



Assessment of Farmer's Awareness on the Safety and Health Implications on the Use of Agrochemicals: A Case Study of Afife Rice Farm in Ghana

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Authors' contributions

This work was carried out in collaboration between both authors. Author MN design the instrument (questionnaire) for data collection, perform the statistical analysis, and wrote the protocol and the first draft of the manuscript, author FA managed the analysis of the study and proof reading and literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Introduction: The quest to meet the food demand of people and the low food productivity in Ghanaian agriculture has necessitated the use of agrochemicals massively by small scale farmers. This study examined the farmer's awareness of the health and safety implications of massive agrochemical usage in Afife irrigation scheme in Volta Region of Ghana.

Methods: One hundred and ten farmers were sampled randomly from the Afife rice farm. A standardised questionnaire was used to collect information about farmer's practices, knowledge and attitude about agrochemical application and personal protective equipment (PPE) usage coupled with personal observations. Data collected were analysed using descriptive statistics.

Results: A great significant number of respondents ($p \leq 0.05$) were aware of PPE and were trained

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on its usage. About 88% of the respondents put on protective attires during spraying activities with most farmers using relatively good clothes as working gear on the farm.

Conclusion: In effect the farmers have satisfactorily adopted and practised a precautionary method of Agrochemical use.

Practical Application: The results of this research would assist policy makers, government agencies, and extension agents involved with Afife farmers to know the specific training needs of the farmers in Afife Irrigation Scheme. This would also help them to build capacity of the farmers in the specific area they are deficient in.

Keywords: Agrochemical; safety; personal protective equipment; health; awareness; Afife.

1. INTRODUCTION

Agriculture is one of the three most dangerous sectors in which to work, along with construction and mining. Out of a total of the estimated 335,000 fatal workplace accidents that occur worldwide each year, some 170,000 of these involve agricultural workers. The work environment involves exposure to the physical hazards of weather, terrain, fires and machinery; toxicological hazards of pesticides, fertilizers and fuels; and health insults of dust. Agricultural work is associated with a variety of health problems. Agricultural workers are at a high risk for particular cancers, respiratory diseases and injuries. Because of the remote location of much of this work, health services are lacking, often without appropriate safety and health measures, information and training [1,2].

Machinery, such as tractors and harvesters, account for the highest rates of injury and death among agricultural workers and self-employed farmers. Exposure to pesticides and other agrochemicals constitutes one of the main occupational risks, which could lead to illness or death. Other hazards are inherent in animal handling and contact with dangerous plants and biological agents, and give rise to allergies, respiratory disorders, zoonotic infections and parasitic diseases. Noise-induced hearing loss, musculoskeletal disorders, such as repetitive stress injuries and back pain, as well as stress and psychological disorders are also frequent. The situation is particularly evident in developing countries and in the farms or plantations in some of the countries in transition or even in some industrialized countries [1,2].

Exposure to agrochemicals poses an increasing health risk in agricultural work. Pesticide sales and use have continued to climb over the years. In developing countries, workers and farmers face greater risks due to the increasing use of more toxic chemicals – which may have been

banned or restricted in other countries – involving non-use of suitable personal protective equipment either because it is not available, or too costly or uncomfortable, incorrect application techniques, poorly maintained equipment, inadequate storage practices, and the reuse of old chemical containers for food and water storage. The end users often do not have access to information on the risks associated with the use of chemicals and on the necessary precautions and correct dosage. A joint press release of the ILO/WHO on the number of work related accidents and illnesses indicated that use of pesticides causes some 70,000 poisoning deaths each year, and at least seven million cases of acute and long term non fatal illness [1,2].

However, Agrochemicals are important agricultural inputs to protect crops from diseases, pests and weeds. The uses of agrochemicals contribute not only to healthy growth of crops and animals but also to improve farm work efficiency and stable supply of tasty agricultural produce [3].

According to Miller [4], agrochemical use has increased 50 fold, since 1950 and 2.3 million tonnes (2.5 million short tonnes) of industrial pesticides are now used each year. Seventy -five percent (75%) of all herbicides in the world are used in developed countries however; its use in developing countries is increasing.

The incidence of occupational hazards in agriculture is generally poorly recorded and documented. Official data tend to under-report occupational accidents. In many countries agricultural workers do not benefit from employment injury benefit schemes, either because the social protection system is weak or because agricultural workers are specifically excluded from general schemes. In the case of illness and injury associated with agrochemicals, poor reporting is compounded by the difficulty of

establishing a correct diagnosis, especially as the most serious effects become apparent after years or decades of exposure. Many workers may never see a doctor because health services are not available or easily accessible in rural areas, and why few medical practitioners, are able to clearly diagnose and treat intoxication from pesticides [1,2].

Safety and health in the use of agrochemicals has been one of the primary concerns of international organizations and of many governments, employers and workers and their organizations for over two decades. Some agrochemicals such as pesticides are extremely hazardous to the health of workers and the general public, and also to the environment. However, they can be used safely if proper precautions are taken. In Ghana, herbicides have effectively been used to control weeds in agricultural systems [5].

Afife is a farming community, which is known to be dominant in rice cultivation. Farmers in this community embrace the use of agro chemicals throughout their rice cultivation process thus from land preparations, weed control to fertilizer application. But as a result of them being linked to chemicals may have led to several health implications. These health complications could be as a result of measures being taken before; during and after the use of agro chemicals hence there is a need to undertake this study which is intended to help convey the importance of these issues to bring out measures, to reduce exposure to hazards in chemical usage through modifications or practices. The objectives of these investigations were to assess the extent of use of Personal Protective Equipment (PPE) among the users of agro chemicals and to assess the extent to which lack of adherence to safety precaution causes health implications.

2. MATERIALS AND METHODS

The research was focused on gathering data on hazards and risk situations in relation to agro chemicals. Safety and health in the use of agro chemicals involves finding things and situations that could potentially cause harm to people. The scope of hazard identification and risk assessment was generally based on the following aspects of work and their interaction:

- i. Physical appearance during the use of agro chemicals
- ii. equipment, materials and substances used

- iii. Measures taken before, during and after using agro chemicals.

2.1 Study Area Description

Afife rice farm is located in the Volta region of Ghana precisely at Kpli valley near Klenormadi in the Ketu North District. Approximately between latitudes 6°04' and 6°08' and longitudes 0°45' and 0°55' East at a distance 162 km east of Accra. The gross area is 950 Ha and the net irrigateable area is about 880 ha. The main crop grown is rice. Afife rice farm was the preferred choice because of its leading name in rice cultivation among many other Government established schemes in Ghana. Besides that, it has a high level of recognition over the previous years in terms of supply of agricultural machinery and equipment.

2.2 Data Collection and Technique

Two approaches were used to collect data. Techniques used were questionnaires and direct observation. The purpose of this method was to integrate the strengths and weaknesses concerned with each method. The multiple approach method is also highly complementary and hence increases validity, scope, depth and completeness of knowledge [6,7]. The study was carried out for 14 weeks where farmers consent for willingness to participate in the study was sought. Those who were willing to participate in the study were interviewed and questionnaires administered to them.

For quality data, only those farmers who consented to participate in the study were contacted. This is because the researchers realised that using these sampling techniques i.e. random, accidental or purposive would result in poor quality data since most of them gave all kind of excuses why they will not be available for the interview and questionnaires and for that matter unwilling to participate in the study. Data techniques adopted for the study were the following:

1. Direct observation
The researchers observed how farmers carried their farm activities especially when they are applying agrochemicals. This was carried out on selected days within the study period.
2. Survey
 - In the survey, 350 questionnaires were administered to the selected farmers

(These were administered to the men, and women to solicit data. This design permitted the respondents to tick the answer to the question that were provided) at random from the group of farmers who normally engaged in rice production. However, only 110 questionnaires were retrieved since most of the farmers were not willing to be involved in the study. To avoid double interview of the same farmer special identification numbers were given to them. Both closed and open ended questions were used. Questions were centred on general knowledge of safety issues regarding agrochemical usage, PPE, trainings received on the PPE and challenges encountered in the usage of agrochemicals among other critical issues. The current investigation is guided by the following research questions:

- Do farmers have knowledge about the dangers associated with handling of agrochemicals?
- Do farmers have enough knowledge concerning the PPE use in the Afife rice irrigation scheme?
- Do the farmers have adequate training on the use of PPE in the Afife rice irrigation scheme?

The questionnaires were pre-tested in a rural farm and accordingly modified before the actual field work was launched. The questionnaire was divided into background information, bio data (sex, age and education) and PPE use among others. After pretesting, intensive field work was undertaken from 2nd week of June to September 30th of 2014. A number of activities were performed during the field work. Among them were interviewing and personal observations.

The target population of the study focused on men and women. Afife rice farm is about 880 ha and divided into eleven sections averaging 80 ha. In all, one hundred and ten (110) respondents which comprised of ninety six (96) farmers, six(6) operators, four (4)sprayers, two (2) welders and two (2) auto mechanics were selected at random.

2.3 Data Analysis

The data obtained from farmers, operators, auto mechanic and sprayers were edited, coded and

subjected to statistical analysis using the Statistical Package for Social Scientists (SPSS) version 16 software on the computer and the results expressed using tables in order to address the purpose of the study. The mean score was used to identify the various areas of challenge as far as the use of PPE in agrochemical handling and the farmer's knowledge on the health implications of agrochemical use. The mean score was computed after farmers responses to each of the questions were obtained using a five point likert type of scale. A five point Likert scale (1=strongly disagree (SDA), 2=disagree (D), 3=Neutral (N), 4=agree (A) and 5 =strongly agree (SA)) was used to assign weight for the items on the questionnaire.

The mean response to each question was computed using the underlisted formula:

$$\bar{X} (\text{weighted mean score}) = \frac{\sum FX}{N} ,$$

where

\bar{X} = Mean score, \sum =Summation, F=Number of respondents (%) to a particular question, X= Numerical value of the scale point, N= Total number of respondents to a question.

The mean response to each question was interpreted using the concepts of real limits of numbers. The numerical value of the scale points and their respective real limits are listed below:

Strongly Agree (SA) =5 point with real limits of 4.50-5.49.

Agree (A) =4 point with real limits of 3.50-4.49.

Neutral (N) =3 point with real limits Of 2.50-3.49.

Disagree (DA) =2 point with real limits of 1.50-2.49.

Strongly Disagree (SDA) =1 point with real limits of 0.5-1.49.

2.4 Decision Rule

Any mean score below 3.0 was considered as a serious challenge to farmer's use of PPE and knowledge or awareness level of health implications of agrochemical use. Consequently, any mean score above 3.0 was considered as not a challenge.

3. RESULTS AND DISCUSSION

3.1 Demographic Characteristics

According to the data collected from the field survey, more than half of the respondents who engage in farming activities within the Afife community were male with just a handful being female (27.3%). The farming activity within this farming community was skewed towards the aged since majority of respondent were found between the ages of 36 and above 55years (67.3%). This is an indication that the youth were disinterested in the farming activities leaving the old to grow the food crops within the Ketu North District. Again the gender disparities were also another sign that the female were responsible for the house chores whilst the male do the entire hard job in the farm.

3.2 Educational Level of Respondents

In the Table 1, the educational background of respondents showed clearly that 48 out of 110 respondents went through middle school; another 24 respondents completed secondary school with 22 of them making it to Junior high school. This was an indication that at least a good number of them could read and write.

In addition about 90% of the respondents interviewed were farmers with the remaining 5.5%, 3.6% and 1.8% being operators, sprayers and welders respectively. This was a revelation that most of the folks within the Ketu North district who completed either the second or first cycle institutions turned into farming when they could not continue their education.

The study also revealed that quite a lesser number of respondents interviewed worked as labourers (20%) while the majority worked as masters on their own farms.

3.3 Farming Experience of Respondents

The Farming experience of respondents presented in the Table 1 shows that, 43.6% of the respondents have over 15 years farm work experience while 7.3% of them had some working experience between 11 – 15 years. However, 29.1% of the respondents were 6 – 10 years experienced with 20% of the respondents having below 5 years working experience. This was in agreement with the ages of respondents within the Ketu North District. The statistics

revealed that a significant ($p \geq 0.05$) number of them were well experienced as far as the farm work is concerned and this had guided them over the years since experience is the best teacher as the saying goes. This could also be attested to by the personal observation made by the researchers when they observed them during their farm activities on how they carried them.

Table 1. Demographic characteristic of respondents

Variable	Number	Percent
Age (years)		
Under 25	16	14.5
26-35	20	18.2
36-45	18	16.4
46-55	34	30.9
Above 55	22	20.0
Total	110	100.0
Gender		
Male	80	72.7
Female	30	27.3
Total	110	100.0
Educational level		
Primary	4	3.6
Middle School	48	43.7
Junior High School	22	20.0
Secondary School	24	21.8
None	12	10.9
Total	110	100.0
Farm experience (years)		
Below 5	22	20
6-10	32	29.1
11-15	8	7.3
Above 15	48	43.6
Total	110	100.0

3.4 Use of Personal Protective Equipment

The issue of wearing prescribed attire when spraying is a vital precaution against hazard during the farm operation. In response to the question as to whether this important safety measures were ensured, 62 out of 110 respondents strongly agreed that they do wear prescribed attire when spraying on the farm. Another 34 respondents were in agreement whilst 10 of them were neutral. On the contrary, 4 respondents did not wear any of such protective cloths when on the farm spraying. This means that about 88% (SA+A) of respondents with a mean score of 4.4 put on protective attires during spraying activities on the farm. This conformed to what [8] in the practical guide or manual 5 advised, that personal protective equipment and

clothing of the approved type and appropriate for the task must always be used when handling or using agrochemicals, particularly the concentrates marked as “toxic”, “harmful” or “corrosive”. Each item of protective clothing should be suitable for its circumstances of use. Respirators, in particular, should be of a type approved by a responsible authority [8].

Meijden G. [9] reported that, in Ghana generally, farmers do not wear any protective materials at all, no matter what pesticide is being applied. A little more than half of the respondent interviewed at the Afife farming community agreed that their working gears were strong enough to protect them when dealing with harmful chemicals on the farm with the minority being indifferent. It can be deduced that most farmers used relatively good cloths as working gear on the farm. [8] also averred that the strength of PPE required will depend on the harmful effects of the agrochemical and the way in which it is used. However, this research was partially in conflict with [9] that Ghanaian farmers hardly use PPE when using pesticides since about 88% of respondent in this study said they use PPE and 85% of them agreed their PPEs were strong when using harmful chemicals as prescribed by [8] manual 5. The attestation of the farmers were confirmed though personal observations. This could be attributed to the frequent trainings provided by agricultural extension workers to the farmers and the educational level of the farmers as most of them are able to read and write. They are able to read and understand the instructions in the manual that accompanies the agrochemicals.

3.5 Use of Personal Protective Equipment to Protect the Body

The use of personal protective equipment had been one of the best ways of freeing the human body from contacts with dangerous chemicals used on the farm for almost all farming activities. It had therefore become very important to take into consideration certain precautions to eliminate the occurrences of occupational risk on the farm. Table 2 present the responses of respondents on how often some personal protective equipment were used. It indicated that, majority of the respondents were in agreement with the statements that they used these protective equipment when dealing with Agro chemicals on the farm. The reality for their acceptance were that, these protective equipment were used to protect their feet, eyes,

hands as well as their respiratory tracts. As suggested by [10] most agrochemicals present a risk to the user which may be controlled by engineering control measures. Where recourse to the above measures does not suffice, personal protective equipment should be used. However, the use of goggles and respiratory devices showed a little alarm as about 45% and 47% of the respondents showed indifference in their uses respectively. The researchers personally observed the farmers dress for spraying of their field and some of them did not put on the aforementioned two gargets. It implies that the results obtained through the questionnaires are consistent with observations made by the researchers. Nevertheless, it can be concluded that majority of the respondent did not take for granted their health when using agro chemicals on their farms.

3.6 Handling of Personal Protective Equipment

From the research, 87% (SA +A) of the respondents, were very confident that they were able to use PPE properly and therefore, 77% (SA+A) of them made sure that, worn-out PPEs were regularly replaced because they feel more comfortable when they use personal protective equipment. Besides 81% (SA+A) of them said they felt unprotected when not using the correct personal protective equipment. The study however revealed that, only few respondents had misconceptions on the statements under discussion. This indication was clear as respondents said that there were wide spread of the knowledge on the use of protective equipment during farming activities and therefore attached some importance to the use of the PPE. This had some agreement with [8] manual 5 which stated that the various items should be checked for signs of wear and tear and repaired or replaced as necessary. It is good practice to wear outer garments proper. Table 3 gives more details of respondents' responses.

3.7 Awareness of Health Issues on the Farm

According to the respondents interviewed, they were aware that the use of agro chemicals, equipment and tools had potential risks associated with them in the farm. 84 respondents who represent 76.4% strongly agreed to the above statement and the remaining 26 respondents who represent 23.6% agreed. All of

the respondents accepted the fact that any risk incurred during the use of these chemicals, equipments and tools were as a result of carelessness on the part of the user. In a related question about feeling of discomfort/reaction after the use of agrochemicals, 85% (D+SDA) disagree having such an experience. However, 10% (SA+A) confirmed such a feelings of discomfort on some occasion when they were not properly dressed. Further, the respondents were asked if they have ever experienced short/long term residual effects of agrochemical fatality, the various responses elicited were as recorded in Table 3. [9] averred that a major poisoning when using knapsack sprayer is the spilling of pesticides over the back of the operator because of faulty locking cap of the container, cracks and leaks in containers and in over aged rubber hoses and not renewing or loosing 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. Personal observation and checks of most of the sprayers revealed that they were in good working condition. This could be that extension workers and agrochemical sellers educated them on the risk involved in the use of these chemicals, tools and equipment if not used properly. It could also be attributed to their level of education and experience in the farm. This was true as Murray, [11] reported that there exists risk when agro chemicals are used without protective clothing and hence the high risk of contamination. However, precautions must be taken to prevent some of this risk such as chemical accidents or spills that can affect the individual, community and environment. [12] averred that occupational health and well-being and quality of life of working people are crucial prerequisites for productivity and are of utmost importance for overall socio-economic and sustainable development.

Table 2. Use of PPE to protect the body

Personal protective equipment (PPE) usage	Responses(percentages)					
	SA	A	N	D	SDA	MS
I always wear the prescribed attire when spraying on the farm	56.4	30.9	9.1	3.6	0.0	4.4
My working gear is strong enough to protect me when dealing harmful chemicals on the farm	47	38	2	6	7	4.1
I always wear shoes on the farm to protect my feet	54.5	30.9	10.9	1.8	1.8	4.3
I always protect my eyes with goggles when spraying with agrochemicals	27.3	29.1	23.6	9.1	10.9	3.5
I wear gloves to protect my hands when at work	32.7	30.9	21.8	7.3	7.3	3.7
I wear respiratory device when handling harmful chemicals or materials	25.5	27.3	18.2	14.5	14.5	3.3

MS= Mean Score

Table 3. Handling of personal protective equipments

Handling of PPE	SA	A	N	D	SDA	MS
I feel comfortable when using the PPE	67	17	8.6	3.7	3.7	4.4
I regularly replace my worn-out PPE	55	22	11	8	4	4.2
I am confident that i can use the PPE properly	69	18	3	4	6	4.4
I feel unprotected when not using the correct PPE	69	12	3	8	8	4.3
I am aware of the existing potential risk associated with the use of agro-chemicals, equipment and tools in the farm	76.4	23.6	0.0	0.0	0.0	4.8
I have been trained to use PPE properly	47	44	2.0	7.0	0.0	4.3
The storage floor is free from slip	52.7	23.6	12.7	7.3	3.6	4.1
Chemical spills on storage floor were clean immediately	63.6	20.0	9.1	5.5	1.8	4.4
Opening on the storage floor were covered adequately	12.7	30.9	21.8	16.4	18.2	2.0
I have feeling of discomfort/reaction after the use of agrochemicals	6	6	3	12	73	1.6
I have some personal experience on residual (long/short term) agrochemical effect	5	5	4	13	73	1.6

MS=Mean Score

3.8 Storage Floor Condition

The storage rooms where these chemicals were kept were considered to be one way of exposing oneself to hazards and health risk. According to respondents, although many things were kept in the stores, the place was always accident free zone. These were attested by 76.3% (SA+A) of respondents reached out to. They were in agreement that the storage floors were always free from slip. Again, about 83.6% (SA+A) of respondents said chemicals which spills on the storage floor were cleaned immediately to prevent storage attendant from slipping. With openings on storage floor, only 43.6% of the respondents said they were adequately covered. However, 34.6% (D+SDA) of them did not adequately cover openings found in the storage floor. 21.8% of them also said they were not very sure if such openings were covered. It was quite clear that more than half of respondents kept the storage floor from spills with only few respondents who had little concern to openings on the floor. This calls for attention since these opening might breed rodents which would lead to destruction of items ranging from foodstuffs to chemicals. Data collected from the field is shown in Table 3 above.

3.9 Training on the Use of PPE

Detailed responses of respondents on as to whether the individual were properly trained on the use of personal protective equipment were captured in Table 3. It indicated that 91% (SA & A) of them had been trained on how to use PPE properly. This revelation by the respondents regarding the use of PPE is a confirmation of their awareness of safety issues on agrochemical usage. The respondents attested to the use of recommended PPE during mixing and application of agrochemicals. This acclamation has a great positive implication for the health and wellbeing of the farmers. This may lead to the reduction in agrochemical ingestion, absorption, inhalation and intoxication. This result could be attributed to the farmers having a regular contact with extension agents and also training on the use of PPE. The finding is underscored by [13], who reported that inadequate extension services and limited resources also contributed to the regular and widespread incidence of poisoning and misuse of pesticides. However, only 9% (N & SD) of the respondents were not trained on the usage of PPE. This means that quite a large number of respondents went through training properly on how to use personal protective

equipment in order to avoid the occurrences of a health risk. In accordance with [14], the results of this study agreed that all workers should be trained on occupational health and safety. Those specifically working with pesticides are given special training on equipment and pesticide use. Furthermore they should also be trained on hazards associated with pesticides and risk prevention/control measures.

4. CONCLUSION

The research revealed that a great number of farmers in Afife Irrigation Scheme had satisfactorily adopted and practised precautionary method of agrochemical usage. Nevertheless, there are few farmers who have not been practising safe agrochemical usage and since there must be zero tolerance for agrochemical fatalities there is the need to adopt further practical and effective interventions to eliminate agrochemical safety hazard. In that regard, further training of farmers on the agrochemical safety and related health implications is recommended among the stakeholders (farmers, agrochemical dealers and extension workers) couple with awareness creation on dangers associated with unsafe use of the agrochemicals. For sustainability of the aforementioned interventions, frequent capacity building of farmer's and monitoring should be encouraged.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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