

Pesticides Exposure and Biological Monitoring of Ache Activity among Commercial Farm Workers in Tanzania: A Case of Tea Estates

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Abstract: *This study was conducted in three Tea companies in Tanzania. The survey was done to determine the extent of occupational pesticide exposures, injuries and diseases in line with blood test to determine cholinesterase inhibiting substances in the blood samples. Blood samples were taken from 96 spray men, randomly selected from each company. Data on pesticides risk and exposure assessment were collected through personal and face-to-face interview using structured interview schedule, observations and focus group discussion. Simple descriptive statistics were used in the analysis using Statistical Package for Social Science (SPSS) computer software. The Acetyl cholinesterase Test mate photometric analyser kit (RBC) was used to test the cholinesterase inhibiting substances in the blood sample of selected spray men. The exposure rate was found to be 30.7%. Spray men tested for AchE were found to be highly exposed and their blood test fell below the borderline of 24.5u/ghgb. At least 32.4% have occupational pesticides diseases, namely, Headache, Skin irritation, Strong flue, Chest pain, and Coughing, while the rest are under pesticides environment. The survey established that majority of workers in tea companies use pesticides out of ignorance. They cannot associate health problems with pesticides use and exposure. Moreover, there are no proper technical advice/training given to workers on the proper use of pesticides and pesticides safety. Most workers do not take serious note on pesticide safety, coupled with improper use of PPE's, despite efforts of awareness creation on safety precaution using posters on almost every notes board of the companies. It is recommended that special pesticides safe use action need to be developed in tea companies. They should develop job rotations programs as well to minimize exposure among farmers directly working under pesticides. Likewise, enforcement mechanisms need to be established to non compliance of safety practices and PPE use including termination of contracts on non compliance to safety precautions. On the other hand, workers need to be exposed to pesticides safe use and handling training as well as identification of pesticides exposure symptoms. Periodic and ad hock inspection of workers need to be effected by designated national authorities on occupational health and safety.*

Keywords: Pesticides Safe Use; Pesticide exposure, Acetyl cholinesterase; Tea production. Pesticides handling

1. Introduction

The economy of Tanzania largely depends on Agriculture. Agriculture is an important sector of the Tanzanian economy in terms of food production, employment generation, production of raw material for industries, and generation of foreign exchange earnings. The agricultural sector produce about 26 percent of GDP (Economic Survey, 2008).

Tea subsector is one of the most important agricultural sector contributing highly to the national GDP. The Tanzanian tea is grown under two production systems firstly by smallholders, on plots averaging less than a hectare, and secondly on large estates, which often exceed 1,000 hectares.

The sector contributes more than \$30 million to Tanzania's export earnings, making it the fifth largest export crop after cashews, coffee, cotton, and tobacco. More than three-quarters of Tanzania's tea is exported. The tea industry provides employment to 50,000 families and directly or indirectly affects as many as 2 million Tanzanians.

In government efforts to support agricultural development, pesticides are highly used in areas where tea, coffee, flowers, fruits and vegetable farming are practiced, both in small and large scale production. Both small and large scale farmers indiscriminately use large quantities of different pesticides

Owing to heavy foreign investment and the privatization and rehabilitation of the tea estates, which took place from 1988 to 1993, tea companies are using high amount of pesticides to

combat pest and diseases affecting the crop. With regard to this, farmers in developing countries face immense risks of exposure owing to the use of toxic chemicals that are banned or restricted in other countries (Adhikari, 2010).

More pressure for reforms came in 1994, when the Ministry of Agriculture and Cooperatives recommended privatizing the Tea Authority factories to open the way for a more high input production. On the other hand, less concern was put on health concerns and occupational exposure among the employees working under pesticides environment in the companies. FAO (1988) emphasized that the risks of pesticides exposure are even greater in developing countries which usually lack the infrastructure and suitably trained personnel for their safe handling during the stage of distribution.

It is estimated that 18% of pesticides in Tanzania is used in the public health sector while 81% is used in livestock and agricultural sectors and 1% is used in other areas including protecting buildings from damage caused by insect pests (Agenda, 2006). Commercial farmers, to the greatest extent depended heavily on use of these pesticides for control of different pests and diseases.

1.1 Statement of the Problem

Pesticide poisoning is very common in developing countries particularly rural areas where pesticides application is highly practiced (Yassin *et al.*, 2002). According to Abate *et al.*, (2000), most African countries' extension programs

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encourage the use of pesticides but do not consider their effects in the environment and health risks associated with consuming pesticides residues in food materials.

In Tanzania particularly, pesticides are increasingly being used as a means to combat crop pests and diseases to increase productivity. Experience shows that much as efforts are concentrated on the use of hazardous chemical in improving productivity, less emphasize is put in protecting health of the working population against health impacts of pesticides. Much as the tea industry provides employment to 50,000 families, this population is equally at risk of pesticides exposure resulting from direct or indirect contact with hazardous chemicals.

Numerous studies had been undertaken to assess issues pertaining to pesticides use and handling, pesticides health and environmental impacts, pesticides residues, packaging and transportation among smallholder farmers. The study on pesticides use by smallholder farmers by Ngowi et al. (2007) in vegetable production in Northern Tanzania showed that 68% of farmers reported having felt sick after routine application of pesticides. Pesticide-related health symptoms were associated with lacking adherence to information provided on pesticide labels.

On the other hand, there is limited information on status of workers exposure to pesticides in large scale agricultural firms and hence understanding pesticide exposure among workers is essential for drawing firm conclusions about the health effects of pesticides to exposed workers in the controlled agricultural production system.

1.2 Objectives of the Study

1.2.1 General Objective

The general objective was to assess is the extent of occupational exposures, injuries and diseases to spray men in Tea Companies in Tanzania.

1.2.2 Specific Objectives

- (i) To determine the extent of pesticide exposure among workers in large scale tea farming
- (ii) To determine cholinesterase inhibiting substances in blood samples of spray men
- (iii) To establish the extent of pesticide use and handling in Tea companies.

1.3 Research Questions

- (i) To what extent are the workers in tea companies exposed to hazardous pesticides in their working environment.
- (ii) What are the levels on Acetyl Cholinesterase Enzyme Activity in blood sample of spray men?
- (iii) What are the pesticides handling practices among workers in tea companies?

1.4 Justification of the Study

Studies done in areas where pesticides are extensively used in onion and tomato production indicated high pesticides exposure among farmers, poor pesticides handling and disposal of pesticides containers.

The rationale for undertaking this study is to enhance deeper understanding of the extent pesticides exposure in large scale commercial farming and bridge the information gap in this larger scale production which is assumed to be highly controlled.

The study was therefore set to unveil the extent to which workers are exposed to pesticides and identify the limiting factors of effective use of the PPE's. Understanding the extent of exposure among workers is of paramount importance for Ministry of Agriculture, Livestock and Fishes to set up occupation health safety guidelines so as to enforce the current rules and regulation governing occupational safety and health issues that focus more on large scale farming as opposed to current efforts that are more concentrated in occupation safety and health issues in mining and processing industries.

1.5 Scope of the Study

This study interviewed workers involved in large scale tea production. Workers employed and specifically working in section of production where the use of pesticides and other agrochemicals in combating pests and diseases in high.

1.6 Limitation of the Study

The study was done during pesticide application period; workers were very busy and mobile in pesticides application. Companies were hesitant to allow workers to the blood sample test. Likewise, some workers were afraid of undertaking blood test in fear of HIV/AIDS test.

2. Literature Review

2.1 Introduction

This part of the study provides the synopsis of literature review, which includes conceptual framework and review of variables also known as empirical review.

Pesticides Safety and first-aid equipment

According to FAO (1988), all necessary safety, first-aid and rescue equipment and supplies which may be required, should be available and readily accessible before handling a pesticide.

Depending on the hazard of the material being handled, such necessary supplies may include specific or all-purpose gas masks; respirators; goggles or face shields for eye and face protection; water-proof and impervious complete outer clothing, including gloves, boots, hat and long-sleeved, buttoned coat or suit completely covering the worker; adequate emergency water supply for washing off corrosive or toxic materials getting on the skin; and facilities for washing eyes such as fixed or portable eyewash fountains.

Pesticides Exposure among farming population

The farming populations in areas where pesticides are highly used are at risks of diseases resulting from pesticides exposure. Mourad (2005) reported that families of farmers have increased risks of neuroblastoma, nervous system tumours, Hodgkin disease, bone and brain cancer due to

long-term exposure to pesticide and pesticide residues. In a study by Meuling et al. (2004) reported that daily occupational exposure of an individual to chlorpyrifos may result to its accumulation and/or its metabolites in tissues resulting in adverse effects like deaths

The acute health effects of organophosphate exposure among smallholder farmers showed that erythrocyte acetylcholinesterase activities during spraying and non-spraying period were comparable. Similarly, the prevalence of cough, headache, abdominal pain, excessive sweating, nausea, diarrhoea, and vomiting did not differ significantly between spraying and non-spraying periods (Ngowi, 2002).

3. Research Methodologies

3.1 Introduction

This chapter is on the overall research design, sample size, data collection methods and procedures that were observed in finding answers to the research questions.

3.2 Research Design

The survey adopted participatory research methodology by involving workers in collecting data. It implemented as cross sectional study after securing the company's consent and involved pesticides risks and exposure assessment using structured questionnaires and checklists, and red blood cell (RBC) cholinesterase test using the Acetyl cholinesterase Testmate Photometric Analyser Kit.

3.3 Target Population

The study population included workers working pesticides environment in large scale tea companies. The list of names from which the sample was selected was obtained from respective HR offices. The units of analysis were individual workers in respective companies.

3.4 Sampling Procedures and Sample Size

Purposive sampling was used to select tea companies under the study. Decision to select tea companies was based on their extensive use of pesticides in production and risks associated with the pesticides exposure in the plucking process. Workers were randomly selected in proportional to the number of worker directly working under pesticides environment. A total of 96 workers were interviewed and tested for RBC cholinesterase inhibiting substances

3.6 Data Collection Procedure and Tools

Three data collection tools were employed. These included an Acetyl cholinesterase Testmate Photometric Analyser Kit for red blood cell cholinesterase test, questionnaire, and checklist for pesticides risk and occupation diseases assessment.

3.7 Data Analysis And Presentation

Analysis of in information collected was done using two different approaches. Information collected with structured interview using questionnaires was cleaned and analysed using the SPSS (Statistical Package for the Social Sciences) computer software.

Data of blood samples collected through Acetyl cholinesterase Testmate Photometric Analyser Kit were compiled and analyzed manually using excel.

4. Results and Discussion

4.1 Demographic Characteristics

4.1.1 Respondents' Profile

Majority of the workers were males (81.1%), with the highest education level of primary education (91.9%). Majority of female workers (75%) were only found were involved in weeding and irrigating tea nurseries. A considerable proportion (43.2%) had worked in the company between 1-5 years, and 10-20 years (13.5%), hence the results reflect a real situation in as far as pesticides exposure is concerned.

4.1.2 Pesticides used in tea companies

Five different types of pesticides formulations were identified by the workers. The major groups of pesticides used include insecticides, (Dursban 21.6%), herbicides (Round up 27% and gramoxon 24.3%), and fungicides (Dithane 37.8%). Gamaline (18.9%) was also identified.

Dursban and gramoxon are classified in class II of WHO Hazardous class, while dithane and round up are in class IV according to the WHO classification of pesticides. This shows that workers are at high risk of exposure.

Pesticides used in large scale tea farms were found to fall under different registration status. Gramoxon is registered under restricted registration, which implies that they are only allowed to be used in extreme situation under highly controlled and protected conditions. Its permit is provided under specific conditions.

Gamaline is a non registered pesticide, not included in list of Registered Pesticides in Tanzania, implying that investors are using other pesticides products other than those registered in the country, posing much risks in handling and management in cases of pesticides exposure.

According to the WHO Hazard classification of pesticides, Class Ia – Extremely hazardous, Class Ib – Highly hazardous, Class II – Moderately hazardous, Class III – Slightly hazardous, Class IV - Not hazardous under recommended conditions of use.

Table 1: Pesticides recorded as commonly used in Tea companies

WHO Hazardous class	Trade name	Common name	Chemical family*	Registration Status	No. of responses	% of responses
IV	Dithane M-45	Mancozeb	OP	Provisional	28	37.8
II	Dursban 24ULV	Chlopyrifos	OP	Provisional	16	21.6
II	Gramoxon	Paraquat	-	Restricted Registered	18	24.3
IV	Round up	Glyphosate	-	Provisional	20	27
	Gamaline	-	-	-	12	18.9

* OP= Organophosphates;

4.1.3 Frequency of pesticides application, spraying equipments and pesticides storage

The survey showed that workers (51.4%) have spraying schedule for pesticides spraying, 18.9% spray continuously till they finish pesticides provides, spraying up to six hours a day. The major spraying equipment is the knapsack (76%) while in some cases buckets (21%) are used. Majority store pesticides and spraying equipments in pesticides store (70.3%).

4.2 Pesticides Handling and Management

4.2.1 Adherence to pesticides label instruction and first aid

The survey revealed that only 32.4% sometimes read instruction on pesticides containers and just a few follow the instructions. Arguments put forward for not following instructions include some labels written in English (foreign language), unknown signs and symbols. On the hand, 24.3% of all workers interviewed do not read the labels at all and 13.5% depends on the supervisors to read for them. It was revealed that 70.3% get information on pesticides safety from the health and safety officials of the company. It was also noted that pesticides empty containers are collected back to the pesticides store (59.5%) for disposal.

With regard to pesticides safety training, majority of workers (78.9%) had not been equipped with pesticides safety training, and safety is much more referred to in transport facilities.

It was also revealed that most workers do not know first aid action in case of pesticides poisoning. 21.6% do not know what do in case of oral, and lung contamination, 16.2% drink milk while 35% would do nothing. In skin/eye contamination 59.5% wash with clean running water. A considerable proportion (51.4%) does not spray with leaking sprayer.

Table 2: Adherence to pesticides label instruction and first aid

Response	Number of workers	% of workers
Read instructions always	24	32.4
Follow instructions	18	24.3
Get information on pesticides safety	52	70.3
Trained on pesticides issues	2	2.7
Drink milk as First aid in case of oral contamination	16	21.6
Wash with water as First aid in case of skin/eye contamination	46	59.2
Do nothing lung contamination	26	35.1
Report to hospital in pesticides contamination cases	16	21.6

4.2.2 Pesticides poisoning and AchE activity

It was revealed through red blood cholinesterase test that 30.7% of the workers are highly exposed to pesticides and their AchE activity fall below the WHO international borderline of 24.4u/ghgb. This implies that workers are highly exposed to pesticides in commercial large scale tea farms that are assumed to be highly controlled in terms of occupational safety and health practices.

On contrary, only 16.2% of the workers said they had pesticides poisoning due to exposure, and a considerable proportion (59.5%) said no, yet pesticides symptoms were observe among them, implying a lacking connection between pesticides exposure and resulting health impacts.

4.2.3 Pesticides risk perception

The survey revealed that majority of worker understood the concept that pesticides are of poisons and has the potential to harm/kill. It also showed that 91.9% of the spray men had emergence water in tea farms and nurseries while spraying pesticides.

Despite the fact that pesticides are poisons, most worker do not properly use PPE's provided, especially gloves due to unfavourable hot weather and difficult handling of tender tea seedlings (in order to avoid damages of seedlings during transplanting and weeding).

Inspection of pesticides stores showed that there were in good conditions, enough light and good ventilation. There were no spillages, PPE's available, good pesticides arrangement and warning alert at the entry.

4.2.4 Signs and symptoms of pesticides poisoning

A health survey to detect signs and symptoms of pesticides poisoning was carried out. This was done by interviewing workers after taking blood samples for red blood cholinesterase test.

It was observed that majority had headaches (32.4%) skin irritation (32.4%), strong flue, coughing (24.3%) and chest pain (10%)

The survey further revealed that much exposure resulted from dursban and gramoxon in tea nurseries and farms through skin contamination. This was because worker were not using gloves despite being provided, in fear of damaging seedling when handling tree nurseries.

Table 3: Signs and symptoms of pesticides poisoning among 37 workers

No.	Symptoms	Numbers of workers	Percentage of workers
1.	Headache	12	32.4
2.	Skin irritation	12	32.4
3.	Strong flu	12	32.4
4.	Chest pain	10	27
5.	Coughing	9	24.3
6.	Excessive sweating	7	18.9
7.	Nausea	7	18.9
8.	Dizziness	6	16.2
9.	Loss of appetite	5	13.5
10.	Throat irritation	5	13.5
11.	Fever	4	10.8
12.	Wheezing	4	10.8
13.	Eyes irritation	3	8.1
14.	Lacrimation	3	8.1
15.	Pain during urination	3	8.1
16.	Poor vision	3	8.1
17.	Salivation	3	8.1
18.	Stomach pain	3	8.1
19.	Vomiting	3	8.1
20.	Diarrhoea	2	5.4
21.	Difficulty in breathing	2	5.4
22.	Sleeplessness	2	5.4
23.	trembling	2	5.4
24.	loss of consciousness	1	2.1
25.	Nose bleeding	0	0

4.2.5 Precautionary behaviour and Personal hygiene

The survey revealed that some workers ate and/or drank while spraying, and took a bath soon after spraying (91.9%), clothes worn during spraying were washed soon after spraying (40.5%) while 21.6% wash once a week.

Unhygienic personal behaviour was much profound at two estates where 72.7% and 37.5% respectively washed spraying clothing once a week.

4.2.6 Use of Personal Protective Equipments (PPE's)

It was revealed that majority workers (83.8%) were supplied with personal protective equipment (PPE's), some wear protective gears when working with pesticides while other do not wear them due to hot weather and danger of damaging young tea seedlings.

Workers working without PPE's was prevalent in estates where herbicides are highly sprayed all day long, and in tea nursery were transplanting and weeding require high care handling. Spraying, transplanting of tea seedlings, and weeding of tea nurseries in most cases done with bare hands, exposing them to hazardous pesticides.

The case was more serious in one estate where 87.5%, do not wear glove, masks, glasses, overalls respectively during weeding of spraying nurseries, 100% have no respirators and/or head covers. Almost 100% of female workers were found to work without PPE's resulting to high exposure to pesticides.

Table 4: Protective gears used

PPE	Number of workers	% of workers
Boots	33	89.2
Overall	27	73.0
Gloves	26	70.3
Masks	25	67.6
Glasses	24	64.6
Head cover/helmet	7	18.9
Respirator	0	0

5. Conclusions and Recommendations

5.1 Conclusion

The survey had shown that workers in large scale tea companies are exposed to pesticides and majority were still working under pesticides environment.

Pesticides exposure and poisoning are among the occupational hazards observed in tea nurseries and farms through red blood cholinesterase test and risk and exposure assessment.

Workers do not put in effective use of PPE's despite the fact that they are provided by the companies. The major reason for not using PPE's was based on hot weather difficulties in handling tender seedlings with gloves and gumboots.

The study also had shown that majority workers do not read pesticides labels. A few that read do not use the information in the application process. The major source of information on pesticides safe use was found to be supervisors and health officers.

It was also found out that most workers in large scale tea companies are not trained on pesticides safe use and handling practices. They use pesticides out of ignorance and cannot associate health problems with pesticides use and exposure. It was also realized that there was no proper technical advice given to workers on the proper use of pesticides and pesticides safety. Likewise, most workers do not take serious note on pesticide safety, coupled with improper use of PPE's, despite efforts of awareness creation on safety precaution using posters on almost every notes board of the estates.

5.2 Recommendations

An in-depth training on pesticides safety and handling is vital to all workers, and more especially to supervisors and health and safety officials of each estate to gain awareness, taking precautions, understanding and recognizing signs and symptoms of pesticides poisoning.

Workers also need to be introduced to first aid principals and procedures to be applied in case of problems of pesticides poisoning or related effects before consulting a medical doctor.

Enforcement mechanisms need to be established to non compliance of safety practices and PPE use including termination of contracts on non compliance to safety precautions

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