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Socio-Economic Factors and Pesticide Usage Pattern of Vegetable Farmers and Environmental Impact of Pesticide Use: Evidence from Kalpitiya Divisional Secretariat Division, Puttalam District, Sri Lanka

K. Prasannath[1]*, V. Prasannath[2], M.F.F. Nasla[1]
[1]Department of Agricultural Biology, Faculty of Agriculture, Eastern University, Sri Lanka
[2]Department of Biosystems Technology, Faculty of Technology, Eastern University, Sri Lanka

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***Corresponding author**
K. Prasannath

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Abstract: Utilization of synthetic pesticides has been the chief means of controlling pests and diseases in crop farming. In this context, a study was undertaken to assess the pesticide usage pattern, evaluate the socio-economic factors which influence the usage of agrochemicals and determine the environmental impact of pesticide use in vegetable cultivation in Kalpitiya Divisional Secretariat (DS) division of Puttalam district, Sri Lanka. Hundred farmers were selected through stratified random sampling method from Kalpitiya DS division, which is a predominantly vegetable cultivating area. Well-structured, pre-tested questionnaires were used to collect data during *Maha* 2016/2017 cropping season. Descriptive statistics and probit model were used to analyze the data. Field Use Environmental Impact Quotient (FEIQ) of pesticides used by the farmers was also determined. The results of the study showed that the foremost constraint in the vegetable cultivation was insect damage (92%) followed by diseases (84%) while weed problem was minimal (22%). The average extent of cultivation was 2.18 acres where only 14% of respondents' cultivated land size was greater than 4 acres. Percentage of farmers having more than 5 years of experience in cultivation was 74%. Only 36% of farmers received extension service. Pesticides were applied on vegetable crops by 94% of the farmers. On an average, pesticide application frequency was 4.4, whereas pesticide use (active ingredient) by weight on the vegetable crops was 0.58 kg ha^{-1}. The average FEIQ of pesticide use in the study area was 75.28 ha^{-1}. Probit analysis displayed that educational level, farming experience and access to extension service had a positive and significant ($p<0.05$) relationship on farmers awareness about risks of pesticide use. Vegetable farmers of this area use extensive amount of pesticides which cause more damage to the environment. Therefore, it is recommended to deliver information to the farmers about the cautious use of toxic pesticides and promote the use of less toxic pesticides.
Keywords: Environmental impact quotient, Pesticide use, Socio-economic factors, Vegetable cultivation.

INTRODUCTION

One of the foremost problems in agricultural production is crop damage by pests [1]. At present, a common way to control pests is the use of synthetic pesticides, but they have a destructive influence on the natural environment [2]. Pesticide use continued to keep on the most popular method of pest control by farmers even though pesticide showed harmful effects on human health, environment and crop ecosystem [3]. Misuse and Overuse of pesticide is same among farmers of developing economies and Sri Lanka is no omission. Sri Lankan farmers have a tendency to disregard technical recommendations and base usage on their own experience often leading to unselective application [4].

Kalpitiya DS division is a predominantly vegetables cultivating area in the Puttalam district of Sri Lanka. The farmers of this area experience different types of problems during cultivation. In order to manage these problems, farmers apply chemical pesticides more number of application and high dosage of pesticides.

The amount of active ingredients by weight is not a strong indicator to measure the impact of pesticides use because the toxicity of the pesticides to humans and the environment is not considered. Although pesticide use frequency is a good indicator to measure the impact, it does not consider the qualitative aspect of the use of more toxic pesticides of low dosage [5]. The field use environmental impact quotient (FEIQ) developed at Cornell University, USA, considers the toxicological aspect of the pesticides used. The EIQ was helpful in providing information on the potential environmental effect of current application practices.

With this background, the objectives of the study were to (i) assess the pesticide usage pattern, (ii) evaluate the socioeconomic factors which influence the usage of agrochemicals and (iii) determine the environmental impact of pesticide use in vegetable cultivation in Kalpitiya, Sri Lanka.

MATERIALS AND METHODS

The study area was Kalpitiya DS division of Puttalam district, which is a typical agricultural area that is threatened by high pesticide use in the Puttalam district and even in Sri Lanka. Hundred vegetable farmers who cultivate chilli, red onion and vegetables in more than 0.25 ha were randomly selected through stratified random sampling method from Kalpitiya DS division, which is a predominantly vegetable cultivating area. Pre-tested structured questionnaires were used to collect data during *Maha* 2016/2017 cropping season.

The indicators to measure the pesticide usage were: (i) The FEIQ of pesticide use, (ii) the amount of active ingredients (a.i.) of the pesticide used, by weight, and (iii) pesticide application frequency. Pesticide use (a.i.) per hectare of vegetable production was calculated from the total pesticide used by the farmers. The mean frequency of pesticide applications by the sampled farmers was also calculated. The environmental impact of pesticide use was measured with respect to the environmental impact quotient (EIQ) [6]. The FEIQ was calculated by multiplying the reference EIQ with the percent of active ingredient and dosage rate of pesticide per hectare. The purpose for which EIQ had been used was to make an environmental impact assessment of the vegetable cultivation.

Field Use EIQ = EIQ of a pesticide x
% active ingredient of the pesticide x
Dosage rate per ha

The average environmental impact of pesticide use was calculated by summing over the field use EIQ and dividing it by the number of farmers surveyed.

Descriptive statistics and ordered probit model were used to analyze the data.

Ordered Probit Model:

$$Y = \beta_0 + \beta_1 X1 + \beta_2 X2 + \beta_3 X3 + \beta_4 X4 + \beta_5 X5 + \beta_6 X6 + \beta_7 X7 + \varepsilon$$

Y=Ordered Awareness Y = 1, if Scale Scores < (X - SD)
Y = 2, if (X - SD) < Scale Scores < (X + SD)
Y = 3, if Scale Scores > (X + SD)

X1 = Age
X2 = Family Size
X3 = Farming Experience
X4 = Educational Level
X5 = Income
X6 = Land Area
X7 = Access to extension service (Yes = 1, No = 0)

RESULTS AND DISCUSSION

Socio-economic characteristics of the vegetable farmers

The average age of the farmer was 45.32 years with an average family size of 4.92. Results showed (Table 1) that the average extent of cultivation was 2.18 acres where only 14% of respondents' cultivated land size was greater than 4 acres. Farmers had 15.31 years of experience on average in cultivation. Percentage of farmers having more than 5 years of experience in cultivation was 74%. Number of years they attended schools was 10.23 where 62% of the respondents had education level of grade 5 to grade 11. The vegetable farmers received an average monthly income of Rs. 37,850. Only 36% of farmers received extension service.

Table-1: Selected socio-economic factors of the farmers

Variables	Mean	Standard Deviation
Age (Yrs)	45.32	11.68
Family Size (No.)	4.92	1.44
Education (Yrs)	10.23	2.74
Experience (Yrs)	15.31	5.32
Monthly Income (Rs.)	37,850	12,310
Land (ha)	2.18	0.43

Different vegetables cultivated by the sample farmers

The most cultivated vegetables in the area was cabbage (24%) followed by onion and beetroot each of 18%. The percentage of vegetable cultivated in the area is given in Table 2.

Table-2: Different vegetables cultivated in Kalpitiya area

Vegetables	Percentage
Cabbage	24
Onion	18
Beetroot	18
Chilli	16
Raddish	10
Spinach	08
Longbean	06

Kinds of stresses experienced in vegetable cultivation

The results of the study indicated that the foremost problem in the vegetable cultivation was insect damage followed by diseases while weed problem was minimal compared to pests and disease problems (Table 3). More destructive insect pests and diseases of major crops are presented in Table 4.

Table 3: Problems faced by vegetable farmers

Problems	Percentage (%)
Insect pests	92
Disease	84
Weeds	22
Other means	48

Table-4: Major insect pests and diseases of vegetable crops in Kalpitiya

Crop	Insect pest	Disease
Cabbage	Caterpillar complex	Damping off
Onion	Leaf eating caterpillar	Twister
Beetroot	Leaf miner	Leaf spot
Chilli	Thrips	Leaf curl

Management of pest problems

In order to manage the insect pests, diseases and weeds problems most of the farmers use chemical pesticides (94%) and 72% of the farmers mange by mechanical means. Other management mechanisms as in Table 5 include proper planting time (48%), crop rotation (32%) and using resistant varieties (18%) so as to succeed from the above various problems. In general, farmers assume that the only solution to pest problems is to spray more frequently and using different types of pesticides [7].

Table-5: Coping mechanisms to manage pests

Vegetables	Percentage
Chemical pesticides	94
Mechanical means	72
Proper planting time	48
Crop rotation	32
Resistant varieties	18

Probit regression analysis

The results of the probit analysis of the 100 observations are presented in Table 6. Results revealed that educational level, farming experience and access to extension service had a positive and significant ($p<0.05$) relationship on farmers awareness about risks of pesticide use. Farming experience is a key factor for wise decisions of farmers in the field [8].

Table-6: Factors influencing farmers' awareness about risks of pesticide use

Number of obs. =100 LR chi^2 = 49.94
Prob > chi^2 = 0.0000 Pseudo R^2 = 0.4351

Variables	Coefficient	Std. Err.	P Value
Age	-0.0739	0.2452	0.731
Family Size	-1.25808*	0.1569	0.088
Farming Experience	0.0335**	0.1239	0.029
Educational Level	0.1889***	0.0643	0.000
Income	3.43e-06	2.61e-06	0.413
Land Area	-0.4792	0.1839	0.841
Access to Extension Service	2.5159***	0.8231	0.001

(*Significant at 0.1 level, **Significant at 0.05 level, *** Significant at 0.01 level)

Usage of synthetic pesticides by the vegetable farmers

Around 56% and 54% of farmers used coragen and calcrone insecticides respectively. Among fungicides, captan (54%) and antracol (48%) were applied by more farmers. Most of the farmers used goal weedicide in the Kalpitiya area.

Pesticide use (a.i) by weight and pesticide use frequency

Farmers on an average applied 4.4 pesticide applications on vegetable crops. Pesticide use by weight on the vegetable crops was 0.58 kg ha^{-1} (a.i). In view of the low-dose pesticides replacing high-dose pesticides, the amount of active ingredients by weight is not a robust indicator to measure the impact of pesticide use as the toxicological aspects of pesticides are not considered [9]. Even though pesticide use frequency is a good indicator to measure the impact, it does not consider the qualitative aspect of using more toxic pesticides of low dosage.

Field use environmental impact quotient of pesticide use

FEIQ developed at Cornell University, in the United States, considers the qualitative toxic aspects of the pesticides used. The average field use EIQ of pesticide use in the Kalpitiya area was 75.28 ha^{-1}. Table 7 provides FEIQ value and three EIQ values for important components of agricultural systems: farm worker, consumer and environment. FEIQ is the average of the EIQ value for farm worker, consumer, and ecological components.

Table-7: FEIQ and three EIQ values for components of agricultural systems in the study area

FEIQ (ha^{-1})	Environment impact components		
	Consumer	Farm worker	Environment
75.28	23.0	53.94	148.9

The results indicated the farm worker component was 2.4 times greater than the consumer component, and the environmental factors were rated 2.8 times greater than the farm worker component and 6.5 times higher than the consumer component (Table 7), revealing the probability of a higher impact on the environmental component. Farm workers spraying pesticides without wearing protective clothing may have serious consequences on their health. Vegetable growers not observing pre-harvest intervals put consumers at greater risk.

CONCLUSIONS

Insect pest damage was the chief risk experienced by the farmers and 94% of farmers are dependent on chemical pesticides. The aaverage FEIQ of pesticide use in the study area was 75.28 ha^{-1}. Vegetable farmers of this area used extensive amount of pesticides. Effective extension services should be increased in order to educate the farmers and motivate farmers to better use of pesticides through generating awareness about ill effects of chemical pesticides. Farmer training campaign should be introduced on alternative aspects of pest control strategies such as integrated pest management.

REFERENCES

1. Tilman D, Cassman KG, Matson PA, Naylor R, Polasky S. Agricultural sustainability and intensive production practices. Nature. 2002 Aug 8;418(6898):671.
2. Basiouny AL, Hamadah KS, Tanani MA. Efficacy of the wild plant *Fagonia bruguieri* (Zygophyllaceae) on acid and alkaline phosphatase activities in the desert locust *Schistocerca gregaria* (Orthoptera: Acrididae). Egyptian Academic Journal of Biological Sciences. 2010; 2(2): 1-10.
3. Administration Report. Department of Agriculture, Vavuniya. 2005.
4. Wilson C, Tisdell C. Why farmers continue to use pesticides despite environmental, health and sustainability costs. Ecological economics. 2001 Dec 1;39(3):449-62.
5. Sharma R, Peshin R, Shankar U, Kaul V, Sharma S. Impact evaluation indicators of an Integrated Pest Management program in vegetable crops in the subtropical region of Jammu and Kashmir, India. Crop Protection. 2015 Jan 1;67:191-9.
6. Kovach J, Petzoldt C, Degni J, Tette J. A method to measure the environmental impact of pesticides. 1992.
7. Prasannath K, Prasannath V, Sinthuja S. Study on Risk Identification and Pesticide Usage in Paddy Cultivation in Alayadivembu Divisional Secretariat Division of Ampara District, Sri Lanka. Proceedings of the 4th International Conference on Agriculture and Forestry. 2017; 3: 40-45.
8. Nagenthirarajah S, Thiruchelvam S. Knowledge of Farmers about Pest Management Practices in Pambaimadu, Vavuniya District: An Ordered Probit Model Approach. Sabaragamuwa University Journal. 2008; 8(1): 79–89.
9. Pimentel D, Peshin R, editors. Integrated pest management: pesticide problems. Springer Science & Business Media; 2014 Apr 10.