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Farmers Awareness on Agrochemical Usage and Its Effect on Human Health within Kurunegala District

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ABSTRACT

The use of pesticides and fertilizer usage in agriculture were grown dramatically over the past 30 years. Currently, approximately 600 active pesticide ingredients were used and results in both acute and chronic health effects. Contamination of soil and water through human and industrial waste and agrochemicals were a universal problem and a major issue in developing countries. The objective of the study was to explore the awareness of paddy farmers in Kurunegala district on existing knowledge on agrochemical usage and their effect on human health. The data were collected through a structured questionnaire *via* face to face interviews from 100 farmers of ten villages representing in Kurunegala district, from March to April 2016. Descriptive statistic and inferential statistics were used to analyze the data in Statistical Package for the Social Sciences (SPSS) statistical package software. Multinomial logistic regression was used to predict the relationship between age categories (20-39, 40-59 and 60-79) and human health. This study revealed that, the majority of the farmers were applied synthetic fertilizer (71%) for their cultivations as they received fertilizer subsidy from the government. Farmers were taken their drinking water from wells (95%) and water was purified (53%) before drinking as they were aware of different health issues coming from drinking water. The model was statistically significant ($P < 0.05$) at the 95% confident level. Further, there is a relationship among the human health and pesticide usage, fertilizer usage and drinking water in the farmers in Kurunegala district. All age categories were not concerned about agrochemical usage. Further, farmers who were below the 60 age group were highly concern about drinking water than the above 60 age group.

KEYWORDS: Agrochemical, Chronic kidney disease, Drinking water, Inorganic fertilizer, Insecticide

INTRODUCTION

The worldwide consumption of pesticides has reached 2.6 million metric tons (Aspelin, 1997) and 85% is used in agriculture. However, the largest volume of pesticide is used in developed countries, further, the usage of pesticide were growing rapidly in developing countries (World Research Institute, 1999).

Continuous use of agrochemicals have caused damage to the environment, affected human ill health, negatively impact on agricultural production and reduced agricultural sustainability (Widawsky *et al.*, 1998). Use of pesticide in Sri Lankan agriculture began in early 1950s, and since then the amounts used have shown a steady increase by almost 110 times between 1997 and 1995 (Wilson, 1998).

Further, the agrochemical usage has been a dangerous issue to agriculture production, soil-water environment and human health in paddy and vegetable cultivation in Sri Lanka (Wimalawansa and Wimalawansa 2014). However, the misuse and overuse of pesticide are very common among Sri Lankan farmers (Nagenthirarajah and Thiruchelvam, 2008). Currently, approximately 600 active pesticide ingredients are used and results in both acute and chronic health effects (Dennis, 1993). Human health hazards like cancer, heart disease, diabetes, kidney ailments are known to be the major outcomes of careless use of pesticide (Selvarajah and Thiruchelvam, 2007). Chronic kidney disease (CKD) is the most prevalent among male farmers in the 40 to 60 age group engaged in rice cultivation. (Centre for Science and Environment, 2012).

The fertilizer subsidy has been given to farmers by the government more than four decades in Sri Lanka (Ekanayake, 2009) and farmers expect it to be continued in the future. The main objective of the subsidy scheme was to make fertilizer available as cheaply as possible in order to encourage its wider use thereby increasing agriculture productivity (Ekanayake, 2009). However, at present, around 600,000 tons of solid fertilizers and 250,000 L of liquid fertilizers are imported to Sri Lanka annually (Weerarathna, 2013).

Agrochemicals continue to leaching out to streams and shallow wells, contaminating drinking water sources (Susset and Grathwohl, 2011). A few chemical contaminants have been shown to cause adverse health effects in humans as a consequence of prolonged exposure through drinking-water (Fawell and Hulsmann, 2009). Water treatment is required to remove or destroy pathogen and chemicals. In many cases (e.g. poor quality surface water), multiple treatment stages are required, including, for example, coagulation, flocculation, sedimentation, filtration and disinfection (Anon, 2011).

The specific objective of this study was to explore the awareness of paddy farmers in Kurunegala district on existing knowledge on agro chemical usage and their effect on human health.

METHODOLOGY

Study Area

This study was carried out in the Kurunegala district. There are about 1.51 million of population living in this district in 4816 km^2 area. More than 70% of farmers are cultivating paddy and vegetables. Study area was selected by using ten divisional Grama Niladari (GND) divisions including namely Brahmanagama (IL_3), Danikithawa (IL_3), Huruggamuwa (IL_3), Ipalogama (IL_3), Karakole (IL_3), Kithulwehara (IL_3), Mirihanegama (IL_3), Nabadawewa (IL_3), Othota (IL_3) and Yatihena (IL_{1a}) in Kurunegala district.

Data Collection

The study mainly focus on the paddy farmers living in Kurunegala district. Primary data was collected by means of structured questionnaire during the period from March to April 2016. Farmers were randomly selected from 10 villages in Kurunegala district. The ten farm families were accounted from each village.

A pretested questionnaire was used to gather the data from respondents *via* face to face interviews. The questionnaire consisted of four main question categories including, general information of the farmer, farm information, problem associated with agrochemical usage and attitudes of the respondents regarding, agrochemicals, agrochemical usage, chemical fertilizer usage and drinking water and it's quality. The knowledge on the usage of pesticide, synthetic fertilizer and the drinking water were measured by using five point Likert scale statement ranging from strongly disagree to strongly agree.

Data Analysis

Data was analyzed by using both descriptive and inferential statistics with the use of (Statistical Package for the Social Sciences) SPSS version 16. Descriptive analysis was performed to summarize and understand the baseline information of the selected respondents.

Multinomial logistic regression was carried out to predict the nominal dependent variable, which has more than two categories with selected independent variables. It can also be used for ordinal variables as well. In this study the multinomial logistic regression was used to predict the relationship between three different age categories and factors which affect the human health.

Multinomial Logistic Regression

The function derived for the Multinomial logistic regression model was expressed as,

$$(Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3)$$

Where, Y - Age categories
β_0 - Intercept
β_1, β_2 - Regression coefficients
X_1 - Pesticide usage
X_2 - Fertilizer usage
X_3 - Drinking water

RESULTS AND DISCUSSION

Descriptive Statistics of the Sample

Majority of the respondent were belong to 40-59 age group (56%) and the 20-39 age group respondents 23% while, 21% respondents were represented above 60 group. Although, 10% of respondents completed their primary education, majority of them were educated up to O/Ls (59%).

Each and every human being must have a reliable, clean drinking water source. According to the study, majority of respondents (95%) were collecting their drinking water from wells and others (5%) were taking water from tube wells (Table 1). Agrochemicals continue to leaching out to streams and shallow wells, contaminating drinking water (Susset and Grathwohl, 2011). As a result of that, people believe that, different health issues were risen from drinking water. Further, because of widespread chemical pollution, people have no idea whether their well water is safe to drink. Although the majority of respondents' (52%) water sources were situated more than 200 m away from cropping fields, the highest percentages (53%) of respondents were adhered to purify water before drinking by boiling and filtering.

Agricultural sector is one of the main culprits polluting the environment (soil and water) through agrochemical pollution, particularly by indiscriminate and over usage of chemical fertilizers, herbicides, and pesticides (Wittmer *et al.*, 2010). It was evident that, although the health issues were raised related with the agrochemical usage in Sri Lanka, farmers were not tending to organic agriculture from traditional agriculture. Because, the governments have provided support to stimulate paddy production by way of introducing guaranteed price schemes (Ekanayake, 2009) therefore, farmers were applied fertilizer for their cultivations successfully.

Table 1. Descriptive statistics of the sample

Variables	Percentage (%)
Age (years)	
20-39	23
40-59	56
Above 60	21
Education level	
Up to grade 5	10
Up to O/L	59
Up to A/L & above	31
Water source of drinking water	
Well water	95
Tube well water	5
Water treatment	
Boiling	22
Filtering	31
Not treatment	46
Distance from farm to drinking water bodies	
Within 100m	31
Within 200m	12
Above 200m	57
Fertilizer usage for cultivation	
Only chemical fertilizer	71
Chemical fertilizer with organic fertilizer	29
Amount of fertilizer usage	
Recommend level	71
More than recommend	17
Less than recommend	12
Pest control method	
Only pesticide usage	100
Other methods	-

According to this study, majority of farmers (71%) were applying synthetic fertilizer (Figure 1). But, it is interesting to note that, 29% of farmers are tending to use organic and inorganic fertilizer together for their cultivations.

The majority of the respondents (71%) were applying chemicals at the recommended rate (Table 1). However, Sri Lankan farmers use pesticides with higher concentrations with increased frequencies and mix some pesticides together to combat pesticides resistance when compared with other Asian countries, (Chandrasekera *et al.,* 1985). According to this study, 17% of farmers used to apply fertilizer more than the recommended rate. Further, the previous studies have revealed that, the heavy use of fertilizers and pesticides was recorded in Nuwara Eliya area more than the recommended levels and as a result of that, it was directly affected to their water resources (Henegama *et al.*, 2013). As a result of that, there were high levels of nitrate and basic cations were recorded in well-water in crop fields in Nuwara Eliya (Rajakaruna *et al.,* 2005). Therefore, in near future the same problem will be evolved in Kurunegala district if the farmers are not adhered to apply fertilizer at the recommended rate.

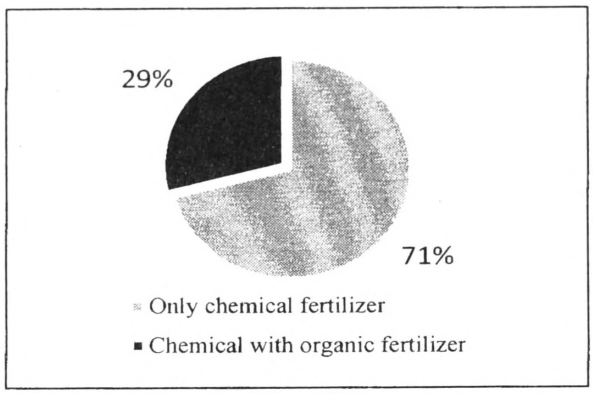

Figure 1. Chemical fertilizer usage

This study revealed that the majority of farmers (71%) are still using the synthetic fertilizer for their cultivations. However, it is interesting to note that, 29% of farmers were using both organic and inorganic fertilizer together for their cultivation, rather than using only synthetic fertilizer. Furthermore, fertilizer subsidy that has been given to the paddy farmer also tends to promote inorganic agriculture in the selected areas.

Multinomial Logistic Regression Analysis

According to the results, the model was statistically significant (0.05>P) at the confident level of 95% (Table 2).

Table 2. Model fitting information

Model	Chi-square	Degrees of freedom	P value
Intercept	-	-	-
final	190.49	118	0.000*

**Significant at 5% level (0.05>)*

According to the Table 3, it is envisaged that the all three factors namely pesticide usage, fertilizer usage and drinking water usage, which affect the human health are statistically significant.

Table 3. Likelihood ratio tests

Effect	Chi-square value	Degrees of freedom	P value
Intercept	0.000	0	-
Pesticide usage	85.647	42	0.000*
Fertilizer usage	65.421	30	0.000*
Drinking water	64.719	34	0.001*

**Significant at 5% level (0.05>)*

Irrespective to the demographic factors (age, gender, education level *etc.*), these three variables have higher impact on the health conditions of the households in the selected area. There is no usually any interest in the model intercept (i.e., the intercept in Table 3).

The results obtained from the Multinomial logistic regression were reported in the Table 4.

Table 4. Parameter estimates table

Age[a]	Factors	Coefficient	SE	P value
20-39	Intercept	-16.093	1.750	0.000*
	Pesticide usage	0.723	0.986	0.464
	Fertilizer usage	-0.411	0.940	0.662
	Drinking water	15.839	1.163	0.000*
40-59	Intercept	-14.249	1.312	0.000*
	Pesticide usage	-0.599	1.033	0.562
	Fertilizer usage	-0.870	0.876	0.321
	Drinking water	16.811	0.000	0.001*

*S*ignificant at 5% level (0.05>),* [a]The reference category is: 60-*80; df=1; SE-standard error*

The dependent variable (age of the respondents) was categorized into three categories as 20-39 age category, 40-59 age category and 60-80 age category. The reference age category was 60-80.

The second set of coefficients were found in 40-59 age category. Pesticide usage and fertilizer usage for both sets of coefficients were not statistically significant (P>*0.05*). However, drinking water for both sets of coefficients were statistically significant (P<*0.05*). It was evident that, these two categories were concerned about drinking water than the 60 – 80 age group. Thus, other two factors namely, pesticide usage and fertilizer usage were not considered by the all three age categories.

CONCLUSIONS

The study revealed that, the majority of the farmers applied synthetic fertilizer for their cultivations as they were received fertilizer subsidy from the government. Although, farmers were taking their drinking water from wells, water were purified before drinking as they were aware of different health issues coming from drinking water. The findings of the study revealed that, there is a relationship among the human health on pesticide usage, fertilizer usage and drinking water of the farmers in Kurunegala district.

All age categories were not concerned about agrochemical usage. Further, farmers who were below the 60 age group were highly concern about drinking water than the above 60 age group.

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