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Farmer: Agrochemical Use and Associated Risk Factors in Fadan Daji District of Kaura LGA, Kaduna State, Nigeria

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Abstract **Background:** Occupational poisoning via the use of agrochemicals is common in developing countries. This is because grass-root farmers, who are the majority, are poor, illiterate and are undertrained on ethics surrounding its use. This is a cross sectional descriptive study carried out in Fadan-Daji (FD) district of Kagoro Chiefdom, Kaura LGA, Kaduna state, Nigeria. **Methods:** Three villages - Kodwak, Uzha-Tuyit and Zankam were randomly selected in the district. A sample size of 250 farmers was obtained using a p-value of 82%, while the selected farmers completed structured questionnaires. **Results**: Physical, chemical, biological, mechanical and psychosocial events occurred at the same time in the FD Farming community. Thus, clients present with multiple finding or symptoms. In this study most farmers experienced chest pain/tightness, cough, dizziness, reddening of the eyes; sneezing and rheum more often following the use on their farms. This study further revealed that farmers in the studied communities (31.6%) resorted to self-medication ranging from analgesics, to over the counter antihistamines, whilst 23.6% reported that they ingest milk as antidote. 32.4% did nothing about it while only 12.4% of the respondents visited a health facility. 54.4% of FD farmers used no form of personal protective devices (PPDs). **Conclusion**: Our findings revealed that the root problem faced with the FD like the average farmer of the developing world is lack of relevant education in terms of ethical use and disposal of agrochemicals which has made a significant number of FD farmers more susceptible to the agrochemical side effects resulting from its use. Such a community located in the heart of Nigeria also being a food basket needs prompt attention in terms of improved western/farmer education and health facilities.

Keywords: *agrochemicals, risk factors, farmers, Fadan-Daji, Nigeria*

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1. Introduction

Farming is a major occupation in Africa especially among rural dwellers, serving as a means of livelihood. The recent fluctuations experienced by farmers in plant yield as well as unsteady and fluctuating climatic conditions with the increasing population in the developing world and the globe in general has prompted the need for an improvement in farm produce. The quest for possible strategies to meet the ever-growing agricultural needs through use of physical, biological and chemical firepower in the arsenal of agriculturists has posed additional challenges to the users of same. To feed her growing population, Nigeria must increase food production by 4% per year for the next 10 years. To accomplish this challenge, the use of inorganic fertilizer must increase from an average of 10 to 50 kg/ha; since organic sources of soil nutrients will not be sufficient [1]. The conventional methods of raising farm productivity since the World War II has centred on employing the use of externally acquired inputs like fertilizers and protection chemicals among others [2]. Agrochemical is a generic

term for various chemical products used in agriculture. Agricultural chemicals include fertilizers, pesticides, herbicides, rodenticides to mention but just a few used to eliminate the presence of living things that causes injury or diseases to crops and to improve production. Although many kinds of chemicals are used in agriculture, they can be categorized into simple groups according to the functions they performed. This includes insecticides, herbicides, fungicides, molluscides, and rodenticides, just to mention but a few [3]. The impact of pesticides on the human immune system has also attracted attention from scholars [4,5,6]. Studies have shown that long-term low-dose exposure to pesticides leads to the development of respiratory diseases such as asthma, reduced sperm quality and sperm count, causing sterility [7,8]. Inorganic fertilizer Consumption Remains Low in Africa and the Middle East. International Agriculture and Trade Reports, Situation and Outlook Series, USDA Economic Research Service, WRS-94-3, July, pp: 32-37. [9]. Pastoral Care, Safety Health Practitioner Magazine, Nov 2008 United Media. International Inorganic Fertilizer Development Center (IFDC), (1996), Africa Inorganic fertilizer Situation, IFDC November, Pesticides include organochlorines, organophosphates, carbamates, formamidines, thiocyanates, organotins, denitrophenols, synthetic pyrethroids and antibiotics [10]. The major pesticides used in Nigeria by farmers include; N, N'-dimethyl-4, 4'-bipyridinium dichloride (Gramaxone), Methyl parathion (Paraphos), Bushfire, Glyphosate (Roundup), Perlagonic acid (Slasher).. Agrochemicals refer to substances used to help manage an agricultural ecosystem, or the community of organisms in a farming area. When pesticides are applied, the possibilities exist that these chemicals may exert certain effects on non-target organisms, including soil microorganisms [11]. Many of the Class highly or extremely toxic pesticides are still being used in developing countries especially in Nigeria where annual estimation the use/application of pesticide is about 125,000 - 130,000 metric tons [12]. Although pesticides are important, their effects on non-target organisms are of great concern because this poses a risk to the entire ecological system [13]. [14] Several studies evaluated risk by type of farming operation or pesticide use. Exploring alternative agricultural methods such as the use of biological and possibly ecological strategies [15] could be better methods of controlling the increasingly various risk associated with the use of agrochemicals worldwide.

Many agrochemicals are toxic and may pose significant health risks. In many countries, the use of agrochemicals is highly regulated.

The WHO classified pesticides by hazard and this is reviewed every year as newer compounds enter the agrochemical market. The hazard classification is based on the LD50 for rats (mg/kg body weight). The classification is Class Ia, Ib, II, III named extremely hazardous, highly hazardous, moderately hazardous and slightly hazardous respectively.

Despite the usefulness of agrochemicals, the side effects on the soil and the health hazards/risks they pose to the rural farmers especially in the developing countries are quite alarming. This ranges from those associated with operational habits and illiteracy. Almost all (100% and 99.17% respectively) indicated a high level of usage of gamalin 20 and Ferenox while 17.50% indicated the usage of cocobre-sandoz. Majority (77%-100%) indicated that they scoop and stir pesticides with bare hands after application of pesticides. About 82% and 95% experienced redness of the eyes and body pain respectively whenever they apply pesticides. 20% use overall protective clothing, 28.3% used jungle boots and handkerchief. The study concluded that cocobre-sandoz, pererox and gammalin 20 were the only pesticides popularly used by cocoa farmers and very low percentage of the farmers used preventive or control measures against health hazards that are associated with these pesticides [16]. In Nigeria generally, farmers do not wear any protective materials at all, no matter what pesticide is being applied. Such hazards associated with 'unnotable' habits through use of pesticides among grass-root farmers should be areas of salient concern. Cracks and leaks in containers and in over aged rubber hoses, and not renewing or losing washers are a great cause for leakages that often poison the user, wastes pesticides, causes environmental pollution and may become phytotoxic where pesticides fall on crops at high doses [17]. Results from studies conducted on human health and occupational exposure to pesticides among smallholder farmers in cotton zones of Cote d'Ivoire and Lesotho respectively showed that exposure to pesticides and occurrence of ill health symptoms is evident in agricultural households in cotton growing areas of Cote d'Ivoire and that a greater health risk is present when a lack of training and education on the use of pesticides [18,19]. Some other unhealthy and unprofessional habits associated with the use of pesticides by some sampled rural farmers in Nigeria include did not wear protective clothing like gloves, goggles and boot, the habit of drinking during the application of chemicals, did not wash their contaminated cloths after use of chemicals, smoking during application, did not wash their contaminated cloths after use of chemicals, stored their chemicals in the living room together with foodstuff including bedrooms most have encountered health problems with the use of these chemical including tearing, redness of the eyes, cough, difficulty breathing, excessive sweating, headache and yellowing skin. The other complaints included lack of muscle coordination, 56% of the sample population have one ailment or the other which might be as a result of improper use of chemicals which include dermatosis, cancer, allergies [20]. These studies deduced a positive and significant relationship between level of education and source of information with the farmers' knowledge of precautionary measures. Pesticide application has become a great threat to human health [21,22,23]. Exposure to nitrosatable pesticides or to pesticides contaminated with nitrosamines has been suggested as a possible explanation for the higher rates of brain cancer among farmers because of the long standing hypothesis that NOC exposure is a potential risk factor for this cancer [24,25,26]. Italian farmers [27] who used insecticides or fungicides had a significant twofold increased risk of brain cancer. One fact remains that Inorganic fertilizer seems to be the one of the practical way to provide enough plant nutrients to restore Africa's nutrient-depleted soils and feed Africa human population, the implication of this is as a result of the fact that Organic sources of mineral nutrients are certainly not available in sufficient quantities to feed sub-Saharan Africa's current population of about 750 million-and that population will

be 1.1 billion by 2020 [28] population [29]. Agrochemicals are the result of modern technology that depends on inorganic fertilizers and pesticides. Over use of these chemicals have severe effects on environment that may lead to an immediate and long term effects. Investigating farmers' awareness of agrochemicals residues and their behaviors regarding application is important in order to reduce human factors that negatively affect agricultural safety [30].

1.1. Geographical Background and the People of Fadan Daji District

Southern Kaduna makes approximately 3 million in population, representing about 50% of the 6.066 million population of Kaduna State according to the 2006 National Population Census, consists of 12 Local Government Areas (LGAs) of the State. The people are bonded by same socio-cultural and historical ties, some dating back to the ancient Nok Terracotta civilization of the 500BC. Southern Kaduna people welcome and embrace all comers, are therefore deeply indigenous and autochthonous people like other native populations. Fadan-Daji district, in Kagoro development area, Kaura Local Government area in the southern part of Kaduna state, Nigeria is inhabited predominantly by the 'Gworok' tribe. There are three health facilities in Kagoro community (ECWA Comprehensive Health Centre, Primary Health Centre & Child Welfare Centre and Turaki Buga Memorial Hospital). The Study population are predominantly agrarian and lie within on coordinate 9° 36' N and 8° 23' E. Based on the 2006 Projected Census figure, the district has a population of 77008 of which the growing population is more than 50% of the population. Kaura is a Local Government Area in Kaduna State, Nigeria. Its headquarters are in the town of Kaura, having an area of 485 km² and a population of 222,579 at the 2006 census. Kaura LGA is major farming community in Nigeria [31].

Figure 1. Map of Nigeria showing Kaduna State

Source: http://commons.wikimedia.org/file.Kaduna_state_nigeria.png

1.2. Aims and Objectives

Studies have showed that there are several untoward effects associated with the use of these agricultural chemicals, such as acute illnesses like headache, fatigue, and chronic illness like Lymphomas, Leukaemias, stillbirths amongst others, hence, this research seeks to establish farmers' knowledge of the hazards attendant to the use agro chemicals (pesticides and fertilizers) as well as to elucidate the response to the management of clients and or patients in the communities exposed to the agrochemicals in Kaura LGA, Kaduna State, Nigeria.

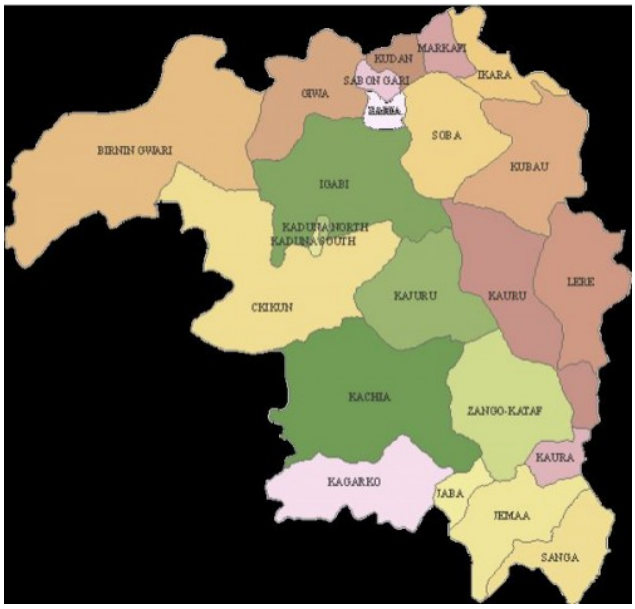

Figure 2. Map of Southern Kaduna, Nigeria

Source: www.nigerianmuse.com/20100527092749zg/maps-various-states-and-their-local-governments-in-Nigeria

2. Materials and Methods

2.1. Study Design

The study is a cross-sectional descriptive survey. One district was randomly chosen from the eleven (11) districts in Kagoro. Three villages were randomly chosen out of the eight (8) villages in the selected district; which include Kodwak, UzhaTuyit and Zankam. The calculated sample size was two hundred and fifty (250) using a 'P value of 82%. An estimated population of each village was gotten from which the sum total of the three villages was made. A proportion of the questionnaire administered to each village was made based on the ratio of the population of the village to the sum total as against the sample size.

2.2. Study Population, Sampling Technique and Sample Size Determination

Study was carried out among farmers (male and female) constituting a population of 15,000 within the three villages of Fadan Daji district in Kagoro Chiefdom. The sampling technique used was a multistage sampling technique consisting of two simple random sampling techniques whereby three villages were randomly selected from the eight villages in the district. Using the sum total of the population of all three villages randomly selected, the proportion of farmers from the sample size was calculated for each village using the population size of the individual villages as described by S.I. Ogunjimi et al

2012 [20]. Sample size was determined using Fisher's stratified Test (1998). [32]

2.3. Data Collection

A structured (interviewer-structured) questionnaire was administered to 250 farmers within the three study villages.

2.4. Data Analysis

Data collected were analyzed using the SPSS 20.0 statistical package and manual analysis.

2.5. Ethical Considerations

Ethical approval was obtained from council of chiefs headed by the Traditional ruler of Kagoro and the Local Government secretariat as well as the three village heads.

3. Results and Discussion

The interviewer-structured questionnaire was administered to 250 farmers within the three villages. Both male and female farmers were interviewed. Some had formal education while few did not. Few belonged to a farmers' cooperative society while others were not and almost all the correspondents use fertilizers and pesticides.

Table 1. Socio Demographic Profile of the Respondents Sex and level of education of the respondents

		Number	Percentage
Gender	Male	154	62
	Female	96	38
Level of education	No formal education	35	14
	Incomplete primary	12	4.8
	Completed primary	79	31.6
	Incomplete secondary	54	21.6
	Completed secondary	18	7.2
	Incomplete Tertiary	41	16.4
	Completed Tertiary	11	4.4

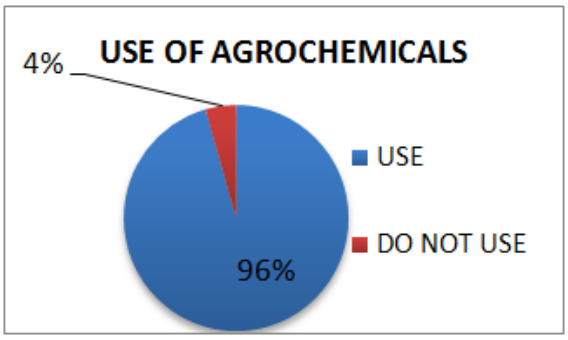

Figure 3. The Use of Agrochemicals by farmers

Table 2. Knowledge and competence in the use of Agrochemicals for different scenarios

	Number	Percentage
Farm Application only	123	49.2
Storage of produce	12	4.8
Farming & Storage of produce	115	46

Table 3. Use of Personal Protective Equipment (PPE)

Personal protective equipment	Number	Percentage
Mask	54	21.6
Nothing	136	54.4
Boot	7	2.8
Gloves	18	7.2
Coat	6	2.4
Apron	3	1.2
Goggles	14	5.6
Cap	12	4.8

Table 4. Habits of farmers during the application of agrochemicals

Activities while applying the chemicals	Number	Percentage
Attend to visitors	23	9.2
Smoke	1	0.4
Eat	12	4.8
Drink	13	5.2
Nothing	201	80.4

Table 5. Time spent on the farm after application of agrochemicals

Time spent in the farm after application	Number	Percentage (%)
Leave immediately	100	40
<30mins	22	8.8
30–59mins	20	8
1–1hr59 mins	31	12.4
2–4hrs59mins	50	20
> 5hrs	27	10.8

Table 6. Identification of expired chemicals

How to detect expired chemicals	Number	Percentage (%)
Check expiry date	108	43.2
Poor action	76	30.4
Do not know	46	18.4
Appearance of the chemical	13	5.2
Ask dealer	7	2.8

Table 7. After-use of empty agrochemical containers

Use	Fertilizer		Pesticides	
	Number	Percentage	Number	Percentage
Openly Disposed	1	0.4	177	70.8
Farm utensil	89	35.6	6	2.4
Domestic utensil	120	48	19	7.6
Sold	38	15.2	22	8.8
Burn	2	0.8	26	10.4

Table 8. Source of drinking water

Source of drinking water	Number	Percentage
Well	138	55.2
Bore hole	45	18
Tap	49	19.6
River/stream	16	6.4
Rain	2	0.8

Table 9. Side effects experienced

Side effects experienced	Number
Cough	106
Dizziness	95
Eye reddening	92
Sneezing	84
Rheum	78
Chest pain	75
Skin itching	74
Eye itching	71
Headache	69
Body pain	58
Vomiting	39
Others	27

Table 10. Intervention sort after experiencing side effect

Response to side effects of chemicals	Number	Percentage (%)
Self-medication	79	31.6
Ingested milk	59	23.6
Did nothing	81	32.4
Visited health facility	31	12.4

Table 11. Co-morbidities

Associated medical conditions	Number	Percentage (%)
No known morbidity	89	35.6
Peptic Ulcer Disease	84	33.6
Others	30	12
Hypertension	30	12
Hepatitis	14	5.6
Diabetes mellitus	3	1.2

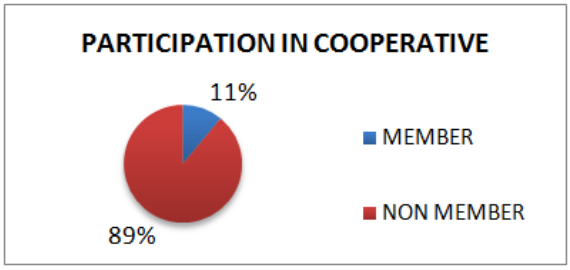

Figure 4. Respondents' participation in Cooperative

Gender distribution of was 62% (males) and 38% (females), indicating more of masculine gender are into farming than the feminine in Fadan-Daji (FD).One thing is to use agrochemicals following its intent; another thing is the knowledge of effect and risk associated with its residue resulting in the course and after use of such. Results obtained from our study are however discussed in terms of level of education, awareness of the use of agrochemicals, sensitive habits/attitudes, protective measures and common clinical presentations of farmers using agrochemicals:

3.1. Level of Formal Education and Awareness

Most of the farmers from FD had formal education at varying levels. The farmers had low level of formal education. Our study observed 56.8% of those without any form of education and those who did not complete their education when put together in comparison with 43.2% recorded for those that completed any form of education. Only 4.4% had tertiary education as against 39.8% respondents that have less than tertiary education- *see* Table 1. In terms of awareness of agrochemicals with reference to pesticides and fertilizers, 96% of the farmers are aware and also use agrochemicals while only 4% do not use it. Our study closely is related to the findings from a randomly selected farming community on issues of health and safety implications of the massive agrochemical usage in Ibadan metropolis, Nigeria in which the study revealed that 24% of the respondents had no formal education while 60% had below tertiary education [33].

3.2. Use, Storage, Attitude and Protective Measures

51.46% of the sampled farmers use agrochemicals only for farming purposes, 48.12% used and store agrochemicals while less than 1% for storage alone. It was obvious that FD farmers do not strictly adhere to the use of personal protective devices (PPDs). 54.4% used no form of protection, while the distribution of those who use PPDs -wear mask (21.6%), gloves (7.2%), goggles (5.6%), cap (4.8%), coat (2.4%) and apron (1.2%) constitute 45.6%. It is imperative to point out that the 4.8% recorded for those that wear cap as PPD may not be absolutely correct as the natives wear cap as part of their traditional dress code. The low record in the use of the mentioned protective equipment could be attributed to financial constraint, ignorance of risks associated with the use of agrochemicals and non-availability of PPDs. The negative effect is more on health related challenges as farmers are often opened to health risks. A related study pointed out that- Despite adequate awareness of safe insecticide management, most of the spray-workers were observed to be reluctant to put this knowledge into practice, either due to the inadequacy of PPE or negligence. Furthermore, a sizable faction of these workers still had limited knowledge and erroneous risk perceptions, thus increasing their risk of OIP. Therefore, appropriate communication strategies and training could reduce the occupational risk of insecticide exposure, which would ultimately minimize the related health hazards of insecticidal poisoning [34].

3.3. Habits During and After Use of Agrochemicals

Occurrences of various forms of unethical habits associated with use, during and after the application of agrochemicals among the respondents - Attended to visitors (9.2%), smoked cigarettes (0.4%), ate (4.8%), drank (5.2%) -*see* Table 4. However 60% stayed within the farming environment between 30 minutes and 5 hours after application –*see* Table 5, making a significant number of FD farmers more susceptible to the agrochemical side effects especially via inhalation. These explain the high occurrence of side effects experienced by these farmers since the duration of exposure to the chemicals contributes to the possibility of developing side effects. A related study by Yaser Issa et al (2010) stated

that there were positive changes with less use of large quantities of pesticides (>40 units/year) (PD -51; CI -0.60, -0.43), in applying the recommended dosage of pesticides (PD +0.57; CI +0.48, +0.68) and complying with the safety period (PD +0.89; CI+0.83, +0.95). Changes also included farmers' habits while applying pesticides, such as less smoking (PD -0.20; CI-0.34, -0.07) and eating at the work place (PD -0.33; CI-0.47, -0.19) [35].

3.4. Identification of Expired Chemicals

54% of FD farmers identified expiry dates of agrochemicals either by poor action (less potency), poor color appearance or do not even know at all while 46% either checked dates on containers or asked dealers –Table 6. This order words showed that farmers in Fadan Daji know how to access agrochemicals but do not comply with the importance of verification of their expiry date and most probably do not attach any significant importance to associated risks.

3.5. Disposal of Agrochemical Containers

77.63% of the respondents disposed the empty container of pesticides, 8.33% use the pesticide containers for domestic purposes while 2.63% used the pesticide containers as farm tools. In contrast to the use of the pesticide containers, 2.16% of respondents disposed the fertilizer containers, 48.12% of respondents used the fertilizer sacks for domestic purposes by way of food storage materials. These unhealthy and unprofessional habits of FD farmers who use agrochemicals in no doubt a great concern to the world health management system as it also agrees with a similar study carried out in Nepal which pointed out habits peculiar to safety and used containers of agrochemicals among farmers that 26.31% burnt the empty agrochemicals containers, 6.43% indicated that they used same for various household purposes (e.g., for food and water storage) while 14.61% indicated that they buried them and 29.23% indicated that they left the empty agrochemicals containers in their farms [30]. Another study carried out among cocoa farmers in Ondo State Nigeria strongly agrees with the foregoing. This indicated that 10.4% disposed of pesticide container by burying it in the soil, burning, 2.1% threw such into refuse heaps while 25.0%; sold them to buyers; however, the 35.4% majority washed their pesticide containers for other uses such as storing palm oil [36].

3.6. Occupational Health Practice

Physical, chemical, biological, mechanical and psychosocial events occurred at the same time in the Fadan-Daji Farming community. Thus, clients present with multiple finding or symptoms. In this study most farmers experienced chest pain/tightness, cough, headache, dizziness, reddening of the eyes; sneezing and rheum more often thus Table 9 showed clearly that the numerator may not align to the denominator. Similar studies confirm this experience amongst oil industry workers which pointed that -with the Environmental Monitoring, it was deduced that Health Hazards and the Biological Health Hazard are prevalent in the Refinery. With the Hazards Risk Assessment Matrix, the level of risk these identified Health Hazards pose on the workers was 3D, 5E, 3C and 0A respectively. However, workers' susceptibility to work related-diseases depends on a lot of factors, and it usually takes some time before the manifestation of the illnesses and diseases on the worker could be diagnosed [37]. Another is that - occupational or workplace hazards are dangers to human health and wellbeing which are associated with specific occupations. While efforts are made to reduce hazards, these hazards remain present in the workplace by nature of the profession. It is also danger to health, limb, or life that is inherent in, or is associated with, a particular occupation, industry, or work environment. It includes risk of accident and of contracting occupational disease [38,39].

3.7. Co-morbidities and Risks Factors Associated with Direct and/or Indirect Pesticide Exposure

Other health related risks that the respondents were opened to by way of medically related conditions were Peptic Ulcer Disease, Hypertension, Hepatitis and Diabetes mellitus constituting 64.4%. It implies that irritation of the gut, blood vessels/heart and liver -*See* Table 11. Our study observed obvious multiple risks faced by the Fadan Daji farmers irrespective of sex and age in agreement with various studies all over the world. In furtherance with this, studies have shown that there are multiple risks associated with the exposure to agrochemical agents without PPDs. Direct and/or indirect exposure to pesticides has been shown to be linked to end-stage renal disease (ESRD) among farm women [40]. Mamane *et al* also showed that amongst 15 cross-sectional epidemiological studies focusing on respiratory symptoms and the exposure to agricultural pesticide, 12 of the studies indicated significant associations with respiratory health problems including breathlessness or chest tightness, chronic cough, wheeze, and dyspnea [41,42]. Direct and/or indirect exposure to pesticides has also been associated with the risk of different cancers. This accounts for some epigenetic factors that modify and alter the genetic code of persons exposed. Several epigenetic mechanisms, like DNA methylation, histone modifications and micro RNA expression, can be triggered by environmental factors including pesticide exposure [43,44]. Regular pesticide exposure was shown to be associated with increased odds of pancreatic cancer [45,46]. Environmental and occupational exposure to pesticides indicates a possible association with the development of prostate cancer [47,48]. This has also been implicated as a significant risk factor for developing myeloid leukaemia [49,50,51]. The results from a case-control study in Spain suggests that living in the proximity of cultivated lands that are treated with pesticides is a possible risk factor for multiple childhood cancers, the main cause of disease-related deaths in children living in Spain [52]. Breast cancer, a multifactorial disease and the commonly diagnosed cancer in women is known to have traditional risk factors like reproductive status, family history, genetic mutations, and lifestyle. However, cumulative evidence has recognized a relationship between breast cancer and occupational factors, including environmental stimuli like pesticide exposure especially at a young age [53,54,55]. Risk factors leading to injuries are present in every work place. Among all occupations,

industrial and agricultural workers have the highest risks [56].

3.8. Intervention Sought after Experiencing Side Effect

Our study further revealed that the farmers in the studied communities (31.6%) fall back to one form of self-medication of mostly analgesics and local antihistamines while 23.6% ingested milk as antidote. 32.4% did nothing about it while only 12.4% visited health facilities which were however mostly miles away from their farms – *see* Table 10. This development is another pointer to the risk of self-medication and inadequate health facilities in FD community. Furthermore, as a result of the foregoing, it is very difficult to effectively track and monitor farmers that are affected with health related issues resulting from the use of agrochemicals for even the health facilities don't even have statutory records of the few that report such cases. This is also in line with an assertion by the Farmworker justice that -The exact number of workers injured each year by pesticides is unknown, because there is no national surveillance system for acute pesticide illness reporting and no surveillance system for tracking chronic illness related to pesticide exposure. 30 states require health professionals to report suspected pesticide poisoning, but many incidents go unreported due to a number of factors, including workers' failure to seek medical care, workers seeking medical care in Mexico, medical misdiagnosis, and health provider failure to report. Factors deterring farmworkers and their families from seeking medical care for pesticide illness include lack of health insurance, language barriers, immigration status, cultural factors, lack of transportation, lack of awareness of or exclusion from workers' compensation benefits, and fear of job loss [57].

3.9. Lack of Relevant Skills/Education

Our findings revealed that the root problem faced with the Fadan Daji and the average farmer of the developing world is that of lack of relevant education in terms of ethical use and disposal of agrochemicals. For instance, farmers tend to apply pesticides excessively and irrationally because they do not understand the risks of pesticide residues, the guidelines on how much pesticide to use or the standardized regulations in pesticide application [30]. The fact that 47.6% have at least some forms of basic western education did not reflect in the way and manner of handling agrochemicals hence, exposure to more risk. This is in compliance with Huang Y *et al* (2008) and Xu Y (2004) who said that the major problem of If a farmer is relatively less educated, his/her ability to absorb professional knowledge is weaker. Furthermore, his/her capability to recognize pest diseases is also weaker. Hence, the less-educated farmer tends to lack awareness of both pesticide residues and the importance of applying pesticide in standardized ways. Consequently, with less education, there is a higher chance that the farmer will apply prohibited pesticide excessively, leading to highly concentrated pesticide residues [58,59]. In the same vain, Dongmei Z (2006) found that the education and training provided by agricultural technology personnel affect farmers' awareness of pesticide residues [60]. The farmers' cooperative society would have been a forum to educate farmers on ethics involved in the proper procurement and use of agrochemicals and disposal of its residues. Another salient manifestation from this study is the very low participation in the farmers' cooperative society as only 11% of Fadan-Daji farmers belong to such as against 89% that did not belong to any. This has probably limited the farmers to opportunities of education in terms of proper procurement and use of agrochemicals as well as proper disposal of its residues, safety and health/risk management at the grass root level.

4. Conclusion

Our findings revealed that the root problem faced with the Fadan-Daji and the average farmer of the developing world is that of lack of relevant education in terms of ethical use and disposal of agrochemicals which has made a significant number of FD farmers more susceptible to the agrochemical side effects resulting from its use. The FD farmers know how to access agrochemicals but do not comply with the importance of verification of the expiry date and most probably do not attach any significance to associated risks. These unhealthy and unprofessional habits of FD farmers who use agrochemicals are no doubt a great concern to the world health management system. Such a community located in the heart of Nigeria and as a food basket needs a prompt attention in terms of improved western and farmer education, health facilities and funding.

5. Recommendations

Improvement on educating farmers on the use of agrochemicals in appropriate, less risk-related methods, side effects associated with the use of agrochemicals, dangerous habits associated with health risks and the importance of protective measures of agrochemicals especially personal protection equipment. Strict laws on the purchase and use of agrochemicals in farming communities should be put in place so as to reduce exposure of farmers and passive individuals to agrochemicals. Concerned authorities should avoid political bias in sharing equipment/agrochemicals to farmers when they are available for the use of the farmers and encourage the formation of farmers' cooperative society/association in conjunction with the local and state government as well as well-meaning individuals to ensure an easy flow of communication, farming equipment, personal protective equipment and funds to the farmers. Proper record keeping of all cases of acute and toxic effects of agrochemical exposure in order to enable proper health planning should be put in place. Improved health education of farmers by the employment of various forms of communication methods and use of the already existing good system of leadership to further encourage farmers' interest in proper health practices should be explored.

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Conflicting Interest

None.

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