

**Pesticide Handling, Usage and Predicted Contamination in Cameroon: Case of Tomato
(Lycopersicon esculentum Mill) Farmers in Bui Division**

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Abstract

Introduction: Agriculture is a vital economic sector in Cameroon, especially since an estimated 45% of Cameroon's gross domestic product (GDP) depends on it and the traditional food crop is part of an integrated household-farming system. **Objective:** The objective of this study was to assess the way farmers in Bui division handle pesticide, its usage and predicted contamination. **Methods:** A cross-sectional research method was used to collect data from tomato farmers in the Bui Division, using a questionnaire developed by the research team. This study was carried out in Bui, Cameroon, from April to September 2018, to understand phyto-sanitary practices conducted by tomato farmers. **Result:** Majority of the farmers (74%) used their own personal measurement, by their own thoughts and experience, while only 26% use manufactures measurement. Fifty percent (50%) of the farmers obtain pesticides from agricultural product dealers, commonly called "farmers' house". Majority of the farmers (68%) do not use protective wears to protect themselves from the effect of the pesticides, while only 32% of them do use protective wears. Majority (72%) of the farmers do not have any formal training on pesticide application. As a result of exposure to the pesticides, majority (44%) of the farmers suffers from body itches, while 20% suffers from rashes and 8% suffer from body irritation. **Conclusion:** Pesticide poisoning cases were recorded and side effects such as itches, light vision, burns, and rashes were common. This study calls for pesticide residue analysis of

tomato and potable water as well as the monitoring of the health status of the farmers for chronic illnesses.

Key words: Tomatoes, pesticides, residues, environment, and personal protective equipment.

Introduction

In Cameroon, the economy is still fundamentally based on agriculture. The traditional food crop is part of an integrated household-farming system. Agricultural production is mainly based on small scale farms which generally depend on household labour [1]. Then, priority is given to sufficient production of food for household and domestic consumption. The part of produce is exported to neighbouring countries such as Gabon, Equatorial Guinea, and Nigeria. The production is mostly focused on vegetables [2]. To increase production and to meet the high demands, the use of pesticides has been highly used in vegetables farming. However, according to standards set by World Health Organization [2], only pesticides that are safe to farmers and farmworkers, other non-target species and the consumers should be used in production of vegetables. But the safer pesticides are often either more expensive or less efficacious. Farmers and pesticide users are required, to handle, apply and discard leftover pesticides safely to reduce the hazards they pose to non-target animals, themselves, and plant species [3]. Much of the problem came from the toxicity of the pesticides used by many small-scale farmers, without adequate knowledge and failing to adequately protect themselves during pesticide applications. Pesticide application causes serious health problems, but blames are usually laid on pesticides without considering the way the pesticides are applied [1].

Agriculture is a very vital economic sector in the Cameroon since an estimated 45% of Cameroon's gross domestic product (GDP) depends on it [4]. He traditional food crop is part of an integrated household-farming system [5]. Therefore, crop destruction would paralyze many households, so farmers rely on pesticide use for pest control due to its apparent lower cost. However, according to World Health Organization standards [6], only pesticides that are safe to farmers and farmworkers, other non-target species and the consumers should be used in crop production especially tomatoes. Pesticide use has increased over the past 20 years, highest in low-income countries starting from a low base like Cameroon, Ethiopia, and Burkina Faso with an 8-to-50-fold increase [7].

Pesticides use in tomato farms are classified according to their target organisms, chemical class, and toxicity. According to their target organism, they are divided into insecticides, fungicides,

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herbicides, rodenticides, and bactericides. Previous studies have revealed that the most used pesticides in low-income countries like Cameroon are insecticides contrary to herbicides which are the mostly used at the global level, given that weeding is done manually in Cameroon [8-11]. According to research carried out by Tambe *et al.*, [12], 35.6% of the participants were trained on the use of PPE while 64.4% did not received any form of training. Thirteen participants (12.5%) used safety boots during the spraying of pesticides as compared to 87.5% who did not. The use of safety glasses was also assessed, 31.7% used safety glasses when required while 68.3% did not. Regarding the use of gloves, the analysis revealed that 49.0% used glove during work as compared 51.0% who did not. Only 35.6% of the participants put on raincoats during the spraying of pesticides while 64.4% did not wear.

Work-related pesticide poisoning has increased globally, especially in less-developed countries [13]. It has been estimated that yearly about 25 million agricultural workers globally experience unintentional pesticide poisoning [14]. The main obstacle to control and prevent work-related pesticide poisoning is that the scope and magnitude of this issue often remains uncharacterized, especially in an underserved population such as farmers [15].

In a study done by Tambe *et al.*, [16] in 2019, 35.6% of the participants were trained on the use of PPE while 64.4% did not received any form of training. Hirteen participants (12.5%) used safety boots during the spraying of pesticides as compared to 87.5% who did not. He use of safety glasses was also assessed, 31.7% used safety glasses when required while 68.3% did not. Regarding the use of gloves, the analysis revealed that 49.0% used glove during work as compared 51.0% who did not. Only 35.6% of the participants put on raincoats during the spraying of pesticides while 64.4% did not wear.

In this study Tambe *et al.*, also assess the side effects of pesticides on farmers exposure to it. Work-related health problems/complaints showed that 24% complained of skin irritation after spraying of pesticides, 10.6% complained of backache, 9.6% nervous system injury such as headache and dizziness, 16.3% reported visual problems and 4.8% complained of respiratory difficulties [16].

Tomato is the most extensively cultivated fruity vegetable in Cameroon, which is grown in all the different ecological zones in the country. While just about 1% is exported to neighbouring countries like Equatorial Guinea, Nigeria, and Gabon, most of it is consumed locally [17]. Tomato production is a primary farm activity that provides income for most households in the country. Regardless of all the many benefits of the crop, its production still faces myriad of

challenges making it unprofitable. Some of these challenges can either be production, post-harvest, marketing, or a combination of all [18]. Cameroon is among the major producers of tomatoes in the Central African sub-region with almost 1068,495 tons in 2018 [19]. However, the full potential of the crop has been untapped because of numerous constraints such as inappropriate harvesting techniques, excessive field heat and lack of on-farm storage facilities, poor rural roads, inappropriate modes of transport, lack of processing equipment which sometimes reduce the quantities that reach the markets, thus causing shortages and inducing high prices [20].

Materials and Methods

Study design

The research made us of both the descriptive and the analytical research designs. The purpose was to obtain qualitative data based on the theoretical data focusing on poor handling and usage of pesticides by farmers within this area of study and the effects as a result of being exposed to these harmful chemicals in Bui division.

Study Site and population

The element of study covered good number of villages like Yer village, Kimar, Sop, Ngondzen, Wvem, Mbam, Vekovi and Ber on how tomato is cultivated with the use of pesticides in Bui division North West Region, Cameroon. The study population was all the tomato farmers in some randomly selected villages in Bui division North West Region, Cameroon.

Sample Size

Sample size calculation was done using sample size formular for unknown population, where; N= population size, Z= Z-Scores, e= margin of error, p= standard of deviation, N=65, Margin of error=0.05, Confident level= 95%, Standard of deviation=50 %(0.5) and Z-Score=1.96.

$$\begin{aligned} &= \frac{Z^2 \times P(1 - P)}{e^2} \\ &= 1 + \left(\frac{Z^2 \times P(1 - P)}{e^2 N} \right) \\ &= \frac{1.96^2 \times 0.5(1 - 0.5)}{0.05^2 \times 65} \\ &= 1 + \left(\frac{1.96^2 \times 0.5(1 - 0.5)}{0.05^2 \times 65} \right) \\ &= \frac{3.846 \times 0.25}{0.0025} \end{aligned}$$

$$\begin{aligned} &= + \left(\frac{3.8416 \times 0.25}{0.1628} \right) \\ &= \frac{334.16}{5.9101538461} \\ &= 56.54 \end{aligned}$$

This gave a total sample size of 57 participants.

Data Collection Tools

Data was collected in the month of April 2018 using the following data collection tools.

Questionnaires to farmers focused on pesticide management and site effects, Interviews guides, Direct observation, digital camera to get pictures of the farms, the pesticides, and other associated images to be used for demonstration.

The questions were drawn from the terms extracted from the review of the literature in addressed general areas such as problem, problem solving, training, motivation. Most questions were rated on a scale ranging from Yes and No. The rest were open-ended (other) responses were included to give tomato farmers the opportunity to additionally rate other areas in which they felt were important but were not already included on the survey.

Interview guides was used to collect data directly from tomato farmers through face-to-face questions and answer process. This was in the case where the tomato farmers did not have time to fill the questionnaires, or in areas where additional or follow-up questions were needed which were not captured in the questionnaires.

The data was collected from these groups of tomato farmers in order to understand how pesticide are being applied in their tomato farms since some of the farmers are still complaining of health effects being rendered by the used of these harmful pesticides and to recommend possible changes to better the situation.

Data Analysis

Data obtained from the field was analyzed using the Statistical Package for Social Science (SPSS). Results were presented in terms of frequency and percentages using tables and charts.

Results

Questionnaires were administered to the tomato farmers within the cultivated areas. A total of 50 responses were obtained. Of the 50 participants, 76% of the farmers were males while 24% were females. The data obtain shows that 34% of farmer's nurse their own seeds, 28% buy

from other farmers while 20% buy from agricultural products dealers and 18% buy from the market

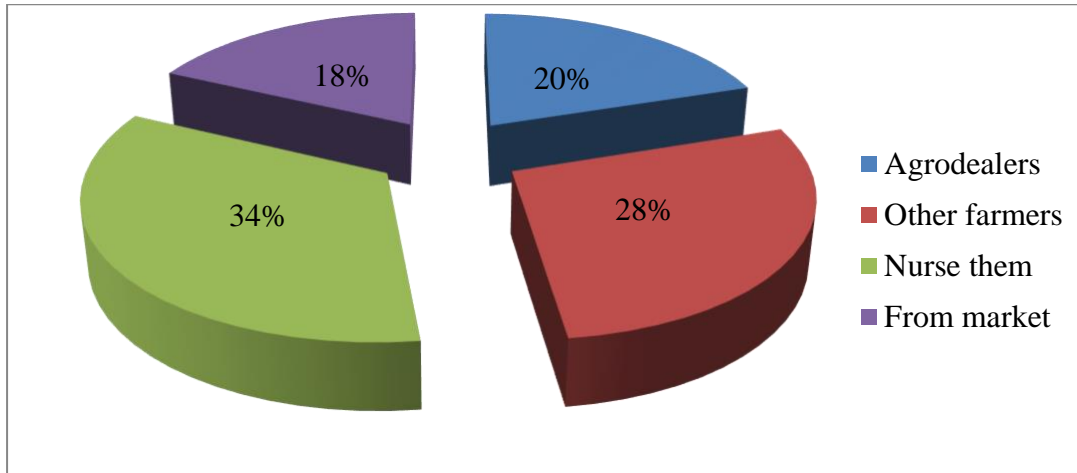


Figure 1: Source of seed for farmers

According to the farmers, 52% of the tomatoes is grown in the rainy season, 40% in both rainy and dry seasons, 6% within the dry season and 2% anytime.

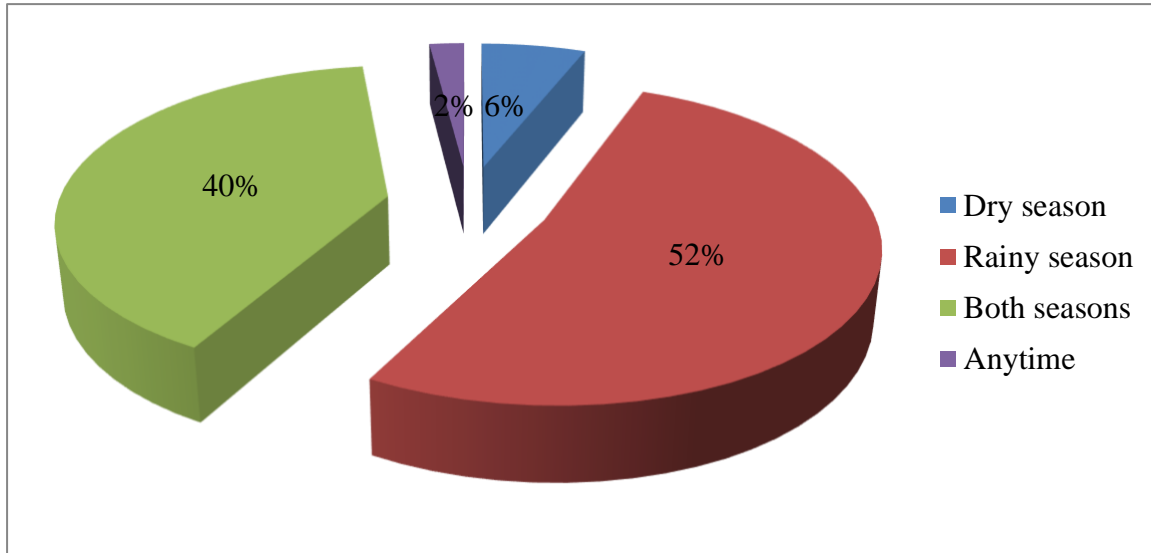


Figure 2: Distribution of Tomato growing seasons

The information above shows that 66% of the cultivated tomatoes take 3-4months to mature while 34% is between 2-3moths.

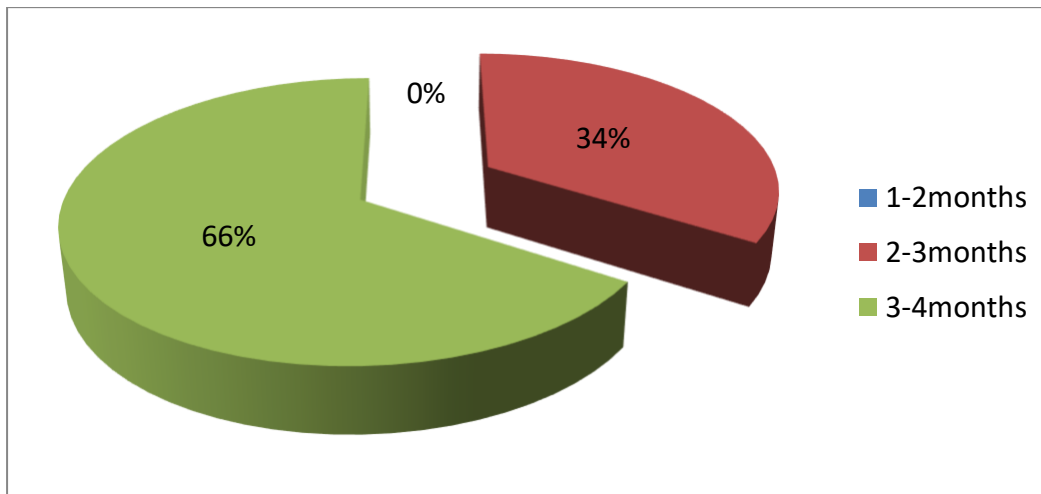


Figure 3: Distribution of period of tomatoes maturity

It was observed that 60% of the farm produce is sold in distant markets, 18% within the local community market, and 14% at international market and 8% is sold in the farm.

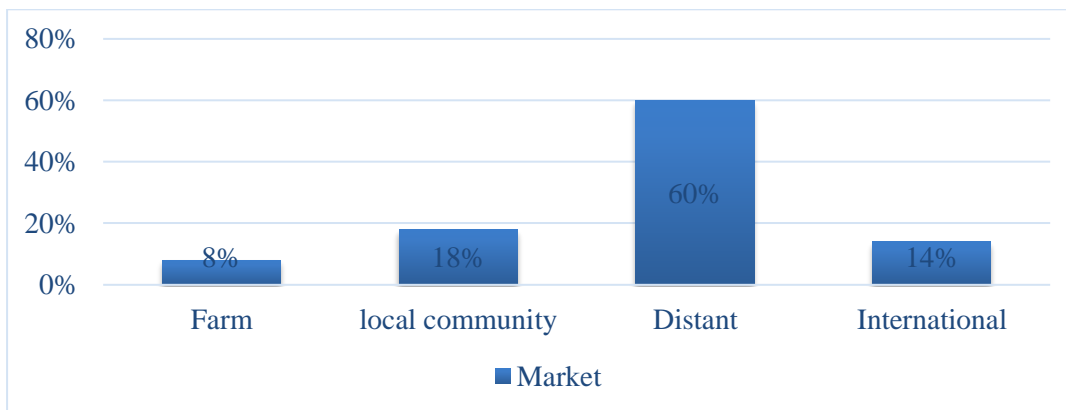


Figure 4: Distribution of available markets for tomato

In terms of farming experience, the result shows that 56% of farmers have experience ranging from 0-10years, 34% from 10-20years, while 8% were from 20-30years and 2% with experience above 30years.

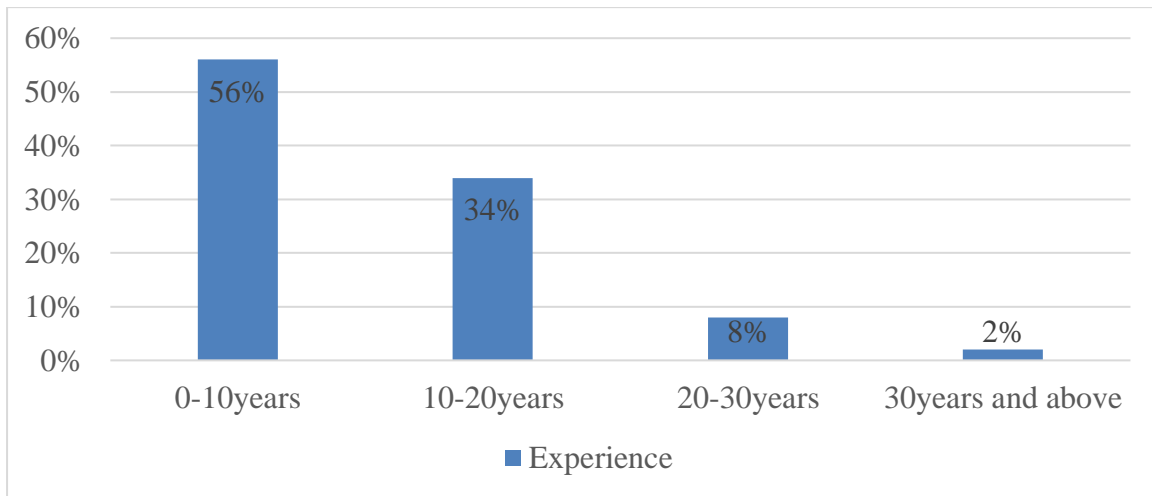


Figure 5: Distribution of years of farmers experience

For information about pesticides, as shown in Fig. 6, 38% of farmers reported that they get information on pesticide use from other tomato farmers and pesticide label, 18% from agricultural products dealers and 6% from workshop/seminars.

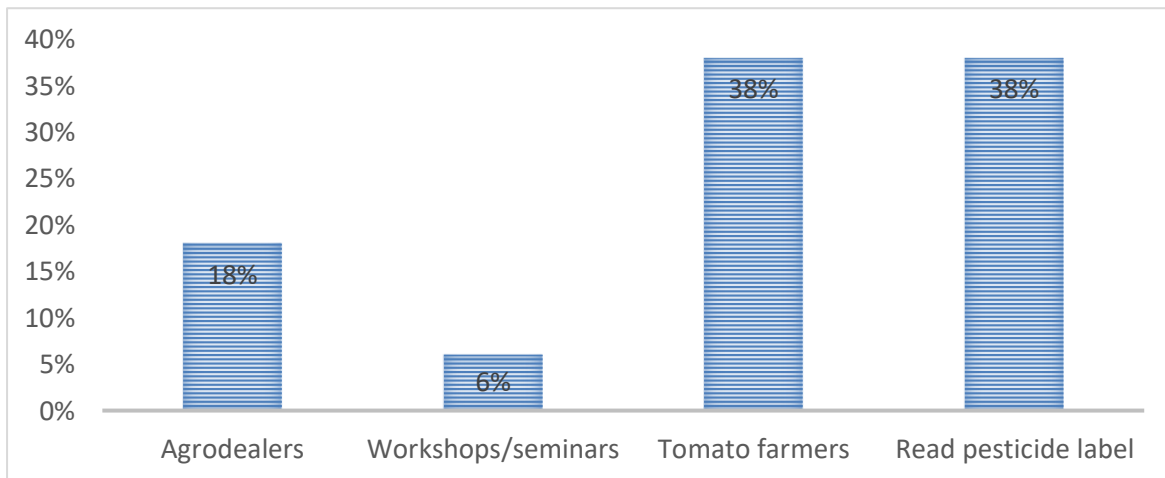


Figure 6: Distribution of sources of information on pesticide used

According to the result, majority of the farmers (74%) used their own personal measurement, by their own thoughts and experience, while only 26% use manufactures measurement (Fig 7).

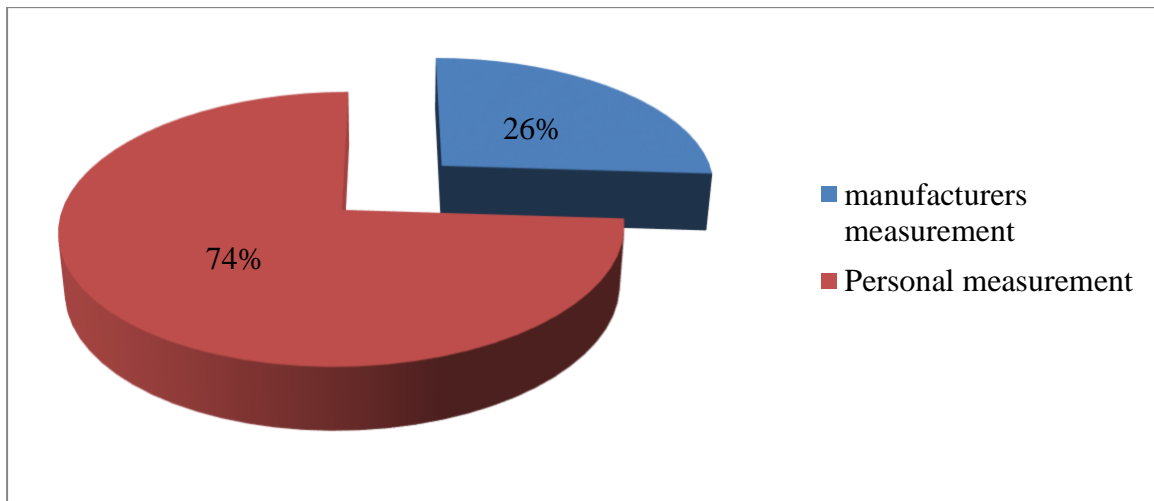


Figure 7: Distribution of pesticide measurement by farmers

Majority of the farmers (50%) obtain pesticides from agricultural product dealers, commonly called “farmers’ house”, while 46% buy from other farmers who also buy in large quantities and keep on sale, and 4% from the market who buy from the agricultural product dealers and retail it at the market.

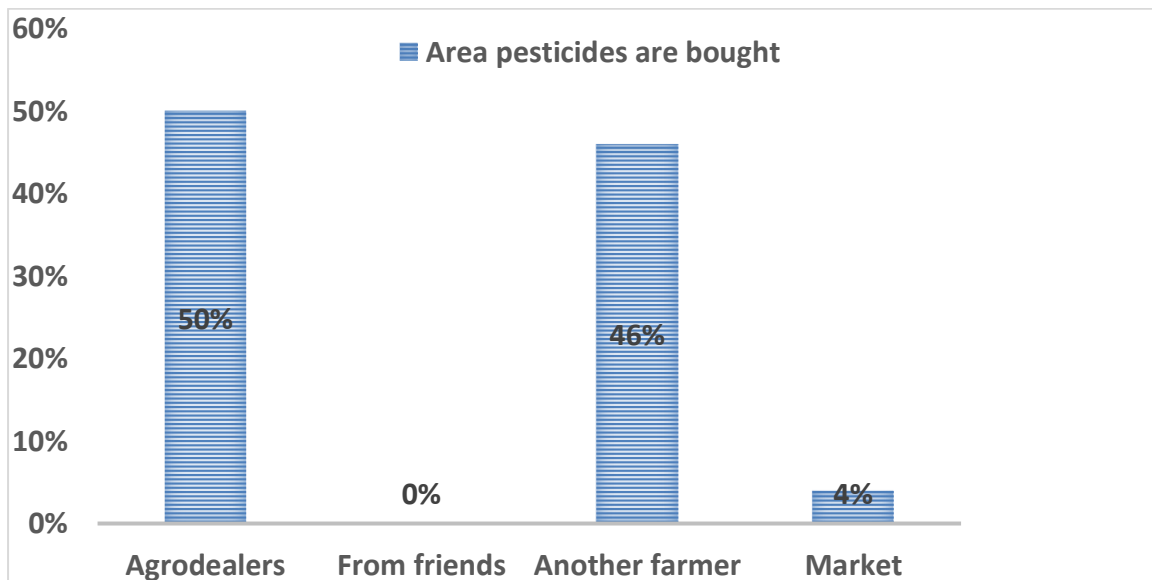


Figure 8: Distribution of sources of pesticides

According to the result, majority of the farmers (68%) do not use protective wears to protect themselves from the effect of the insecticides, while only 32% of them do use protective wears.

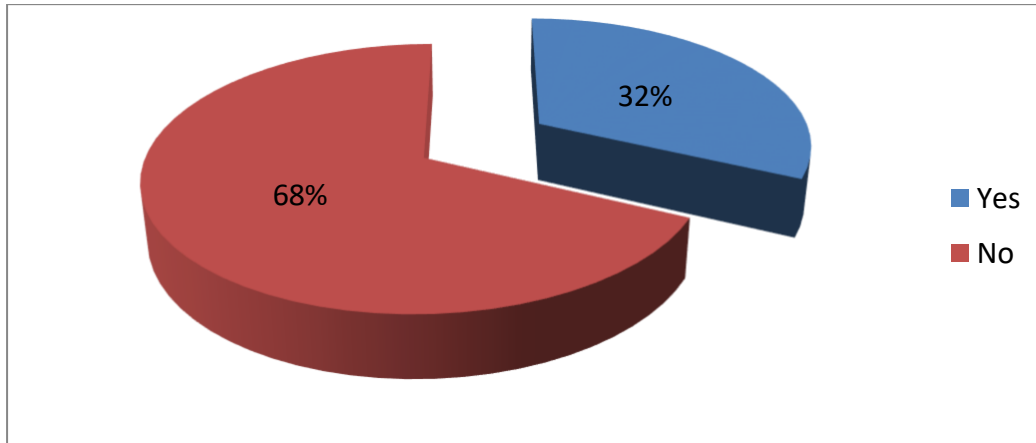


Figure 9: Distribution of the use of protective wears

On the bases of receiving training by farmers on the use of pesticides, majority (72%) of the farmers do not have any formal training on pesticide application, while only 28% have received some training on the use of pesticides.

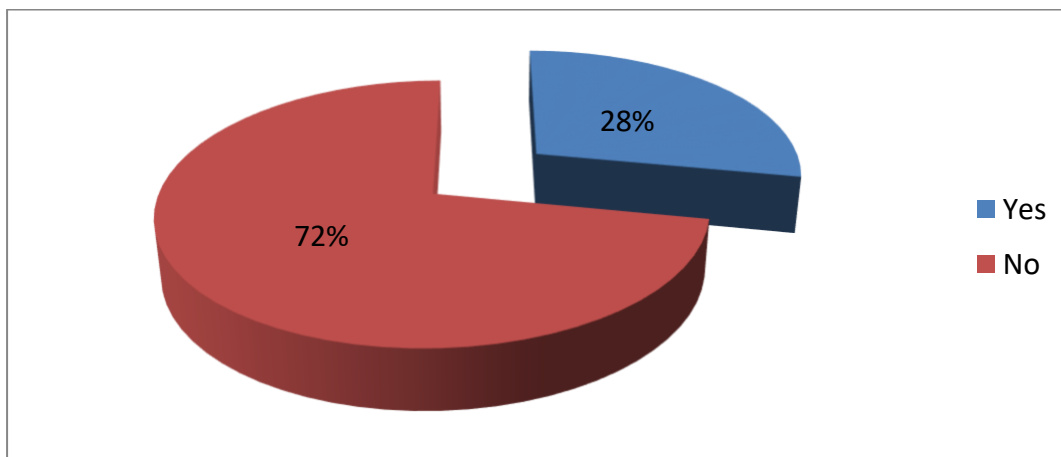


Figure 10: Have received training on pesticide usage

As a result of exposure to the pesticides majority (44%) of the farmers suffers from body itches, while 20% suffers from rashes and 8% suffer from body irritation.

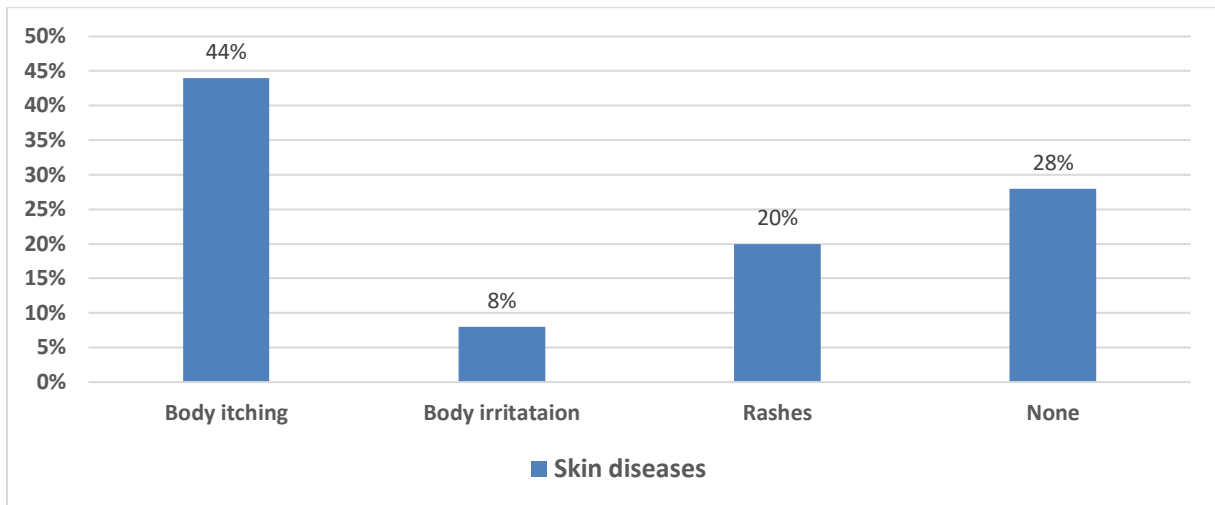


Figure 11: Effect of pesticide on the skin

Considering the effect of the pesticides on the eye, 36% of the farmers do not have any eye problem, but 24% suffer from light vision, 20% have eye pain, 14% with eye irritation and 6% having eye itches.

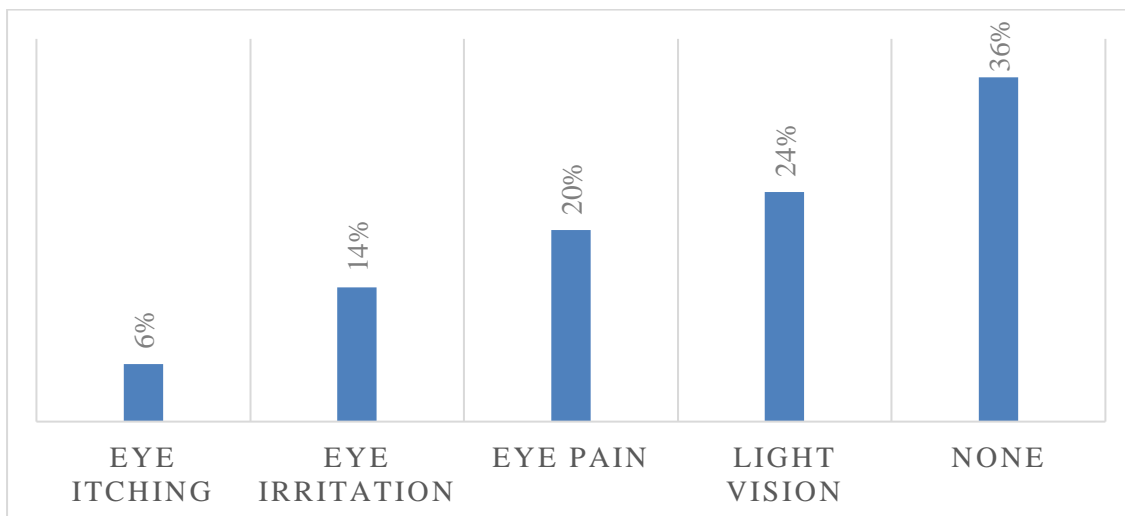


Figure 13: Effect of pesticides on the eye

According to the growth stages, different chemicals are being applied. The result showed that 46% Penncozeb 80wp, 10% of cigone C36, 6% of Doyern, 66% of Monchamp 72wp, 38% of Plantized, 8% of K-Optimal and 8% Vitamin are used in the nursery stage, while 48%,10%,6%,66%,38%,10%,8% with respect to the above order is applied at the transplanting stage, while 100% of all these pesticides are applied at the growth stage.

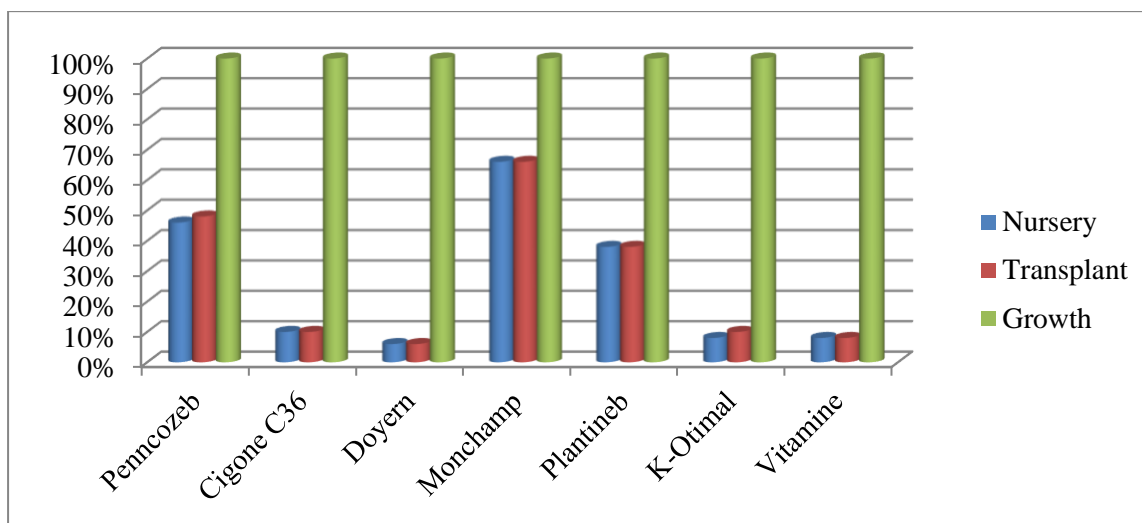


Figure 14: Distribution of chemical at different growth stages

Table 1. Comparison of the recommended pesticide application mode by CPAC/MINADER with the observed application mode by studied farmers.

CPAC/MINADER recommended application modes	Farmers application modes
<ul style="list-style-type: none"> ▪ Avoid mixing two or more insecticides together to control a single pest ▪ Proposed measuring equipment by manufacturer ▪ Effective use of Personal Protective Wears (PPW) ▪ Never allow a mixed pesticide to stand overnight before applying. 	<ul style="list-style-type: none"> ▪ Mixing of insecticides and fungicides in one sprayer ▪ No use of measuring equipment (eating spoons mostly used for all measurements) ▪ Less Personal Protective Wears (PPW) applied ▪ Sometimes mixed pesticides stand for a week before application is done.

Discussion

Pesticide users found in Bui division are mostly men and women who are not well educated, with majority of them being males. These results confirmed the findings of Tarla et al. [21] who reported that majority of small-scale tomato farmers in the Western Region of Cameroon

were males. They are mostly holders of First School Leaving Certificate (FSLC). This is in line with a study done by Tambe et al., [12], where the result revealed that secondary school was the highest level of education attained by majority of tomato farmers in the study area. This little or no education reflects the ignorance on application that obviously leads to misuse and long-term high amount of pesticide residues in harvested tomatoes. This is linked to their ignorance on following instructions from manufacturers. But this study revealed that, in the North West Region of Cameroon in general, gardeners were mostly secondary school graduate. This situation has also been observed in the Foubot area, on tomato farmers. Market gardening is a very important farming type in Bui as it is a major livelihood activity of most people in terms of income, employment, and subsistence.

The most used of fungicides and insecticides testifies the favourable environment for plant diseases development and the effectiveness of those active ingredients. The frequency of uses shows the desire of farmers to protect their crops. However, farmers do not always apply pesticides adequately [12]. It has been observed that, the choice of a pesticide should be always specific to a pest/disease problem found on the field because farmers do not have technical documents establishing the relationship between the pest/disease and the product to be used.

The application parameters such as pre-harvesting time, spraying frequency and period are particular and will obviously lead to high amount of pesticide residues in harvested foods. Days given for active ingredients degradation vary from one product to another. But the farmers don't take it into consideration since they harvest according to the availability of buyers [5]. The period of spraying and frequency also will greatly contribute to the presence of pesticide residues. When tomato fruits matured, farmers harvest twice a week and applied pesticides 2-3 times a week. It could therefore happen that the harvesting and spraying processes take place on the same day. This is an unfortunate situation in which the farm workers and consumers were all consuming high levels of pesticides throughout the year.

Considering these factors, the consumer is under high risk. Farmers do not read pesticide labels due to illiteracy and ignorance [12].

The method of spraying too will contribute to the level of pesticide residues and will lead to the high contamination of the environment. So untargeted organisms will be affected and can induce the ecosystem some difficulties [5]. The measuring tools are not adequate, and they can just use what they have at their one disposal and consequently, the spraying parameters (dosage, spraying materials and time, frequency, etc.) will not cope with the good agricultural

practices (GAP) as recommended. The rate and frequency of pesticide application are generally influenced by the disease/pest pressure, season, label, frequency of rainfall, or the advice of pesticide distributor.

In addition, the mixture done by pesticides applicators does not respect any standard norms. They mix mostly insecticides and fungicides for once spraying. But some will mix many fungicides to improve the effectiveness and to cope with the market prices because powerful pesticides are expensive, and their capital does not permit them to invest on that. The mixture becomes too toxic, and this exposed farmers to the numerous kinds of diseases which are linked to it effect in the long term and short term. The safety measures taken by these farmers are not enough for the majority since there is no training and assistance to conveniently take precautions for their personal health.

It's also observed that most of these pesticides are used to eliminate insects, control blight and as well enhance plant growth. All these pesticides are applied on the leaves of the plant, stem, and the fruit. All these are geared toward obtaining high yield thus more pesticides need to be used to fight against these diseases.

Unfortunately, 38% of farmers did not receive any advice of the agricultural extension workers. According to the farmers who received their advice, they assisted in the choice of pesticides and technical follow up. When farmers were left on their own, pesticide sellers orientated them towards the available products or those products that correspond to the amount of money the farmer can afford. Tomato farmers had little opportunities to attend training on proper pesticides handling and usage practices [12]. Most of them were willing and ready to attend training workshops as they believe it will address most of the problems they have been facing over time.

Conclusion

This study was aimed to survey and trained tomato farmers in Bui division on good pesticide handling and usage practices. Poor pesticide handling and usage on tomato recorded numerous effects on farmers in Bui ranging from environment, food and health as farmers were operating not respecting the standard norms set by the CPAC/MINADER on good pesticide management. The quantity and frequency of pesticides applied here overloads the environment and pesticide residues in the harvested products and the water should be above the maximum tolerable levels for human consumption. Thus, this study calls for pesticide residue analysis of tomato and potable water as well as the control of the health status of the farmers for chronic illnesses.

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