



Assessment of the current patterns and practices of use of pesticides in tomato based agrosystem in Kaliluni, Kathiani Constituency, Kenya

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Full Length Research

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Pesticides have been of great benefit to agriculture in Kenya by decreasing crop damage from insects, weeds, plant diseases, rodents and other pests. They have also saved lives through control of disease - carrying insects and increased the quality and quantity of agricultural produce. However, pesticides are poisons, that if not properly used can affect human health and contaminate the environment. In this study, 72 households in Kaliluni, Kathiani Constituency in Kenya were involved in a cross-sectional survey to assess the frequency of pesticide use, storage, use of personal protective clothing, mixing, disposal of pesticide containers and knowledge of pesticides. Tools used for data collection were: structured pretested questionnaire, personal interviews, focused group discussion and observational checklists. The study revealed that 86.1% of the respondents use pesticides on weekly basis whereas 12.5% use it after every two weeks. It was found that 72.2% of the respondents store pesticides in insecure and unventilated store. In addition the study revealed that 50% of the respondents always wear apron when applying pesticides whereas 41.7% do not wear apron when applying pesticides. Majority of farmers, 76.4%, mixed Carbamate and Pyrethroid before applying the pesticides to tomatoes. According to the study, 51.4% of the farmers bury the expired chemicals whereas 26.4% ensures that they buy enough chemicals thus avoiding expiry of chemicals. From the study it was found out that majority of the farmers, 59.7% were aware that pesticides have effect on environment while 40.3% are not aware of the same. Education interventions particularly at the point of sale and by relevant Government Agencies would be critical avenue for promoting safe use of pesticides by farmers.

Key words: Pesticides, pesticide residues, tomatoes.

INTRODUCTION

Pesticides have been of great benefit to agricultural operations by decreasing crop losses due to insects, weeds, plant disease, rodents and other pests. The major impact of pests on crop agriculture is that they cause reduced crop productivity, quality and consequently contribute to endemic poverty especially in developing countries (Nderitu *et al.*, 2007). Pesticides are also known to cause environmental contamination, pollution and also kill non target beneficial organisms such as those useful in plant pollination (Nderitu *et al.*, 2007). Of major concern is the fact that pesticides cause public health problems when residues are consumed in food products. Pesticides are associated with significant public health hazards, ranging from short-term impacts such as headaches and nausea to chronic impacts like cancer, reproductive harm, and endocrine disruption (Berrada *et*

al., 2010). In developing countries, unprecedented public and environmental contamination occur due to use of more toxic pesticides, poor pesticides handling practices, inadequate management and regulation of these chemicals (Waichman *et al.*, 2007; Gitonga *et al.*, 2010 and Ntow, 2008).

The potential of pesticides to cause both short and long term adverse effects to the environment as well as public health has attracted global attention. The Montreal Protocol of 1987 was designed to protect the ozone layer by phasing out ozone depleting substances like Methyl Bromide which is used as a soil fumigant. The Stockholm convention of 2001 banned the use of persistent organic pollutants due to their resistance to degrade, bioaccumulation in living organisms, travel over long distance from the point of source and toxicity to animal

and humans (Adelola, 2004; Fernandez and Grimalt, 2003; Ritter *et al.*, 1995; Scheringer and Wania, 2003; Stroebe *et al.*, 2004 and UNEP, 2001).

According to Basel convention of 1989, the pesticide containers are considered to be hazardous waste and should be disposed of in an environmentally sound manner. The 1998 Rotterdam Convention on the "Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade", aims to reduce the environmental and health risks posed by Persistent Organic Pollutants.

The legal notice number 120 of Government of Kenya on water quality prohibits pollution of water by discharging or application of any poison, toxic, noxious or other pollutant into aquatic environment. The National Environmental Management Authority in Kenya, (NEMA), is charged with the responsibility of promoting sustainable environment management. However, according to Wandiga (2001) some of the pesticides in spite of their ban or severe restrictions are still available in the Kenyan market and therefore still in use.

A large proportion of fresh horticultural produce consumed in Nairobi is grown in the neighboring counties of Kiambu, Machakos and Kajiado (Odour *et al.*, 1998b). It is estimated that over 300,000 farm families earn the major part of their income through the cultivation and marketing of vegetables (Asaba *et al.*, 2000). Kenya as one of the major horticultural producers in the world imports approximately 7,000 metric tons of synthetic pesticides worth 4 billion Kenya shillings annually (USD 50 million) (Birech *et al.*, 2006). In as much as pesticides have ensured continuous supply of tomatoes, inappropriate use are a major concern due to environmental and health impacts associated with pesticides. Studies have shown build up of pesticide up the food chain and some levels of contamination of water, sediments, eggs, crops and human fluid by pesticides (Wandiga, 2001). Kaliluni in Kathiani Constituency, Machakos County, is an agricultural productive area faced with several environmental challenges among which are pests and diseases in tomato crops. The proximity of Kaliluni to the capital city of Kenya, Nairobi, creates high demand for tomato produce pushing farmers to harvest their tomatoes before the required withdrawal period and increased use of pesticides on tomatoes per season due to pests and disease resistance (Lichtenberg, 2013; Fabro and Varca, 2011). During the control of these pests and diseases farmers could be predisposing themselves to health risks due to inappropriate handling and use of pesticides.

The purpose of this study was to assess the current patterns and practices of use of pesticides. It included assessing the frequency of use, storage, use of personal protective clothing, mixing of pesticides, disposal of containers and expired pesticides and knowledge of negative impacts caused by use of pesticides. The findings have the potential to provide useful information

on this so often neglected source of negative impacts on human health and the environment, so that effective strategies to increase awareness regarding the use of pesticides in tomato based agro system can be developed (Haylamicheal and Dalvie, 2008). Presently there are few studies detailing the use of pesticides by farmers growing tomatoes for domestic market to compare with the findings of this study.

MATERIALS AND METHODS

Study area

The study was conducted in Kaliluni, one of the administrative area in Kathiani Constituency approximately 20 kilometers from Machakos town and 150 kilometers from Nairobi, the capital city of Kenya. The increased urbanization in Machakos town and Nairobi city has created high demand for tomatoes for the fresh domestic markets. The semi arid climate conditions favor survival of pests and diseases pathogens which are a threat to crop productivity. To maintain fresh and adequate supply of tomatoes there has been use of pesticides beyond the sustainable limits. The study area has a total of 400 tomato farmers growing tomatoes in the open field through irrigation. The area receives bimodal rainfall and the altitude ranges between 1700 to 2100 meters above sea level. Apart from tomato production, the study site grows french beans for the export market, dairy farming as well as coffee growing. Within the area there are private Agrovet retailers selling pesticides to farmers. The use of pesticides by farmers is supervised by government agencies like Ministry of Agriculture and private sector, who are supposed to conduct farmers training on the safe use of pesticides.

Study design

The study was cross-sectional in nature and employed quantitative methods of data collection. Structured questionnaires were administered, observational check lists, focused group discussion and interviews used for data collection. The study population consisted of all farmers growing tomatoes in Kaliluni. Previsits to the study area were made to discuss the exercise with the relevant authorities. The purpose of the study was explained to all the respondents, and their consent obtained prior to administering the questionnaires.

Study sample

The targeted sample size was 81 farmers; determined using the Fischer's formulae but the actual number of farmers who participated was 72. Participants were randomly sampled from six villages according to the ones who grow tomatoes. The number of farmers participating per village was proportionate to the total number of farmers. The study participants were household heads or any adult household member who was present in the home or farm at time of the study. Additional information was obtained from purposively selected key informants,

Table 1: Gender composition

Gender	Frequency	Percent
Male	45	62.5
Female	27	37.5
Total	72	100.0

Table 2: Level of education

Education level	Frequency	Percent
None	1	1.4
Primary	37	51.4
Secondary	25	34.7
Technical/college	9	12.5
Total	72	100.0

Table 3: Frequency of pesticide use

Using interval	Frequency	Percent
Weekly	62	86.1
Fortnightly	9	12.5
None	1	1.4
Total	72	100.0

who were Agrovet dealers, Government agencies, village leaders and other key farmers.

Statistical analysis

Data and information collected were coded, entered, and analyzed using Statistical Package for Social Science version 18.0 and Microsoft Excel, and descriptive statistics were calculated.

RESULTS AND DISCUSSION

Respondent's gender

The study sought to establish the gender of the respondents and the findings are provided on table 1. This analysis shows that, majority of the respondents, 62.5% or 45 farmers were males while 37.5% were females. The probability, therefore that a respondent is a farmer growing tomatoes is female is much lower than the probability that such a farmer is male.

Level of education

This analysis on table 2 shows that, majority of the respondents (51.4%) had primary education level while 34.7% had attained secondary certificate. Only, 12.5% of the respondents had technical/college education. Surprisingly, about 1.4% of the respondents had no formal education.

Frequency of pesticide use

Respondents were asked to indicate the frequency of use of pesticide. The findings as indicated on table 3 show that: 86.1% of the respondents use pesticides on weekly

Table 4: Storage of pesticides

Storage of pesticides	Frequency	Percent
Not secure and not well ventilated store	52	72.2
In a secure and well ventilated store	2	2.8
One of the rooms in the main house	3	4.2
Others	15	20.8
Total	72	100.0

basis whereas 12.5% use it after every two weeks (fortnightly). In general, 98.6% of the respondents used pesticides more frequently. This is a clear indicator that 98.6 % of respondents use pesticides.

Storage of pesticides

When asked about the how pesticides are been stored, 72.2% of the respondents indicated they store pesticides in insecure and not well ventilated store. This implies that majority of the respondents do not have knowledge on how to store pesticides. About, 20.8% of the respondents said they store their pesticides on the farm, bathroom, toilet, granary and others do not store (table 4).

Use of label and personal protective clothing

As reflected on figure 1, the study found that 83.3% of the respondents always read the label of pesticide provided by the manufacturer before use and only 6.9% do not read the label. In addition, 50% of the respondents always wear apron when applying pesticides whereas 41.7% do not wear apron when applying pesticides. Indeed, 45.8% of the respondents never wear nose mask when applying pesticides whereas 44.4% always wear nose mask on the same. This cause infection to the human body hence poor human health due to disease from the chemicals. About, 58.3% of the respondents always wear boots when applying pesticides to tomatoes and 61.1% of the respondents never wear goggles when applying pesticides. This causes infections to the skin and eyes hence poor human health. In general, majority of the respondents ignores protection measures recommended by pesticide manufacturers when applying pesticides thus need for training on safe use of pesticides to tomato farmers.

Mixed brand of pesticides

The study found that majority of the respondents normally mix brand of pesticides. The mixed brands are as shown on figure 2 where majority of the respondents, 76.4% mixed Carbamate and Pyrethroid before applying the pesticides to tomatoes. 2 % of the respondents do mix sulphur pesticides with others. Sulphur pesticides are not to be mixed with other pesticides because they are alkaline in nature.

Disposal of expired chemicals

Respondents were asked to disclose mode of disposing expired chemicals. As reflected on table 5, 51.4% of the

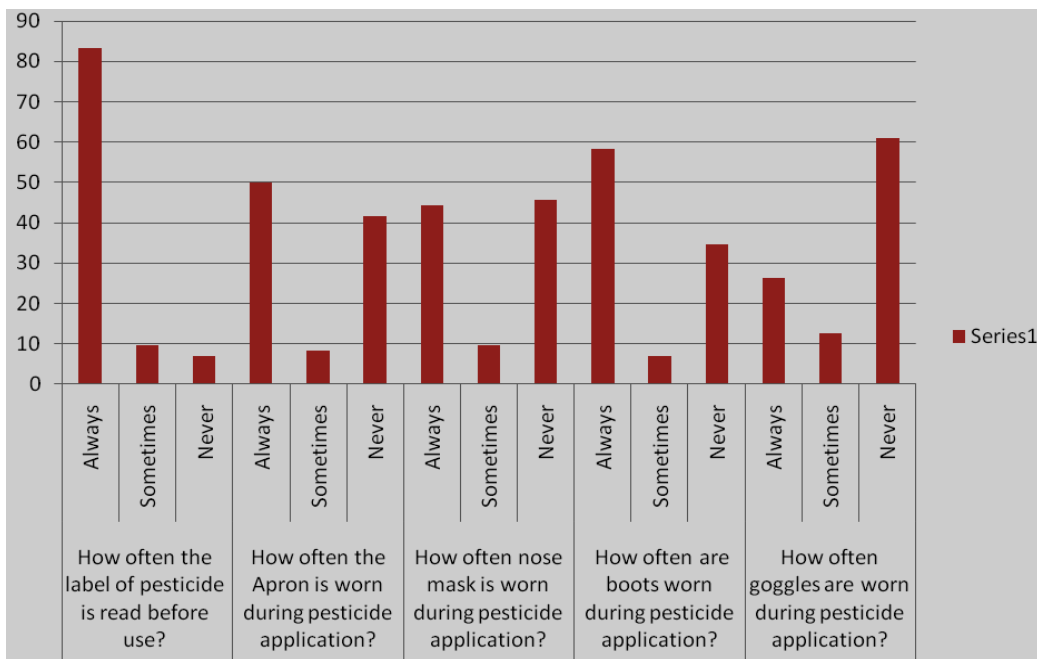


Figure1: Use of label and personal protective clothing

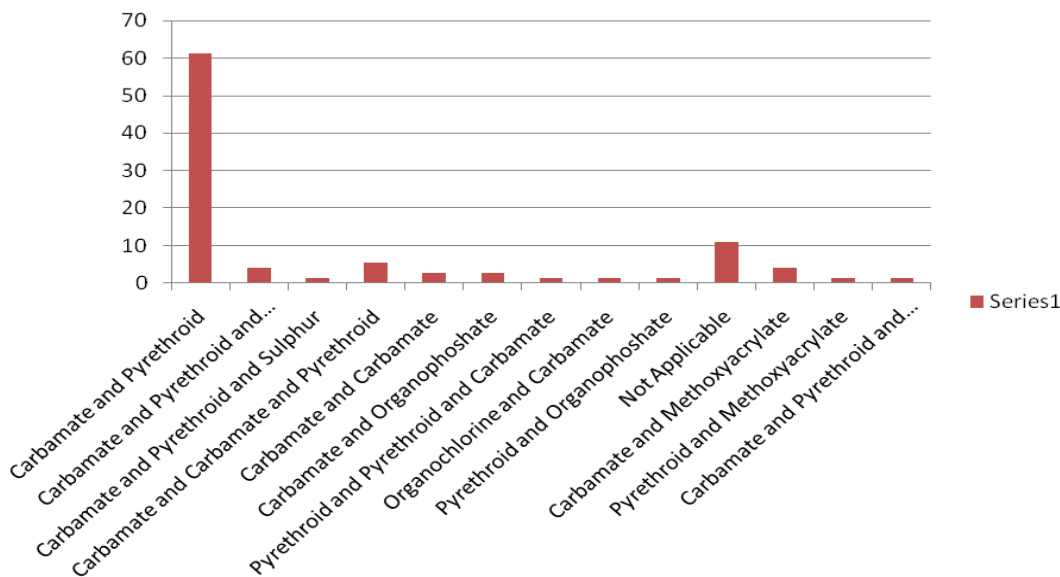


Figure 2: Mixed Brand of Pesticides

Table 5: Disposal of expired chemicals

Mode of disposal of expired chemical	Frequency	Percent
Continue using them	3	4.2
Bury them	37	51.4
Pour them in the field	2	2.8
Toilet	10	13.9
Buys enough	19	26.4
Not Applicable	1	1.4
Total	72	100.0

respondents bury the expired chemicals whereas 26.4% ensures that they buy enough chemicals thus avoiding expiry of chemicals. Unfortunately, 4.2% and 2.8% of the respondents continue using the expired chemicals and pour the expired chemicals in the field respectively which is very dangerous to environment and human health. In general, safe use of pesticides is needed to capacity build the respondents and general public on disposal

Table 6: Disposal of pesticides chemical containers

Disposal mode of pesticides chemical containers	Frequency	Percent
Throw away on farm	8	11.1
Bury in ground in farm	27	37.5
Burn on farm	11	15.3
Other	26	36.1
Total	72	100.0

Table 7: Awareness and negative impact of pesticides on human health

Negative impacts known by respondents on human health	Awareness on negative impacts of pesticide on human health	
	Yes	No
Cancer	5.6	0
Allergies, nausea, dizziness, effects on stomach	77.8	0
Death	15.3	0
Do Not Know	1.4	100
Totals	100%	100%

Table 8: Known effect of pesticides on the environment

Known effect of pesticides on the environment	Frequency	Percent
Death of livestock if fed on feed with pesticide residues	11	15.3
Contamination of water	16	22.2
Kill aquatic organisms	1	1.4
effects on surrounding vegetation	2	2.8
Effects on soil	2	2.8
Kills birds	1	1.4
Pesticides fumes affect non applicator	10	13.9
Not applicable	29	40.3
Total	72	100.0

mode of expired chemicals.

Disposal of pesticides chemical containers

As shown on table 6, it was found that, 37.5% of the respondents bury pesticides chemical containers in the farm whereas 15.3% burn them in the farm. However, 11.1% of the respondents mentioned throwing away pesticides chemical containers on farm. 36.1 % of respondents said that they dispose away the containers in a pit latrine. This poses danger to the environment and human health. Strict measures should be taken to safeguard the environment and human health.

Awareness and negative impacts of pesticides on human health

Analysis on table 7 implies that majority of the respondents, 97.2% were aware that pesticides have negative impact on human health. Of all the respondents who were aware, majority mentioned negative impact such as cancer (5.6%), allergies, nausea, dizziness, stomachache (77.8%) and death (15.3%). However, 2.8% of the respondents who were not aware of negative impact of pesticides to human health.

Awareness of effect of pesticides on environment

Analysis on table 8 implies that majority of the respondents, 59.7% were aware that pesticides have effect on environment while 40.3% are not aware of the same. Of all the respondents who were aware, majority mentioned effect such as death of livestock if fed on feed with pesticide residues, contamination of water and pesticides fumes affect non applicator. However, 40.3% of the respondents were not aware.

CONCLUSION AND RECOMMENDATIONS

The results of the study revealed that majority of the respondents' using pesticides on tomato farming expose themselves to pesticide hazards during storage, mixing and spraying of the pesticides. This has been evidently shown when farmers do not wear the required protective clothing when handling pesticides.

The disposal of expired pesticides and pesticides containers pose danger to the environment and human health. When disposal of pesticides and containers is done on the farm by burying the products or items on the farm, once it rains then the pesticides residues will be carried by water into water bodies where respondents

draw water for domestic use from. This can also have negative effect to the aquatic life.

Farmers are intercropping tomatoes with other crops like kales and maize. This could pose danger to the kale consumers because kales are mostly consumed on daily basis in most households. This is an indicator that most farmers will not wait for the required pre harvest interval before harvesting vegetables like kales. The intercropping could pose danger to non target organisms like bees which are killed by pesticides and this could therefore result in reduced yields to cross pollinated crops.

Based on the analysis and conclusion, the following recommendations are made;

- Since, some of the respondents mentioned throwing away pesticides chemical containers on farm. This poses danger to the environment and human health. The researcher recommends strict measures to be taken to safeguard the environment and human health by the enforcing authority.
- It was found that; majority of the respondents ignores protection measures recommended when applying pesticides thus the researcher recommends training on safe use of pesticides.

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