. Sixty two percentage of the farmers used banned pesticides and 95% of farmers read the instructions given in the label but they did not follow the label instructions. Around 60% of the farmers harvested the products within seven days though the pre-harvest interval for most vegetable is 14 days. Number of cancer patients increased from 2010 (177 patients) to 2013 (300 patients) in Vavuniya District. Therefore, residual effect of pesticides, over dosage of pesticide usage and poor safety measures may cause kidney disease, cancer and liver failure in this study area.

Key words: Awareness · Farmers · Health Impacts Pesticides

INTRODUCTION

Pesticides kill or deter the destructive activity of the target organism and they posses' inherent toxicities that endanger the health of the farmers, consumers and the environment. Particularly Sri Lanka is a developing country; in here agriculture is main sector. In Sri Lanka, Vavuniya is a one of the agricultural district and mainly paddy, vegetables and fruits have been cultivated. Vegetable crop sector in Vavuniya district accounts for heavy use of pesticides [1]. Such as insecticides, fungicides and weedicides.

Pesticides have been misused and overused highly in the agricultural sector of Sri Lanka over the years [1]. Sri Lankan farmers use stronger concentrations of pesticides with increased frequency of applications and mixing of different pesticides together to combat pest resistance compared to neighboring countries like India [2]. Misuse and Overuse of pesticide is very common among farmers of developing economies and Sri Lanka is no exception [1]. Almost all semi-subsistence farmers in Sri Lanka use pesticides [3]. The amount of pesticides used in Sri Lanka had increased by almost 110 times between 1970 and 1995 [4].

Vavuniya is one of the agricultural districts and also most of the farmers depend on synthetic pesticides to control pest. In our preliminary survey, farmers generally lack of knowledge about proper pesticide management, including safe pesticide handling, use proper class of pesticide, storage and also they are not considering on their health impacts and environmental affects. Hence, Vavuniya district is selected as study area for this research to investigate the current pesticide use pattern and practices in vegetable farming compared with recommended standard and study the health impacts caused by agrochemicals.

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MATERIALS AND METHODS

Study Area Description: This research was carried out in Vavuniya district. The Vavuniya District is in the Northern part of Sri Lanka. The district is categorized under the dry zone of Sri Lanka. The mean temperature of this district is 28° C and annual rainfall of 1400mm. The soil of the district is highly fertile due to reddish brown earth, low humid clays and alluvial soil. The study area targeted mainly for vegetable growing farmers of Vavuniya District, where population heavily depends on agriculture for their livelihood. About 30,912 Farm families are engaged in agricultural related activities.

Data Collection: Required primary data were collected by structured questionnaires, semi structured interviews and direct field observations. A total of 120 vegetable farmers were randomly selected from Vavuniya district through questionnaire survey. The study was conducted in different land size such as high, medium and low cropping fields in districts of Vavuniya. Some details about pesticide practices were collected through interview method those were personal precaution measures, quantity of pesticide usage, type of pesticide usage, methods of storage and disposal of pesticides containers. Detailed about available banned pesticides were collected from pesticide dealers in Vavuniya market. Numbers of health hazards were obtained from Regional Director of Health Service in Vavuniya district. Number of patients such as kidney disease, Cancer and liver failure were collected from year 2009 to 2013.

Data Analysis: The data was analyzed using the Statistical Package for Social Sciences (SPSS), version 16. Each data's frequency was calculated by descriptive statistics and Pearson correlation test were used to find the significant different between dependent and independent variables at 1% and 5% interval whereas, level of education was dependent variable and quantity of pesticide usage, banned pesticide usage were independent variables. Chart, table, means and frequency were used to describe the data on the pesticide usage level, % of banned pesticide usage farmers, post harvest interval, health impacts and level of knowledge of the respondents.

RESULT AND DISCUSSION

General Characteristics of the Study Population: The 96% of the farmers were males and remaining was females. Age distribution of the responded population varied from 21 to 75 years and the age category indicated that 38% of younger farmers have been involving in vegetable cultivation. According to the result, around 69% of the farmers' had medium knowledge (Grade 6 to Advanced level) and also 80% of farmers have been working on their farms for more than 5 years.

About 37 % of the sample population was consisted 4 members including both parents and two children. But the average family size was 3.19 per family in the study area which is lower than the national average of family size of 4.3. The average family size indicates that the limited availability of family labour for the cultivation. The mean land size of the study area was 3.1 acre. The land size varied from less than 0.5 acre to above 5 acre. About 38 % of the farmers had the land size in between 2-5acre.

Type of Pesticide Usage: Research finding revealed that, 58% of farmers used class II pesticides but those were moderately hazardous and also about 5% of them used slightly hazardous pesticides that were categorized under class III while 37% of farmers used class IV (Green band) pesticides. About 42% of farmers used class III and class IV pesticides. According to WHO (World Health Organaization) [5] has recommended that, Ia and Ib pesticides should not be used in developing countries and class II should also be avoided.

Famers within the survey area, nearly 62% of farmers had no awareness about banded pesticide usage because they used banned pesticides (34% chlorpyrifos, 6% paraquat, 2% carbaryl and 20% glyphosate) (Table 1).

Table 1: Mostly used pesticides by vegetable farmers

Agrochemicals	% of respondent
Moderately Hazardous (II)	
Chlorpyrifos *	34.0
Carbosulfan	21.0
Paraquat*	6.0
Cabaryl*	2.0
Profenofos	2.0
Chlorfluzuron	8.0
Acetamiprid	24.0
Fenobucarb	11.0
Imidacloprid	33.0
Slightly Hazardous (III)	
MCPA 400g/l	1.0
Glyphosate *	20
Unlikely to present acute hazard (IV)	
Abamectin	51.0
Mancozeb	13.0

*- Banned pesticides

Chlorpyrifos, Paraquat, glyphosate and cabaryl were banned by Registrar of pesticide, (2012) whereas 34% of farmers used chlorpyrifos and 2% used carbaryl. But in case of banned pesticides, Chlorpyrifos and cabaryl were associated with cancer [6]. Glyphosate associated with cancer and kidney disease and also disruption of aromatase activity, prevention of production of oestrogens, causes proliferation of oestrogen-dependent human breast cancer cells [7, 8, 9].

The study showed that, banned pesticides are still being used by farmers because farmers didn't know which were banned. They did not consider about their health effect (Severe acute and chronic) and environmental affect and they considered only their income. Because farmers had very poor knowledge about pesticide poisoning while 62% of farmers used banned chemicals because most of the farmers' didn't know about exposure of banned pesticides and their chemical name, they only knew about their trade name.

Based on the result, about 51% of the farmers had no awareness about recommended dosage of pesticide because they applied the pesticides more than recommended level and 62% of them used banned chemicals. Overall about 51% of the vegetable farmers used over dosage of pesticides that was 10-20% higher concentration of pesticides than the recommended dosage. The reason for over usage was that recommended rates were not effective due to resurgence of pest to chemicals. Therefore, the frequent application of highly hazardous pesticides in high concentrations and banned pesticide usage has been often irrational and posed serious health impacts and financial risks to the farmers. The pesticide usage has caused residues in air, fishery and aquatic bodies' losses, the damage of flora and fauna, unintentional crop exposures, death of birds and honeybees and undesirable residue in food items have all credited to pesticides [10] and also due to extensive use of pesticide, the flora and fauna have been destroyed causing imbalance in agro-ecosystem and biodiversity [11].

According to the recommended guidelines, farmers should allow 1-2 weeks chemical free period depending on the pesticide before harvesting of the crop to reduce the residual effects of pesticides. The research finding revealed that around 60% of the farmers harvested the products within seven days though the pre-harvest interval for most vegetable is 14 days and 62% of them used banned chemicals (Table 1). According to the result, farmers didn't consider about pesticide residual effect and they considered only their income. This result indicates that farmers did not consider about residual effect of banned pesticides and their health impacts. The pesticide usage has caused imbalance in agro-ecosystem and biodiversity [11].

Use of Information in the Pesticide Label: According to the survey results showed that 95% of farmers read the instructions given in the label before using but they did not follow the label instructions. The main reason for not to follow the label instructions was that, they had long time experience in pesticide usage as well as experience in the use of the same pesticide in several occasions. And also Chandrasekara *et al.* [12] reported that, the incidences of overexposure are common within spraying situations and overdosing can take place due to not following the label instructions on safety. According to the statistical analysis, reading of the information was given in the pesticide packs/bottles was negative and significantly related to the level of education of the farmer ($p<0.05$). This indicates that high educated farmers did not read the information of the pesticide label.

Only 15 % of the farmers considered only about the colour band of the pesticide when they purchased and also more than 93 % of farmers paid their attention on the expiry date of the pesticides. This result clearly indicates that, famers did not have more knowledge about pesticides. Based on the statistical result suggest that, there were positive relationship between expiry date and colour band selection with the level of education ($p=0.000$).

Pesticide Application Practices: According to the survey, 83% of the farmers had sprayed chemicals towards the wind direction in order to prevent the wind effect directly to the chemical applicator, but around 18 % of farmers did not consider the wind direction during the application which has serious health effects on the spraying farmer. These farmers believed that, it is not always practical to apply pesticides considering the wind and also farmers did not aware about precaution measures and their long term ill effect. Based on the crosstab result, care of wind direction was positively related with the level of education ($p<0.05$). About 94% of farmers undertook the spraying by family laboures due to the reason that carelessness of hired labourers because they don't apply the pesticides properly and cost more for hired workers. The re-entry period is the time gap necessary to maintain between pesticide application and the re-entry to the pesticide applied field. According to the survey,

although 6 % of farmers who had aware of the idea behind the re-interval period, 44% farmers entered into the field same day of the pesticide application to observe the effects of spraying and among 22% entered into the field immediately after pesticide application. Another 48 % of farmers entered into the field in the following day and 2% stayed for two days to re-enter the field after spraying. According to the correlation test showed that re-interval period was positively related ($p<0.05$) with the education level of the farmer.

About 22 % of farmers who work in the field immediately after application perceived that there was no harmful effect due to this practice. Farmers did not realize the connection between exposure to pesticides and diseases and also they thought they were adapted to acute symptoms and never consider about chronic diseases. Because, 45% of the farmers had medium level knowledge. The reason expressed by them for their action was that labour limitations. WHO (World health Organization) has recommended that displaying a danger sign board in all the newly pesticides applied fields but it had not been practiced in any of the locations in the study area.

Safety and Storage Practices: According to the survey result, around 57% of farmer's stored their pesticides in backyard of the house (Figure 1) and only 6% of the farmer's had awareness because they stored under lockable box. About 7% of them stored the pesticides in their living room and 30% kept in store.

Based on the result, nearly, 94 % of farmers stored pesticides under unsafe place therefore it would be given hazards to human as well as environment and according to the correlation analysis suggest that, the method of storage was positively related with the level of education ($p<0.05$).

Disposal of Empty Pesticide Containers: Disposal of empty pesticide bottles are safety concern and has environmental consequences. Farmers disposed off empty containers in various ways. Around 35% of farmers disposed their empty bottles with their garbage and another 38 % safely buried empty bottles in the ground (Figure 2). About 20% of them disposed around their farm. Such disposal methods may pose some risk to nearby stream, animal food and children health. Nearly 7% of the farmers burnt their plastic empty bottles and packets.

Fig. 1: Unsafe storage of pesticides

Fig. 2: Empty pesticide containers were kept in unprotected place

Table 2: personal protective Measures

Practicing precautionary measures	Percentage
Wearing Full-sleeve shirt	61
Wearing full-length trouser	36
Wearing Gloves	21
Wearing Masks	6
Wearing Shoes	0
Wearing Hat	31
Avoid chewing betel	98
Avoid smoking tobacco	100
Cleaning body with soap after spraying pesticide	59

Source: Author's Survey Data, 2015

This shows that most of the farmers had low-level of knowledge about disposal and storage methods of pesticide.

These unsafe disposals of pesticides containers might give the soil and water contamination. The disposal of pesticides to the environment is related with a long residual action and also this would give more hazardous to human beings and the environment.

Safety Measures: It is universally acknowledged that the primary route of exposure to pesticides is via the skin, because pesticide products can splash or spill into exposed skin during pouring and mixing of concentrated pesticide formulations and spraying when dust can contaminate exposed skin or clothing. Therefore wearing of protective clothes is the most important safety measure aimed to avert or minimize skin contamination as far as possible and, if this occurs, to ensure efficient decontamination.

According to the result (Table 2), around 61% of them wore full-sleeve shirt and 36% of farmers used full-length trouser. In order to prevent the inhalation of chemical particles it is recommended to wear a mask covering nose and mouth. However, only 6% of the farmers wore mask during the pesticides application. Number of farmers used protective gloves was as low as 21% during pesticide formulation, pouring, mixing, loading and spraying. None of the farmers did not use all personal protective equipments. None of the farmers used boots at the time of pesticide application. Most of the farmers are not willing to use foot wears in their fields as they culturally consider the field as a sacred place. However, not wearing of boots has a high possibility of pesticide exposure in vegetable cultivation. None wearing of boots is more critical in fields with stagnant water such as rice fields where pesticides contaminate water resulting in high possibility of dermal exposure.

Fig. 3: Pesticide spraying without taking proper protection

The most important reason for this behavior was uneasiness. People were not using recommended protective gears either due to discomfort faced due to protective gears or due to ignorance showed in Sri Lanka that farmers having good knowledge about the benefits of wearing protective and safety measures when mixing or applying pesticides [13,14]. But surprisingly there was no noteworthy effect of knowledge on safety behavior. About 58% of the farmers used moderately hazardous (Class II) pesticides but they had poor safety measures. Similarly, according to Chitra *et al.*[15] showed in India that majority of farmers (75%) either used moderately hazardous or highly hazardous pesticides and also 88 % farmers used no protection while handling pesticides. Another basic principle needed to be adopted in working with pesticides for the personal protection is maintaining good hygiene to avoid direct contamination of pesticides. According to the research findings, 95% betel chewers and 99% smokers almost totally avoided these habits during the spraying.

Health Impacts: Increasing the use of pesticides in the country's agriculture has invoked widespread concern among specialists about their potential ill-effects on human health.

Research finding revealed that, the most occurred symptoms were headache, dizziness, skin irritation, convulsion and vomiting and eye irritation. The results indicated that, around 79% of farmers had experienced pesticide poisoning during pesticide handling. Out of those, 6% reported eye irritation, 27% headache, 21% dizziness, 5% vomiting, 7% convulsion, 13% skin irritation and 1% kidney disease. Above mentioned health impacts were caused by the poor usage of safety measures followed by farmers during pesticide application and

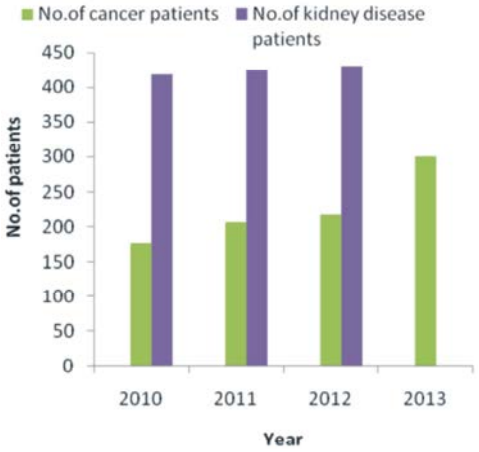

Fig. 4: No. of cancer and kidney patients with years

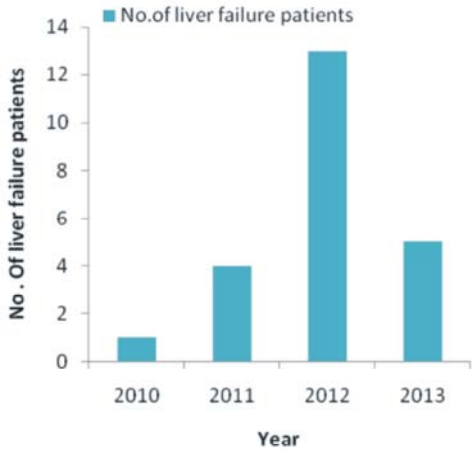

Fig. 5: No. of liver failure disease patients with various years

banned pesticide usage. Pesticides are handled carelessly and no protective clothing or equipment what so ever and 62% of them had at least one illness related with mixing or spraying pesticide [16]. According to the correlation analysis showed that, the quantity of pesticide usage was positively related with the health impacts ($p<0.05$).

Based on the survey, kidney disease, cancer and liver failure were analyzed because these diseases were most prominent in Vavuniya district. According to the survey result showed that the number of kidney disease patients increased around 3% from 2010 to 2012 (Figure 4). Kidney disease may be caused by the usage of chlorpyrifos and glyphosate [9]. But in this study area around 34% of the farmers used chlorpyrifos and 20% of them used glyphosate (Table 1).

The figure 4 showed that, around 16% of cancer patients increased during 2010 to 2011 and nearly 6% increased during 2011 to 2012 and also 38% of them

Table 3: Availability of banned pesticides in local market

Banned Chemicals	Shop1	Shop2	Shop3	Shop4	Shop5
Glyphosate	v	v	v	v	v
Paraquat	X	v	v	v	X
Propanil	v	X	v	X	X
Carbofuran	v	X	X	X	X
Chlorpyrifos	X	v	X	X	v

v: Available in the market

X: Not available in the market

increased during 2012 to 2013 (Figure 4). Therefore, overall about 69% of cancer patients increased from 2010 to 2013. According to the figure 4, there was a sudden increment observed in cancer patients from 2012 to 2013 because 38% increased during that period because increase the usage of banned pesticides and their residual effect may increase the cancer disease patients during that period. But in the case of liver failure in 2011, the number of liver failure patients has been increased 3 times higher than 2010 (Figure 5). Therefore, residual effect of pesticides and improper handling of pesticides, banned pesticide usage may cause kidney disease, cancer and liver failure in this study area.

In this study 20% of farmers used glyphosate weedicide and it was banned in year 2012 due to this weedicide is responsible for the increase the number of kidney disease patients as it contained higher amount of arsenic [9]. So, kidney disease, liver failure and cancer might be caused by increasing the usage of banned pesticides. Hence farmers and consumers should have good knowledge about pesticides impacts on human health and their affect on environment.

Availability of Banned Pesticides in Local Market: Based on the survey, banned chemicals were found in the local market in Vavuniya district (Table 4) so, it gives more chance to buy those banned pesticides by farmers. Because farmers did not know about banned pesticides and also when they buy pesticides they only consider trade name whereas they have not adequate knowledge about chemical name or active ingredients.

Glyphosate, paraquat, propanil, cabofuran and chlorpyrifos were banned. But those banned pesticides are still available in the market. According to the result (Table 3), 62% of farmers used banned pesticides (34% chlorpyrifos, 6% paraquat, 2% carbaryl and 20% glyphosate). The Government/ relevant authorities have to take immediate action to remove banded agrochemicals available in the local markets.

CONCLUSION

This research survey investigated about knowledge of pesticide handling methods and health impacts among vegetable farmers in Vavuniya district, whereas Farmers of Vavuniya district mostly used insecticides (96%) of organophosphate chemical group rather than other types of pesticides and also 58% of them used moderately hazardous (Class II) pesticides while 37% of them used minimally hazardous (Class IV) pesticides. Generally, they are not much aware of pesticide toxicity and protective measures which must be taken at the time of pesticide application and after handling, carrying, mixing, storing and disposal of pesticides bottles.

About 62% of farmers had no awareness for banded pesticide because they have been using banned pesticides (34% chlorpyrifos, 6% paraquat, 2% carbaryl and 20% glyphosate). 51% of the vegetable farmers used over dosage of pesticides that was10-20% higher concentration of pesticides than the recommended dosage. Around 60% of the farmers harvesting the product within seven days of pesticide spraying. Generally, they are not much aware of pesticide toxicity. About 79% had experienced pesticide poisoning during pesticide handling, out of them nearly 6% reported eye irritation, 27% headache and 21% dizziness, 5% vomiting, 7% convulsion, 13% skin irritation, 1% kidney disease and 20% had no any symptoms. Therefore, banned pesticide usage and their residual effect may cause health impacts in this study area due to consciousness of farmers.

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