EFFECTS OF AGRICULTURAL PESTICIDE UTILIZATION ON FARMERS HEALTH IN EGBEDA LOCAL GOVERNMENT AREA, OYO STATE, NIGERIA

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Abstract

Occupational and environmental exposures to pesticides cause a wide range of human health problems. This study assessed the health effect of pesticide use in Egbeda Local Government Area of Oyo State with from socioeconomic point of view by identifying the various pesticides used, describing the health signs and symptoms associated with pesticide application and determining the health effects of pesticide application on farm households. The survey instrument was a well-structured questionnaire administered to respondents through multiple stage sampling technique. A total of 120 respondents were interviewed for the study. Data collected were analysed using descriptive statistics and Tobit regression model. The results showed that commonly used pesticides comprised of herbicides (61.67 %), fungicides (20.0%) and insecticides (18.33%). Majority (95%) reported that they or someone in their family had suffered from pesticide-related health signs and symptoms during or after application of pesticides. The effect of pesticides application on farmer's health's was captured by exposure, frequency of exposure and pesticide cocktails. The coefficient of exposure, frequency of exposure and pesticide cocktails were positive and significant at $p<0.01$, $p<0.1$and $p<0.05$ respectively. It is therefore recommended that the awareness of farmers and authorities needs to be raised regarding the use of protective equipment and correct procedures when handling pesticides and, also, that there should be stricter enforcement of existing pesticide regulation and monitoring policies to minimize the threats that farmers' current practices pose to their health and the livelihood sustainability.

Keywords: Pesticide use, Health effects, Tobit regression, Oyo State, Nigeria

Introduction

Mortality and morbidity rates in agricultural production have remained consistently high throughout the world in the last decade in contrast to other dangerous occupations (International Labour Organization ILO, 1997). Agricultural farm workers are at a very high risk of occupational diseases due to exposure to agrochemicals resulting from inadequate education, training and safety systems. In developed countries such as the US, farmers and farm workers comprise only 3 percent of the workforce, but they account for as much as 8% of all work-related accidents (Médecins Sans Frontières: MSF, 2005). However, in developing countries, less than 20 percent of the world production of agrochemicals are consume, which are responsible for as much as 1.1 million (70 percent) of the total cases of acute poisoning in the working population (United States Environmental Protection Agency: US EPA, 2005).

Modern farming relies on many chemicals such as fertilizers, pesticides and crop preservatives to produce and preserve an abundance of high-quality food. Pesticides are chemical substances that derive their name from the French word "Peste", which means pest or plague and the Latin word "caedere", to kill (Akunyili and Ivbijaro, 2006). Pesticide therefore can be defined as any chemical substance or mixture of substances intended for preventing, destroying, repelling, or mitigating the effect of any pest of plants and animals. They include herbicides, insecticides, rodenticides, fungicides, molluscides, nematicides, avicides, acaricides, repellents and attractants used in agriculture, public health, horticulture, food storage or achemical substance used for a similar purpose (NAFDAC: National Agency for Food and Drug Administration and Control, 1996).Pesticides are widely used in most sectors of the agricultural production to prevent or reduce losses by pests and thus, can improve yield as well as quality of the produce, even in terms of cosmetic appeal, which is often important to consumers (Oerke and Dehne, 2004; Cooper and Dobson 2007).

In Nigeria, pesticides have proven to be indispensable tools in both pre-harvest and post- harvest losses by combating damage from pests and ensuring sustainable food production with improved yield and greater availability of food throughout the year. For example, without the use of pesticides in rice and cocoa production, about 45 percent of total production would be lost to pests and diseases (Tijani, 2006b).However, increasing intensification of agricultural production and food security in Nigeria have led to increased health and environmental concerns and the productivity-enhancing effects of pesticides have been valued greatly, as most studies rarely take into consideration their effects on the environment and on farmers' health (Osibanjo, 2001; Konya, 2005; Adeniran *et al*., 2006).According to Dey *et al*., (2013), pesticides are applied to the environment with the aim of suppressing the impact of plant and animal pests and to protect agricultural and industrial products. For sustainable agriculture and protection of the environment and human health, the importance of using safe pesticides has assumed global importance subsequent to the 'Earth Summit' in 1992.

Pesticides can also improve the nutritional value of food and sometimes its safety (Boxall, 2001; Narayanasamy, 2006). There are also many other kinds of benefits that may be attributed to pesticides, but these benefits are often unnoticed by the general public (Cooper and Dobson 2007; Damalas, 2009). Thus, from this point of view, pesticides can be referred to as an economic, labor-saving and efficient tool of pest management with great popularity in most sectors of the agricultural production (Damalas and Eleftherohorinos, 2011).

Crop farmers use a wide range of pesticides at different levels to reduce losses from pests and diseases. However, despite the popularity and extensive use of pesticides by farm households, serious concerns about the health risks arising from the exposure when mixing and applying pesticides or working in treated fields and residues on food and in drinking water for the general population have been raised (Maroni, 2006; Soares and Porto, 2009). These activities have caused a number of accidental occupational poisonings, and even the use of pesticides routinely can pose serious health risks to farmers both in the short and the long run and can degrade the environment. In developing countries, however, farmers face great risks of exposure due to the use of toxic chemicals that are banned and/or restricted in other countries, incorrect application techniques, poorly maintained or totally inappropriate spraying equipment, inadequate storage practices, and often the reuse of old pesticide containers for food and water storage (Ibitayo, 2006; Asogwa and Dongo, 2009).

Acute and chronic pesticide poisoning usually results from consumption of contaminated food, chemical accident in industries and occupational exposure in agriculture. Pesticides are known to find their way in the blood systems of human beings through four major routes which are the mouth, nose, intact skin and the eyes. According to U.S. Environmental Protection Agency (2007), health effects of pesticides may be acute or delayed (chronic) in those who are exposed. Several adverse health effects are known to result from exposure to pesticides including temporary acute effects like abdominal pain, dizziness, headaches, nausea, vomiting, skin problems, irritation of eyes and excessive salivation as well as chronic diseases like cancer, reproductive and developmental disorders. Effects on the Central Nervous System (CNS) like restlessness, loss of memory, convulsions and coma are also common. In addition, effects on parasympathetic and sympathetic nervous system have been widely reported including respiratory paralysis which is fatal (US EPA, 2005).

Poorly regulated and unsafe use of pesticides coupled with the absence of adequate education has led to increasing pesticide impact on public health and, in particular, on the health of farm workers (Tijani, 2006a). At the same time, the indiscriminate use of toxic substances has become a matter of national concern in Nigeria following revelations about high levels of DDT in the environment and human breast milk (Osibanjo, 2002). Dey*et al*., (2013) posited that the public health effects of pesticides have long been known and the undesired effects of chemical pesticides have been

recognized as a serious public health concern during the past decades. However, the methods for safe storage, handling and application of pesticides are not widely used in most developing countries (Dinham, 2003), particularly in Africa (Williamson *et al*., 2008) posing serious health threats to resource-poor rural farmers as they are users of largest proportions of chemical pesticides (Oluwole and Cheke, 2009).

In view of the adverse health consequences of pesticides by some farmers; it is therefore becomes imperative to examine the health issues of resource-poor rural farmers chronically exposed to pesticides form socioeconomic point of view in Oyo State south-west Nigeria given the intensive agricultural practices in the area using Egbeda Local Government Area as a case study. Specifically, the study described the socioeconomic characteristics of the farm households,, identified the common pesticides used, described the prevalence of ill health associated with pesticides and determined the effect of pesticides on farm households' health in the study area.

Methodology

Study Area: The study was carried out in Egbeda Local Government Area of Oyo State, South-West Nigeria. It has an area of 191 km² and a population of 281,573 (NPC, 2006). It is one of the 33 LGAs of the state and one of the eleven (11) LGAs that make up Ibadan Metropolis. The town is located on latitude $7^0$21'-8^0N and longitude $40^0$2' - $4^0$28'E with a total land area of approximately 191km^2. The Egbeda LGA was carved out of the old Lagelu LGA in 1989 (Lawal, *et al*., 2011). Egbeda LGA is subdivided into 11 wards: Erunmu, Ayede/Alugbo/Koloko, OwoBaale/Kasumu, Olodan/Ajiwogbo, Olodo/Kumapayi I, Olodo II, Olodo III, Osegere/Awaye, Egbeda, Olode/Alakia, and Olubadan Estate. It is bounded in the East by Osun River, in the North by Lagelu Local Government, in the South by Ona-Ara local Government and in the West by the Lagos-Ibadan Express Road. The Local government currently has four (4) urban political wards and seven (7) rural wards covering a total of 136.83km^2.

Sampling Procedure and Data Collection: Multi-stage sampling technique was used to collect the data involving a four - stage sampling procedure. Four (4) wards were selected from the seven (7) rural wards in the local government in stage one. In the second stage, six (6) villages were randomly selected from each of the selected wards, adding it up to 24 villages. In the third stage, five (5) residential buildings were randomly selected in each of the village making a total of 120 residential buildings. One farm household was selected each of the residential building making a total of 120 respondents. Data used for the study were collected with the aid questionnaire. Data were collected on socioeconomic characteristics, commonly used pesticides and practices, signs and symptoms of illness related to pesticide exposure.

Analytical Technique: Both descriptive and quantitative techniques were used to analysed the data. Descriptive statistics were used to describe the socio-economic characteristics, identify the common agrochemicals used, describe the prevalence ill health associated with pesticides application in the study area while Tobit regression model was used to determine the effects of pesticides utilization on health of farm households in the study area. Tobit Regression model was represented mathematically as:

$$Y_{ij} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + e_t$$

Where;

Y = Health Index = $\frac{\text{individual self reported pesticide associated signs and symptoms}}{\text{Total number of identified health signs and symptoms in the study area}}$

X_1= Age (years)

X_2= Gender (Male=1, Female=0)

X_3= Marital Status (Married=1, Otherwise=0)

X_4= Education (number of years of schooling)

X_5= Main Occupation (farming=1, otherwise=0)

X_6= Farming Experience (years)

X_7= Extension contact (yes=1, no=0)

X_8= Exposure (sprayer = 1, non-sprayer = 0)

X_9= Frequency of exposure/duration of spray (number of application/year)

X_{10} =pesticide cocktails (yes=1, no=0)

Results and Discussion

Socioeconomic Characteristics of Farm Households:

Table 1 presents the socioeconomic characteristics of respondents sampled for this study. Majority (93.3 percent) of the farmers interviewed were male with mean age of 52 years. Male headed households made up 76 % of the total respondents. Of the 120 farmers interviewed, 44 percent were educated up to tertiary level and this implies that they should be able to read and understand instructions on pesticide containers' labels. It is worthy of note that majority of the farmers who

were either illiterate or with only primary school education depended on explanations from other farmers and/or pesticide suppliers.

Types of Pesticides Commonly used By Farmers:

This section described the types of pesticides used and World Health Organisation (WHO) classification. The pesticides used in the study area range from moderately hazardous to highly hazardous categories, and thus, all of them have detrimental health effects as reported by various sprayers or workers from time to time. Out of the eleven (11) identified pesticide formulation types used by farmers in the area, most were herbicides, especially Paraquat, commonly used by 89.3 % of the farmers (Table 2), because weeds were the most serious threat to crop production. Herbicides were followed in rank of importance by fungicides (20.00 %) and insecticides (18.33 %). Lindane and monocrotophos, which were used by 48 and 62 % of farmers respectively, belong to a group of pesticides popularly known as the 'dirty dozen' (Pesticide Action Network UK (PAN) 1993; 2009). These pesticides have been banned, severely restricted or deregistered in some countries because of their established hazardous effects on humans and the environment. Also, 55 percent of farmers used Ridomil plus (Mancozeb). This pesticide has no known WHO hazard classification class but it has been reported to cause cancer and disrupt the endocrine system by the US Environmental Protection Agency and the World Wildlife Fund respectively (PAN, 2009). Therefore, it is declared 'not for sale' but to be distributed by agricultural agencies only. However, the pesticide was freely available in the open markets for the farmers to purchase in Nigeria. This confirms that the pesticides regulation policy in the state and indeed in Nigeria as whole is poorly implemented, as reported in line with Osibanjo (2001).

Exposure and Health Impairment: Farmers' Reports of Symptoms of Pesticide Poisoning:

Medical examinations of farm households occupationally exposed to pesticides was beyond the scope of this study. This study relied solely on self-assessed/reported health effects of pesticides by asking the farmers if they experienced any health weakness (discomfort) in their day-to-day handling of chemical pesticides. The primary exposure status relative to pesticides was ascertained based on whether or not the farmer sprayed pesticides. Out of the 120 farmers interviewed, 78.3% reported that they sprayed pesticides themselves. The remaining 21.6 % ("non-sprayers") were involved in other agricultural activities (weeding, replanting, watering, etc.).

Besides, 95percent reported that they or someone in their family had suffered from pesticide-related health symptoms during or after application of pesticides. This is usually the situation in most developing countries where farmers sometimes report ill health and cases of hospitalization following pesticide application (Wilson and Tisdell, 2001; Atreya, 2005; Rao *et al*., 2005; Williamson *et al*., 2008). The sprayers were however asked whether they have experienced these

signs and symptoms during or immediately after pesticide spraying. Some of the signs and symptoms related to pesticides application with a higher prevalence were chest pain/burning sensation (82.5 %), skin redness/white patches (68.33 %), shortness of breath/cough (64.17), excessive salivation (60 %), burning/stinging/itching eyes (57.5%) among others. However, these symptoms were considered as common phenomena and had attributed them to fatigue and tiredness after working in the field. However, upon asking them whether they believed that pesticides could be dangerous to their health and the environment, they all believed this to be true. This indicated that the farmers were well aware of possible health effects of pesticides use, but their actions implied that they did not adhere strictly to the instruction on usage. Williamson *et al*., (2008), reported that this is also a usual practice among farmers in Benin, Ethiopia, Ghana and Senegal. Continuous exposure to pesticides can lead to an array of health effects, depending on the pesticide's toxicity and the dose absorbed by the body (Adams,1995; Coble *et al*., 2005; Ritter and Arbuckle, 2007). Thus, the farmers could have been suffering from chronic diseases associated with pesticide exposure of which they might be unaware of, such as cancer, brain disorders or depression, hormone and reproductive system disruption.

Effect of Pesticides on Farm Households in The Study Area

The result of the Tobit regression model in Table 5 revealed that gender ($p<0.05$), farming experience ($p<0.01$), extension contact ($p<0.1$), exposure ($p<0.01$), frequency of exposure ($p<0.1$) and pesticide cocktails ($p<0.05$) were the significant factors affecting the health's of farmers in the study area. The result shows a positive relationship between gender and health signs and symptoms related to pesticides application. This indicated that male are prone to pesticides related health signs and symptoms than their female counterpart, taking into consideration the fact that males were scored one (1) while females were scored zero in the dummy variable–gender. It is generally known that Nigerian agriculture is male dominated and male farmers have more access to productive resources that their female counterpart. Also, the result revealed a negative relationship between pesticides related health signs and symptoms and farming experience. This shows that older farmers are more aware of health hazards caused by pesticides application and the associated consequences of improper handling. Besides, younger farmers with small farming experience seem to be engaged in pesticides spraying more than their older counterpart and therefore are more likely to be exposed to pesticides related health signs and symptoms. The result shows a negative relationship between extension contact and pesticides related health signs and symptoms. This implies that farmers that have access to extension agents have lower pesticides related health signs. Farmers who access extension services or are active in agricultural activities (attending agricultural meetings, field day and demonstration plots) are expected to have easier access to pesticides

handling information and best available practices. Hence, are less likely to experience pesticides related health signs and symptoms than their counterpart who have no extension contact.

The effect of pesticides application on farmers' health was captured by the exposure, frequency of exposure or the number of application per production season and pesticide cocktails i.e. pesticide combination (two or more pesticides combination). The coefficient of exposure, frequency of exposure and pesticide cocktails were positive and significant ($p<0.01$, $p<0.1$& $p<0.05$ respectively). This implies that farm households who are sprayers were more likely to experience health challenge as regard pesticides application than their non-sprayer counterpart. However, the higher the frequency of pesticides exposure, the increase the health challenges posed by pesticides application. These conform with the work of Kishi*et et al*., (1995) who stated that there exists a direct relationship between the extent of pesticides used and signs and symptoms of illness due to exposure among farmers. The combination of two or more agrochemicals before application has associated effects on health and the environment. Generally, the efficacy of a chemicals cocktails could be predicted from the impact of individual chemical. The components of a mixture can react together to form another compound that may have a higher potency than the individual chemicals. Pesticide cocktails should strongly be discouraged because mixing of pesticides can alter their chemical properties, thereby increasing its detrimental effects on health and environment. Salameh *et al.* (2004) has already mentioned that the combined use of hazardous pesticides and the absence of appropriate precautions are detrimental to the farmer's health's.

Summary and Conclusion

This study assessed the categories of pesticide used, practices in pesticide uses, health symptoms and effects of pesticide use on farming households in Egbeda Local Government area of Oyo State, south-west Nigeria. Results from a survey of 120 farmers revealed much misuse and abuse of pesticides, which may have contributed to their health problems and contaminated their environment. Farmers reported suffering from discomforts ranging from skin irritation, headache, vomiting, eye irritation and nausea after using pesticides. This was attributed to the low level of education of users coupled with a lack of formal training in pesticide use, poor extension services, inadequate education and safety systems. The Tobit model results showed that exposure, frequency of exposure and pesticide cocktails were the most significant pesticides application factors influencing farmers' health in the study area.

Therefore, it is suggested that education on modern trends of health and environmentally friendly pesticide application methods including the wearing of protective clothing among others should be emphasized for the farmers by extension agents with the view to reducing the extent of exposure and pesticide cocktails which will ultimately reduce health risk among farmers in the study area .

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Table 1: Socio-economic characteristics of farm households

Characteristics	Frequency	Percent	Mean
Age			
Less than 31 years	11	09	
31-40years	16	13	
41-50years	49	41	
51-60years	33	28	
61years and above	11	09	51.7
Total	**120**	**100**	
Gender			
Male	91	76	
Female	29	24	
Total	**120**	**100.0**	
Marital status			
Single	10	08	
Married	92	77	
Devoiced/separated	18	15	
Total	**120**	**100.0**	
Household size			
1-5 people	56	47	
6-7 people	43	35	
Above 7 people	21	18	
Total	120	100	5
Educational level			
Primary	29	24	
Secondary	37	31	
Tertiary	13	11	
Non	41	34	
Total	120	100.0	
Extension contact			
Yes	84	70	
No	36	30	
Total	120	100.0	
Farming experience			
Less than 5 years	34	28	
6-10 years	42	35	
11 years and above	44	37	
Total	**120**	**100**	**6**

Table 2. Common pesticides used by the farmers (WHO, 2004; PAN, 2009)

WHO Classification	Type	Hazard Level	Frequency *	Percent
Nuvacron (Monocrotophos)	Insecticide	highly hazardous	74	61.67
Primextra(Metolachlor)	Herbicide	highly hazardous	34	28.33
Cypermethrin	Insecticide	moderately hazardous	19	15.83
Thiodan^{m}	Insecticide	moderately hazardous	11	9.17
Gammaline 20 (Lindane)	Insecticide	moderately hazardous	57	47.50
Gramoxone(Paraquat)	Herbicide	moderately hazardous	107	89.26
Atraforce (Atrazine)	Herbicide	slightly hazardous	72	60.00
2,4-D amine (2,4-D)	Herbicide	slightly hazardous	28	23.33
Apron star(Metalaxyl+ Difenoconazole + Thiamethoxam)	Fungicide	slightly hazardous	78	65.00
Ridomil (Mancozeb&Metalaxyl)	Insecticide	not known	66	55.00
Roundup (Glyphosate)	Herbicide	unlikely to present acute hazard in normal use	32	26.67

Table 3: Exposure and health impairment: farmers' reports of symptoms of pesticide poisoning

Pesticides application variables	Frequency	Percent
Pesticide Usage		
Sprayer	94	78.33
Non-sprayer	26	21.67
Pesticide type		
Insecticides	22	18.33
Herbicides	74	61.67
Fungicides	24	20.00
Pesticide cocktails		
Yes	74	61.67
No	46	38.33
Pesticide-related health symptoms		
Yes	114	95.00
No	06	5.00
Episodes of Self-reported illnesses		
Excessive sweating	45	37.50
Burning/Stinging/itching eyes	69	57.50
Blured vision/dizziness	15	12.50
Dry/sore throat	64	53.33
Chest pain/burning sensation	99	82.50
Shortness of breath/cough	77	64.17
Excessive salivation	72	60.00
Nausea/vomiting	44	36.67
Stomach pain, cramps and diarrhea	58	48.33
Skin redness/white patches	82	68.33

Table 4: Tobit regression results of the effect of pesticides usage on farm households' health

Variables	Coefficients	Standard error	t-value
Constant	2.123	1.764	
Age (X_1)	-8.053	11.213	-1.392
Gender (x_2)	9.341**	4.074	2.292
Marital status (x_3)	1.198	6.738	.178
Education Household Size (x_4)	-8.243	7.688	-1.072
Main occupation (x_5)	-.138	.863	-0.159
Farming experience (x_6)	-6.161***	2.436	-2.529
Extension contact (x_7)	-14.835*	8.408	-1.764
Exposure (x_8)	7.053***	2.213	3.187
Frequency of exposure (x_9)	3.767*	1.936	1.946
Pesticide cocktails (x_{10})	6.861**	3.411	2.011
Log likelihood function	-112.762		

*, **, *** refer to significant at 10%, 5% and 1% respectively.