AN ASSESSMENT OF KNOWLEDGE, ATTITUDE AND PRACTICE OF AGROCHEMICALS USE IN THE FLOWER FARM INDUSTRY, NAIVASHA, KENYA.

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DECLARATION AND RECOMMENDATION

DECLARATION

This is to declare that this is my original work and that it has not been previously published or presented for an award of a degree or diploma in any university or other institution of higher learning.

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DEDICATION

I dedicate this thesis to the Kahiu Family, relatives and friends, who have continuously supported me in my studies.

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ABSTRACT

Intensive agriculture and cut flower farming which are characterized by heavy use of pesticides and fertilizers have been on the increase in developing countries. A number of consequences are associated with heavy use of pesticides; however weak enforcement of laws and regulations suggests that their use will continue. There is a high possibility that Flower Farm Workers (FFW's) lack knowledge in handling, storage and use of pesticides in flower farms leading to increased incidences of pesticide poisoning. This study therefore aimed at; assessing the level of knowledge and awareness of pesticide use among FFW's; evaluating practices in pesticide handling, storage and use among FFW's and finally; examining attitudes and perceptions towards pesticide use among FFW's in Lake Naivasha Basin (LNB).The research design used was a cross sectional survey and the sampling frame comprised the population of Naivasha Division, a total of 180,012. Of these 780 FFW's were interviewed by random sampling. Data was collected using a detailed questionnaire. Additional information was generated from scheduled interviews and focus group discussions. Data entry and analysis was done using Statistical Programme for Social Scientist (SPSS) version 17. Results indicate that 48.7% of the FFW's have undergone training on handling and use of pesticides. A total of 77.6% of the respondents were aware of the adverse effects of pesticides on human health and the environment. Knowledge about the effects of agro-chemicals among FFW's is relatively high and varies from one flower farm to another depending on the level of training. A cross-tabulation between the level of education and use of Personal Protective Equipments (PPE's) by FFW's showed that most respondents (86.8%) who have been through formal education reportedly used PPE's. Correlation between training on handling of pesticides and use of PPE's was positive and statistically significant ($p=0.001$, $r=0.365$), suggesting that increased awareness translates to proper practices in the use of pesticides.. Most of the FFW's feel that the owners of the flower farm use hazardous chemicals which increase yields but without due consideration to their health. Arising from these findings the following recommendations are made. Immediate measures must be taken to acquaint and train the FFW's on proper handling and management of agro-chemicals. In addition, timely and appropriate enforcement of the law is needed to ensure farming activities within LNB are conducted in a environmentally sustainable manner.

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ABBREVIATIONS AND ACRONYMS

AAK	Agrochemical Association of Kenya
BMP	Best Management Practices
FFW	Flower Farm Workers
FFS	Farmers' Field School
FAO	Food and Agriculture Organization
GAP	Good Agricultural Practice
GCPF	Global Crop Protection Federation
GDP	Gross Domestic Product
GMP	Good Manufacturing Practice
HACCP	Hazard Analysis Critical Control
ILO	International Labour Organization
IPM	Integrated Pest Management
KAP	Knowledge Attitude and Practice
KNBS	Kenya National Bureau of Statistics
LNB	Lake Naivasha Basin
MPS	Millieu Project Sierteelt
NEMA	National Environmental Management Authority
PCPB	Pest Control Products Board of Kenya
PPE	Personal Protective Equipment
UNEP	United Nation Environmental Programme
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Since the 1980s, industrial horticulture and floriculture farms in Kenya centred mainly in the Lake Naivasha region have grown into the largest supplier of flowers to the European market (LNRA,1999), exporting more than 88 million tonnes of cut flowers a year, worth $264 million. The more than 30 flower farms in the Lake Naivasha region pose a number of serious ecological problems for upstream rivers in the basin and for the lake. This includes loss of water, an unsustainable increase in the population because of the labourers they have attracted, and pollution through the overuse of pesticides and fertilizers (Food and Water Watch, 2008). As these roses' colourful blooms radiate romance around the world, large flower growers have been accused of misusing a toxic mixture of pesticides, fungicides and fumigants to grow and export unblemished pest-free flowers (Ecobichon 2001). Increased cases of pesticides poisoning due to chemical exposure has been reported (Harper,1990) while poor working condition, health and economic implications have become issues of social and academic inquiry (Rioba, 2010). This study examined knowledge, attitude and practice in the use of agricultural chemicals (agro-chemicals) within the Lake Naivasha basin. Growing concerns have been expressed not only about the health hazards involved in flower production but also on the environmental instability caused by the flowers.

For many years there were no substantial efforts to enforce codes of environmental protection in Kenya (Bolo, 2006). However, and ironically with close trading links with European buyers, the sensitivity of Kenya's natural environment, the strength of the Kenyan conservation movement and the lack of comprehensive and enforceable national legislation have meant that Kenya has one of the most codified flower industry in the world (Rioba, 2010). In the United Kingdom supermarkets are now adding social and environmental requirements to their supplier codes of practice (Dolan *et al.,* 2003). Kenyan growers have largely managed to resist pressure to comply with European flower industry codes of practice (most notably the Dutch Millieu Project Sierteelt (MPS) code). Currently there are two "home-grown" code options for Kenyan flower

growers. The more rigorous code has been developed by the Kenya Flower Council (KFC) and the Fresh Produce Exporters' Association of Kenya (FPEAK)-Kenya Good Agricultural Practice (GAP).

An increase in the number of pesticides and in the amounts used in Africa during the last decade have led to growing attention to possible adverse effects on human health. This may be caused not only by the active ingredients and associated impurities, but also by; solvents, carriers, emulsifiers and other constituents of the formulated product (Schaefer, 1990). These chemicals pose significant occupational and environmental health risks (WHO/UNEP, 1987). Agricultural workers are the most conspicuous occupational group at risk of pesticide poisoning (UNEP, 1986), especially pesticide sprayers. Estimates by World Health Organization (WHO) indicate that worldwide, three million severe pesticide poisoning cases occur annually. In addition, 25 million symptomatic occupational pesticide poisonings occur among agricultural workers in developing countries (WHO/UNEP 1990).

Pesticide use causes acute and chronic ecological damage, either by direct injury to non-target organisms such as birds and fish, or by indirect effects such as elimination of natural enemies (Harper 2002). Pesticides are a single form of environmental hazard in that they are actually designed to harm living things. Many organochlorines compounds are persistent in the environment and have a tendency to bioaccumulate significantly through food chains (UNEP, 1993). Organophosphates have several advantages over other types of pesticides, including high acute toxicity to target organisms, but they are not persistent in the environment as are organochlorines, when they decompose to non-toxic products. However, their acute toxicity is of concern to limnologists studying the Lake Naivasha ecosystem (Becht & Harper, 2002). Aquatic environments are particularly affected because pesticides applied to land-based agriculture systems are eventually carried into water bodies through surface runoff, rivers, and groundwater flow. Therefore, chronic and acute effects of pesticide pollution and bioaccumulation in aquatic flora and fauna are more severe.

Lack of knowledge, poor attitudes and practices in the use of agrochemicals continue to affect the flower farm workers, especially those working in the greenhouses (Agnes and Waibel, 2000). This suggests that, proper knowledge, practice and use of agrochemicals should be established in order to identify the knowledge gap among the most vulnerable groups and employ

the best management practices that would increase public awareness to ensure proper handling and use of pesticide. The results from the study will be an important resource to policy makers to ensure that the relevant organizations adhere to the set standards and conduct civic education to create public awareness.

1.2Statement of the Problem

Increased quantities of pesticides continue to be used in developing countries including Kenya, despite the often inappropriate working conditions facing agricultural workers applying them. It is highly likely that there is inadequate knowledge in handling, storing and use of pesticides in the floriculture industry. This leads to increased incidence of pesticide poisoning among flower farm workers in Kenya. Despite this, literature review suggests that very few studies have been done on the subject of FFWs' knowledge and attitudes with regard to the application of agrochemicals in Kenya. Consequently, little is known about this problem to the extent that workers in flower farms continue to be exposed to the adverse effects of chemical sprays. It is in view of the emerging gaps in knowledge that an assessment of the current levels of knowledge, practice in handling and storage of pesticides was undertaken to generate information. It is expected that this information will help minimize potential health and environmental risks associated with pesticides use. In addition stakeholder awareness will be improved. The findings generated from this study will aid policy makers to ensure that proper and comprehensive policies are formulated and are adhered to, in order to increase public awareness and this will reduce pesticide poisoning.

1.3 Objectives of the Study

1.3.1 Broad Objective

The broad objective of this study was to generate knowledge, attitudes and practices of agrochemicals use in Lake Naivasha Basin, Kenya.

1.3.2 Specific objectives

In pursuant of the broad objective, the study focussed on the following specific objectives;

1. To assess the level of knowledge and awareness of pesticides use among flower farm workers in Lake Naivasha basin.
2. To examine attitudes and perceptions towards pesticides use among various pesticide handlers and distributors within the Lake Naivasha basin

3. To evaluate practices in pesticide handling, storage and use among flower farm workers in Lake Naivasha basin against the best management practices proposed by Kenya Gap.

1.4 Research Questions

1. What is the current level of knowledge and awareness on pesticide use among flower farm workers in L. Naivasha basin?
2. What are the attitudes and perceptions among agricultural farm workers towards the use of pesticides within Lake Naivasha basin?
3. To what extent are methods of pesticide handling, storage, application and use of personal protective equipment influenced by knowledge on the effects of pesticides use among flower farm workers in Lake Naivasha basin?

1.5 Justification

Prior to this study, knowledge, attitude and practice of agrochemical use in the study area was hardly documented and information about the practice and use of pesticides was limited. Studies on pesticide poisoning in developing countries have been few and most of them have addressed the health effects of occupational exposure to pesticides in general and the clinical effects of pesticide poisoning: in Tanzania, (Mbakaya *et, al.*, 1994); in Malaysia, (Nordin *et, al.*,2001); in Thailand, (Klinman,*et, al.*,2011); in India, (Kumar *et, al*.,2010); in Greece, (Damalas *et. al*.,2011); in Costarica, (Polidoro,*et, al.*,2008); in Lebanon, (Salameh *et, al*., 2003); in Kenya, (Ohayo-Mitoko *et, al.*, 1997) and (Mwanthi and Kimani, 1993).

Only a limited number of studies have dealt specifically with the patterns of pesticide handling, knowledge and attitude of agricultural workers (Manda, 1985, Ngowi, 2003, Mokhele, 2011 and Yassin *et al,* 2002). In fact, determinants of pesticide poisoning have not been adequately evaluated nor have systematic prevention strategies for pesticide poisoning in Kenya been developed (Agnes,2000). Studies on public health which focus on the health impacts of agrochemical poisoning among agricultural workers fail to highlight on the level of knowledge among the workers. If left unaddressed, long term pesticide exposure would result to severe health and environmental degradation of both the workers and the environment.

Information acquired on the current level of knowledge and awareness on pesticide use among flower farm workers in Lake Naivasha Basin is vital in designing pesticide awareness programmes among the various governmental organizations and ministries charged with the mandate to check into the welfare of the flower farm workers. An evaluation of practices in pesticide handling, storage and use of pesticides against the best management practices proposed by the various codes of practice would be instrumental in establishing adherence to the laid down rules and regulations by growers and help in ensuring the safety of the flower farm workers.

1.6 Scope of the Study

The subject of this study was knowledge, attitude and practice of agrochemical use in Lake Naivasha basin. The study assessed the level of knowledge and awareness of pesticides use among flower farm workers in Lake Naivasha basin, evaluated practices in pesticide handling, storage and use of agrochemicals against the best management practices proposed by Kenya Gap; examined attitudes and perceptions towards pesticides use among various pesticide handlers and distributors within the Lake Naivasha basin. The study area was Naivasha division, the target population was flower farm workers within the division working in flower farms and applying various types of pesticides in three sub-locations namely; Mirera, Olkaria and Tarambeta**.** A purposive random sampling was used to draw the sample size of the flower farm workers in the six study sites namely; Karagita, Kamere, Kwa-Muhia, Sher Karuturi Staff quarters and Kasarani. This study was done between February and May, 2011.

1.7 Limitations of the Study

The study encountered the following limitations:

The target population was made up of flower farm workers who were then working in flower farms. However, during data collection, a good number of respondents were former flower farm workers who had stopped working in flower farms for various reasons. Information given by these respondents was thus sometimes out dated or biased. However, this limitation did not compromise the quality of the data collected, since respondents were asked to state the year, department and the period within which they have been working in a particular flower farm and comparison was made with data from respondents with recent information about the mentioned flower farm.

Secondly, flower farm workers are sceptical about sharing information about the flower farms in which they work. Most workers are scared of losing their jobs. To counter this challenge, the provincial administration was involved to re-assure the community of the need for their co-operation and the benefits of such a study in identifying issues that would help reduce the increased rates of pesticide poisoning among the flower farm workers and the general public.

1.8 Definition of Terms

Agrochemicals- A generic term for the various chemical products used in agriculture. In most cases, agrichemical refers to the broad range of pesticides, including insecticides, herbicides, and fungicides. It may also include synthetic fertilizers, hormones and other chemical growth agents, and concentrated stores of raw animal manure

Agrovets- A generic term used to refer to retail shops that dispense chemical products used in agriculture and livestock such as dewormers, insecticides and herbicides.

Aquatic- Relating to water, living in, near or taking place in water.

Ecosystem- Is a unit of biological organization consisting of all the organisms in an area interacting with the physical environment and with each other so that a flow of energy leads to characteristic tropic structure, material cycles and biological diversity.

Pest Control Product - A product or substance that is manufactured, sold or used as a means for directly or indirectly controlling, preventing or repelling any pest. It includes any compound or substance that enhances or modifies the physical or chemical characteristics of a pest control products to which it is added; and any active ingredient used for the manufacture of pest control products.

Peri-Urban areas- Areas that fall both within urban setups and the rural/agricultural setting.

Protective clothing: - Clothing selected or designed to protect the wearer against contamination; to be worn, as recommended, when handling, mixing and applying crop protection products.

Pre-harvesting interval/safety period- The period of time which must elapse between the application of a crop protection product and the harvesting of a crop, to ensure that protection product residues on the crop are within acceptable limits.

Re-entry period: - The time which must elapse after crop protection product treatment of a crop or an area before it is advisable for people to re-enter the treated area (Enanga 2009).

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The Lake Naivasha Basin area is approximately 3,400 km^2 lying in the Eastern Rift or Gregory Rift. The basin has immense socio-economic and conservational benefits which support over five hundred thousand people (LNIMP 2012). The lake is also important for biodiversity and received RAMSAR recognition in 1995. But in recent years the basin has faced intensified floriculture development for the export market and this is thought to contribute to pesticide pollution into the lake (Gitahi, 2002) .The floral beauties come at a high cost for the health of the workers that harvest them. This is because most flowers are not grown within the required pesticide regulations. This encourages the use of obsolete and potentially dangerous chemicals, leaving low-wage floral industry workers vulnerable to toxic exposures. A vast range of pesticides, fertilizers and fumigants are used in producing cut flowers. Some of these, such as Dichlorodiphenyl trichloroethane (DDT), dieldrin, methyl bromide and methyl parathion are no longer in use, or deemed too dangerous to use, in the industrialized world (Lallanilla, 2004). Flower buyers worldwide appear increasingly concerned about the environmental and health hazards of pesticide use with some consumers seeking alternatives like organically grown flowers.

The floriculture industry in Kenya is concentrated on the shores of Lake Naivasha - a complex and sensitive ecosystem. The flower farms around the lake understand the environmental degradation resulting from the overuse of water, pollution of the lake, and the increasing population in the area. There have been efforts to make “fair-trade standards” more widespread and reduce the environmental impact of the industry (Hale & Opondo 2005). However the sheer volume of flowers growing in the region cannot fail to have a long-term impact (Thomas, 2008). Since the establishment of the floriculture industry, Lake Naivasha has shrunk to half its original size and the water levels dropped by three meters, its native hippos are threatened by the pollution in the lake and fish catches are dwindling (putting local fishermen out of business (Betch and Harper, 2002). There are also gender and child labour issues - as well as low pay and little job

security for the flower farm workers, the chemicals used in flower growing are a particular threat to a workforce made up largely of women and children (Food and Water Watch 2008).

2.2 Overview of pesticide Use in various Countries

Globally, pesticide sales have soared since the 1970s (Nordin *et., al*, 2001). Many older, non-patented, more toxic, environmentally persistent and inexpensive chemicals are used intensively in developing nations (Lallanilla, 2004). The health and environmental costs of such pesticide use have been documented in many countries. For example, a recent study estimated the environmental and societal impact of pesticide use to be around USD 10 billion per year in the United States (Schaefers, 1990). A close analysis of pesticide use in developed and developing countries is as follows.

2.2.1 Pesticide Use in Developed Countries

Most studies on pesticide use focus on workers' health in the developing world (UNEP, 1981). However, the problem is not limited to developing nations; the issues are just as relevant to growers in developed countries as they are to developing countries. For instance, data from the Netherlands' Ministry of Social Affairs and Employment shows that Dutch floral workers are often exposed to 60 times the recognized 'safe' levels of these poisonous chemicals, often in an indoor situation, where residues and vapours may not dissipate (Lallanila, 2004). Similar concerns have been expressed about workers in the Californian flower industry. According to Richard Wiles, Vice President of Research for the US Environmental Working Group, consumers are buying roses whose toxicity levels suggest, should be handled by workers wearing gloves (Thomas, 2008). The report that pesticide residue on the petals of imported roses is 50 times that allowed on food imports led to a decrease in pesticide use. Figures which indicate reduction in pesticide use in terms of weight of pesticides per hectare can be misleading since they may not reflect the use of newer and more powerful pesticides which are more active at lower doses.

Consumers play a key role in the way flowers are doused with pesticides, fungicides and preservatives.The consumer has come to expect a blemish-free flower. The pursuit of floral perfection extends from consumers to the U.S. Department of Agriculture, which inspects shipments of flowers and plants from other countries (Lallanila, 2004). One insect or a single leaf with a spot of fungus, and an entire shipment can be rejected. This places enormous pressure on

flower growers to ensure every plant is flawless, even if tons of agricultural chemicals are needed to achieve that perfection. Growers do have the responsibility to get flowers through inspection and to make sure they sell. Most United States flower production occurs in California, where flowers and other ornamentals ranked sixth among all crops causing pesticide illnesses, according to data compiled by the California Department of Pesticide Regulation (Ibid)

In San Mateo County-USA, 23% of all pesticides poisoning occurred in the flower industry (Ibid). Exposure to agricultural chemicals is intensified in enclosed greenhouses, where fogging fumigation is common. Protective clothing is designed to shield workers from pesticides, but it is often ineffective. Clothes that are cumbersome or make breathing difficult are often discarded by flower farm workers. Some workers complain about protective clothing that is old or torn (Forget, 1991). Under realistic working conditions, most protective clothing would fail. There are no programmes that tests protective clothing under real-world conditions, and there are no real rules for maintaining protective clothing (Thomas, 2008). Of special concern to experts, is the health of the women who make up the majority of workers in the floriculture industry. Long term exposures to low levels of pesticides might not make the women sick, but a lot of pesticides are cancer-causing agents that can cross the placenta and affect the health of the foetus. Pesticide poisoning is therefore an issue of great concern that requires immediate intervention in order to reduce the increased cases of pesticides poisoning.

2.2.2 Pesticide Use in Developing Countries

Bogota, Colombia is the world's second-largest cut-flower industry after the Netherlands, producing 62% of all flowers sold in the United States (Polidoro *et., al,* 2008). With 110,000 employees and an annual export of USD 1 billion (Euro 771 million), even critics of the flower industry agree that the stable jobs and higher-than-average wages provided by flower growers are a benefit to workers and the national economy (Lallanilla, 2004). In recent years, for example, some large commercial growers have attempted to provide better housing, schools and health care for communities surrounding their farms (Atreya, 2006). The industry provides an important alternative to growing coca. But these economic gains come at a cost to workers' health and Colombia's environment, complaints by consumers have been raised due to over-reliance on chemical pesticides (Ibid).

Unlike in the United States, Colombia has no government regulations about pesticide use inside greenhouses, where toxicity levels tend to rise (Thomas 2008). Even with more stringent guidelines, accidents happen. In 2003, some 200 workers at Flores Aposentos were hospitalized after fainting and developing sores inside their mouths (Associated Press, 2003). Authorities determined this mass poisoning could have been caused by any number of pesticide-handling violations, but fined the company a mere US$5,770 (Euro 4,670) (Ibid). Government oversight is relatively strict in California, United States; each flower farm's pesticide use is available for review on the internet. There are no reliable statistics about chemicals used by Colombia's 600-plus flower farms. This is because only a third belongs to Asocolflores, the exporters' association, which keeps good records (Ibid).

The U.S. requires imported flowers to be bug-free, although not necessarily void of chemical residues, as required for edible fruits and vegetables (Ibid).The reliable highland tropical climate that drew U.S. flower growers to Colombia and Ecuador is a haven for pests (Ibid). This encourages growers to apply a wide range of fertilizers, pesticides and fungicides, some of which have been linked to elevated rates of cancer, neurological disorders and other problems (Sherwood *et., al.* 2002). Causal links between these chemicals and individual illnesses however cannot entirely be tied to chronic pesticide. The Harvard School of Public Health examined 72 children aged 7-8 in a flower-growing region of Ecuador, whose mothers were exposed to pesticides during pregnancy. They found out that the children had developmental delays of up to four years on aptitude tests. Ecuadorian and Colombian flower workers are plagued by work-related health problems, including skin rashes, respiratory problems, and eye problems, due to chronic exposure to toxic pesticides and fungicides (Yassin *et., al*. 2002). In Costa Rica, workers complain of nausea, skin eruptions, headache, dizziness and fainting, symptoms related to pesticide exposure (Thomas, 2008). Flower farm workers experience higher-than-average rates of premature births, congenital malformations and miscarriages (WHO, 1994).

An action-oriented approach to farm workers' education has been undertaken in Nicaragua and Puerto Rico, teaching farm workers about the hazards and safe use of pesticides, as well as empowering them to take preventive and protective actions. The results showed a positive

outcome (Weinger and Lyons, 1992). This would lead, as expected, to a decrease in poisoning prevalence as well as reduced exposure.

In Nepal, a total of 176 metric tons active ingredient of pesticides was imported and 184 metric tons active ingredient consumed in 2003. Nepal lacks rigorous implementation of pesticides legislation and regulations to control pesticides sales, agricultural intensification and heavy use of pesticides has been widely documented in Nepal. Despite such environmental and societal costs of pesticides, Wilson (2000) and Wilson and Tisdell (2001) argued that farmers in developing countries will continue to use pesticides at increasing quantities because of ignorance of sustainability issues of pesticides use, lack of alternatives to pesticides, underestimation of short and long-term costs of pesticide use and weak enforcement of laws and regulations. Thus, the current agricultural pest control systems have locked farmers in technologies which make them dependent on pesticides. There is a pressing need for alternatives to pesticide use. Promoting an integrated pest management program in Lake Naivasha basin is therefore of great importance. A joint Israeli–Palestinian and Jordanian programme was established to decrease pesticide use, promote integrated pest management, and restrict ecosystem damage while maintaining or increasing yield; preliminary results indicated that it was possible to reduce pesticides use and increase yield (Richter and Safi, 1997; Richter *et al.*, 1997). A similar programme should be initiated in Naivasha in order to achieve sustainable development and ecosystem health.

Misuse and overuse of pesticide is very common among farmers in developing economies. In Sri Lanka, farmers have a tendency to ignore technical recommendations and base usage on their own experience often leading to indiscriminate application (Wilson and Tiddsell, 2001). Acute pesticide poisoning has therefore become a major problem in Sri Lanka. The farmers who handle and spray pesticides using hand sprayers suffer from numerous morbidity ranging from headaches, nausea to cramps (Subashiny, 2008). Studies have shown that most users believe that pesticide is harmful to the pest but not to them (Ibid). The farmers perceive illness in terms of inability to function. Pesticide to them may not be a threat because they think they are immune, it is regarded as medicine needed by the plants rather than poison. To them exposure to pesticides is only through inhalation and ingestion not through dermal contact (Palis *et al.*, 2006). These

perceptions lead to poor practices in handling of pesticides and inadequate use of PPE. It is hypothesized that farmers' perceptions and beliefs about pesticides and associated health risks differ from public health views causing them to undervalue the effects of pesticide exposure (Atreya, 2005). According to World Health Organization (WHO, 2005), the estimated occupational pesticides poisoning affected as many as 25 million of the agricultural work force each year in developing countries.

2.2.3 Pesticide Use in East-African Countries

In African countries, many government extension programmes encourage the use of pesticides (Abate *et al.*, 2000), but do not consider their effects in the environment and health risks. As a result and coupled with lack of basic knowledge of pesticides, farmers' decisions on what pesticides and how to use do not have a bearing on health or safety of the environment. Epstein and Bassein (2003) observed that farmers used more pesticides because they base the applications on calendar spray pesticides programmes without necessarily giving much priority to health and environmental considerations. In Ethiopia for example, recent data from the Ethiopian Agricultural Research Institute shows that 18 of the 96 insecticides and nematicides imported by the flower farms, were not on the MPS-Code 2006 list (the list of pesticides registered in Ethiopia) and similarly for 19 of the 105 fungicides. The Pesticide Action Network believes these figures are likely to be underestimated as cited by Thomas, 2008.

2.3 Environmental Cost of Pesticides Reliance

Prevailing agricultural research and policy over the last three decades has locked many farmers into chemical control technology**.** It is now hard to disengage from pesticides use without major change in farming and food production policies. Reliance on pesticides as the main control strategy is not only unsustainable, but also exacts penalties in terms of human and environmental health (Atreya, 2007). These penalties are sometimes borne by pesticide users themselves, but in many cases, it is other sectors of society who may be adversely affected (Ibid).

These 'externalities' result in economic costs which are not reflected in the price of pesticides and therefore no direct market incentive for users to change their pest control practice to reduce these costs (Pimental *et al.*, 1992). There is an urgent need for an agricultural production model which internalizes the external costs of pesticide use and incorporates the

prevention of ill health, environmental contamination and the conservation of biological capital into production processes and markets (Atreya, 2006). The first step is to raise awareness of the economic costs of current policy and practice. This requires a combined effort by decision makers, donors and investors, as well as the governments.

Africa's proportion of global pesticide use is tiny, at only 2% of market value. Researchers and decision-makers often refer to the low volume of pesticides applied per hectare in comparison with intensive agriculture in the North but this should not be equated with low risk or low external costs (Schaefers, 1990). Products used are generally among the most toxic (World Health Organization (WHO) Classes I and II – Extremely, Highly or Moderately Hazardous) and pesticide handling and storage practices are highly hazardous. Many policy makers and some donors regard pesticides as indispensable for agriculture and continue to promote their use. Direct and indirect subsidies on pesticides encourage their application at unsustainable rates and discriminate against safer and more sustainable forms of pest management (Forget, 1991). In Central America, for example, considerable evidence is now available on the consequences of pesticide exposure but so far this data has had little impact on regulatory policies in the region. Elimination of WHO Class Ia and Ib pesticides – Extremely and Highly Hazardous; known to give rise to huge external costs, has been called for in South America, following detailed studies of their impact (Williamson, 2010).

Sustainable agriculture offers a philosophy and a set of practices to reduce pesticide impacts (Crop life, 1998). One of the most successful ways to address both the economic costs of pesticide reliance, health and environmental externalities, is through participatory Integrated Pest Management (IPM) training for farmers and extension staff. Farmer Field School (FFS) which aim at training farmers on IPM have a proven track record in reducing pesticide use, usually by more than 50% (Agnes *et al.,* 2000). Assessment of IPM training programmes of cotton in India and vegetables in Kenya showed that trained farmers reduced their pest management costs by 27-89% compared with untrained farmers. Farmers in IPM projects generally shift to less toxic and less persistent products and a much greater reliance on physical, biological and other control methods. Most FFS programmes have enabled farmers to increase their net income, often by

improving yields or quality, and farmers in several programmes have found new and more reliable markets, sometimes selling pesticide-free or organic produce.

2.4 Codes and Programmes

Growing pressure from some advocacy groups, especially in Europe, has brought about substantial reform within the flower industry (Agnes *et al.*, 2000). For instance, in 1998, Germany instituted the Flower Label Programme which sets guidelines for environmental and worker protection. Similar "green label" programmes have been founded in the Netherlands and the United Kingdom (Lallanilla, 2004). The floriculture industry's response to public concerns and labelling guidelines has brought about significant change (Ibid). There is a significant reduction in pesticide use in Colombia over the last few years. Some flower-exporting countries have instituted their own environmental labelling programmes. The Kenyan Flower Council has developed a Code of Practice to improve workers' protection and reduce dependence on pesticides (Rioba, 2010). Colombia's Florverde programme attempts to ensure protective clothing is available to all workers and chemicals used are low-toxicity chemicals (Associated Press, 2003). Many of these programmes, however, are voluntary and self-regulating. Of an estimated 600 flower-growing farms in Colombia, only 25 have been certified by Florverde. There is however no comparable programme in the United States (Thomas, 2008).

2.5 The Role of Pest Control Products Board (PCPB) in Kenya

The use of chemical pesticides in Kenya dates back to the second quarter of the 21st century when inorganic heavy metals, namely copper derivatives, were used to control fungal diseases in the coffee plantations (Wesseling *et al*, 1993). However, it was only after the Second World War that the systematic use and spraying of pesticides was implemented' in the country (Malaret *et al*, 1983).

The Pest Control Products Board is charged with the responsibility to license and register pesticides imports for use in the country. It was formed in 1982 by the Act of the Kenyan Parliament known as The Pest Control Products Act, Chapter 346 of the Laws of Kenya and it is the most significant government legislation on pesticides. It replaced the "Control of Pesticides Act", enacted when Kenya was part of the "first" East African Community in 1975. In broad terms, the Act aimed to manage and control the trade, manufacture, distribution and use of

pesticides in the country. For pesticide legislation to have the desired impact, five principal conditions must be exercised. These include the political will to enforce the statutory requirements, establishment of an autonomous regulatory unit acting independently from the particular agenda of any specific Ministry, a functional structure capable of managing pesticide issues across government Ministries and Agencies, fiscal resources and qualified personnel to implement the scheme (Malaret, 1983). In Kenya, most of these prerequisites have not been met.

An operative mechanism to implement the provisions of the Act was put in place with the creation of the Pest Control Products Board (PCPB) in 1984, two years after its enactment (Partow, 1995). However, it was only in 1986 that the Board was able to effectively address the pertinent question of pesticide registration. Referred to as Legal Notices, they specified factors and terms to be fulfilled prior to the registration of pesticide products, licensing of premises where pesticides are manufactured, formulated, packaged, sold and stored, labelling, advertising, packaging and import/export of pesticides. The level of detail demanded in the Legal Notice varies. While registration requirements are relatively comprehensive, advertising and packaging is only superficially addressed. Labelling standards have been revised by the PCPB to incorporate the use of pictograms, colour coding and expiry dates. These revisions were initiated by GCPF's Safe-Use Project. However, this is not yet mandatory (Ibid).

2.5.1 Pesticide Products Registered for Use in Kenya

As of February 1994, 370 products were registered for use in Kenya; currently, 894 products have been registered. Of this figure, 59% were already fully licensed by the PCPB, while the rest (41 %) were only provisionally registered pending final recommendations from research trials. Despite the interim status of 41% of the pesticides, there were no specific restrictions on their importation and marketing in the country (Bolo, 2006). Pest Control Products Board (PCPB) estimated that there were some 250-300 unregistered products currently on the market (Partow, 1995). Most of the products registered for use by the board are insecticides (43%), fungicides (22%) and herbicides (18%). Fungicides normally account for half of the Kenyan market, and insecticides and herbicides represent on average 20% and 18%, respectively as shown in Table 1.

Table 1: Functional groups used to register pesticides (PCPB 2010).

Functional Use	No. of Registered products	% of Registered Products
Acaricides	61	7
Fungicide	198	22
Herbicides	111	12
Insecticide	382	43
Rodenticide	18	2
Nematicide	17	2
Miticide	42	5
Larvicide & Others	65	7

Source: Pest Control Products Board, 2010

*Note: Some pesticide formulations have multiple uses and may fall in more than one functional use category

Pesticides classified by the (UNEP *et al,* 2004) as extremely and highly hazardous (i.e. WHO Class Ia and Ib) account on average for around 22% of the volume imported. Moderately hazardous products (WHO Class II) make up slightly over 20% of pesticide imports. A substantial proportion of imports of technical grade material for local formulation are WHO Ia (15%) and Ib (39%), effectively increasing the proportion of these products used (UNEP *et al,* 2002). While the bulkier inorganic chemicals constitute the largest group of imports by weight (21%), significant quantities of organophosphates (15%) and organochlorines (11%) are imported. It also includes volatile fumigants which, although not classified under any category, are acknowledged by the WHO to be of high hazard potential. Pesticide formulations containing highly hazardous active ingredients accounted for 19% of the products registered by the Board, while those classified as "moderately hazardous" constituted the principle group (36%) of the licensed products (UNEP *et al*, 2002). Table 2 shows the various pesticides registered for use in Kenya.

Table 2: Products registered according to WHO Classification (PCPB 2010)

WHO Classification	No. of registered Products	% of registered Products
Class Ia - Extremely Hazardous	10	1
Highly hazardous volatile fumigants	11	1
Class lb - Highly Hazardous	50	5
Class II - Moderately Hazardous	430	48
Class III - Slightly Hazardous	113	13
Unlikely to present acute hazard	132	15
Not classified by WHO/Obsolete	148	17

Source: Pest Control Product Board, 2010

The toxicity rating of an active ingredient is highly dependent on the work conditions in which the formulation is being used, the quantity applied and the extent to which workers handling such products are actually exposed. For instance, if no protective equipment is made available during the mixing and application of chemical concentrates, even a product which is classified by the WHO as 'slightly hazardous could for all intents and purposes qualify to be hazardous (WHO,1994). Toxicity rating is, therefore, not purely a function of scientific evaluation and laboratory experimentation, and needs to be assessed in a social and economic context. It should take into consideration the toxicity of these chemicals under conditions of use in developing countries. Moreover, WHO classification is based on toxicity and does not fully take into consideration the chronic health impacts of some of these pesticides (Partow, 1995).

Apart from PCPB, the Agrochemical Association of Kenya (AAK) is charged with the mandate to train the public concerning the safe use of pesticides, ensure that proper personal protection and equipment standards are adhered to by agricultural workers. AAK is responsible for labelling pictograms and colour codes and ensure proper packaging and repackaging of pesticides. (Rioba, 2010). In addition to this proper transportation requirement is part of its core mandate. Setting up of poison information and emergency management centres is an important role of the AAK though the implementation of these roles has not been adhered to (Partow, 1995).

2.5.2 Pesticide Trade and Supply in Kenya

Pesticide use is now a well-established facet of agricultural production in Kenya and with current agricultural policies to intensify export-crop production, the quantity of pesticides used in agriculture is likely to increase steadily. The pesticide industry in Kenya, as in most developing countries, is a supply industry dependent on transhipments from overseas. Although there is limited local manufacture of copper fungicides and natural pyrethrum insecticides, these activities account for an insignificant percentage of the total volume of pesticides applied to either agriculture or for public health purposes (Pimental *et al*, 1992).

In view of its external source of supply, determining national levels of pesticide use is dependent on effective monitoring and recording of import flows. Once the pesticides are in the country, tracing how and where the chemicals are used is virtually impossible due to the lack of controls on the movement of pesticides within Kenya's borders. Regulations on pesticides are therefore, based on control of importation by PCPB. The Pest Control Products Board's principal

and most effective tool in controlling the distribution and use of pesticides has precisely been through import licensing. However, with new trade liberalization policies, it has become increasingly difficult for PCPB to regulate and control pesticide imports (Malaret, 1983). There are many government institutions, at all levels in the regulation of pesticide use and distribution, making it even more difficult to monitor trade in pesticides as well as obtain accurate information on its magnitude due to bureaucracy.

Although deregulation of trade was not specifically aimed at agricultural inputs, relevant World Bank/IMF's Structural Adjustment Programmes (SAPs), promoting trade liberalization as the route to economic development, have had far-reaching effects on pesticide import documentation (Ohayo-Mitoko *et al*, 1997). As mentioned earlier, the regulation of pesticide distribution and use in Kenya is based, almost entirely, on import control through a licensing system, jointly coordinated by the PCPB and the Ministry of Agriculture (Partow, 1995). This *modus operandi* was briskly undermined by the World Bank trade liberalization policy, prompting a series of revisions in import schedules, which began in 1992 and ended in May, 1993. These removed import regulations on most products. In the new schedule, importation does not require prior approval but products are expected to meet technical, phytosanitary, health and environment standards, on their arrival (Statute law, 1993).

This move literally undermined most of the efforts made over the years to improve the regulation and control of pesticides. Although the PCPB is responsible for licensing all pesticide imports into the country, they are not usually consulted when arrangements are made with donors to import pesticides under commodity aid programmes (Ohayo-Mitoko *et al*, 1997). Hence, consignments entering the country through this channel are not included in the PCPB's total estimates of imported pesticides. Direct pesticide importation by government ministries and parastatals may be exempted from licensing by the PCPB under a "letter of release" and would, therefore, not be recorded (Ibid). Finally, the volume of illicit trade from overseas and from neighbouring countries, especially Tanzania, where pesticides are cheaper because of government subsidies, is quite substantial (Mwanthi and Kimani,1995). Given that some pesticides were smuggled into the country (Palis *et al*, 2006), the suggested figures would only suggest the lower limits of pesticide imports.

2.6 Challenges in Control of Pesticides Products

Lack of reliable data on the nature of pesticide used in Kenya is a severe handicap for the formulation of an informed national policy on pesticide management and use (Mugachia *et al*, 1992). Data collection and monitoring of pesticide use should therefore be a multi-faceted on-going exercise, involving all the institutions and individuals who deal with pesticides. Secondly, international and national efforts on safe use of pesticides have dwelt on regulatory initiatives, whether as national pesticide registration schemes regulating the marketing and distribution practices or setting controls on the international pesticide trade through the notification and information exchange instruments. The overall effectiveness of such regulatory activities to enhance safe-use in developing countries has been limited by lack of administrative and technical back-up to enforce implementation and compliance with statutory stipulations (Partow, 1995). Other than product registration and import licensing by the PCPB which were impaired in 1993 by the World Bank's Structural Adjustment Programme, resulting in trade liberalization, there are no further regulatory mechanisms. This has been exacerbated by the poor record of industry in adherence to the FAO Code. Its impacts on safe-use practices are insufficient at a national level, especially in flower farming.

2.7 Theoretical Framework

This thesis draws significantly from the concept of sustainable development which is closely associated with the work of the World Commission on Environment and Development, also known as the Brundtland Commission (WCED, 1987). The commission stated that development must meet the “needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1987) Ecological integrity, social inclusion, and economic growth are the sought-after benefits characterizing inclusive and sustainable growth. Ecological sustainability implies that non-renewable and other natural resources are not depleted for short-term improvements. Economic sustainability on the other hand implies that improvements do not depend on continuing infusions of resources that cannot be maintained.

Sustainable development was introduced as a concept that could provide a new vision for national and international development. Ease the unbearable pressures on the planet's fragile ecosystems; facilitate the formulation of new solutions to the recurrent socioeconomic needs of the developing

countries and finally provide greater assurance that contemporary approaches to development would not deprive future generations of the resources needed for their development (US-EPA 2010). This research considers sustainable development as the combination of a type of economic development that is ecologically sustainable and which ensures a decent level of welfare for all members of society. Furthermore, economic profits need to be addressed with a holistic view beyond mere economic growth and observe the impact of economic and business practices (Pezzey, 1989; Jones & Klenow, 2010).

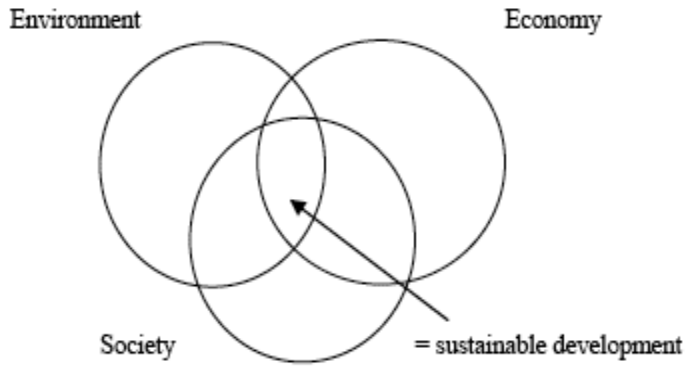

Figure 1: Sustainable Development (Source: O' Riordan, 1998)

The sustainable well-being of communities is inextricably linked to both the health of the earth's ecosystems and the health of humans living in the community. However, ecosystem health and human health can be overlooked by individuals, businesses, or regulatory agencies when making economic and social decisions, often due to an inability to foresee the full range of intended and unintended consequences. Yet the full range and long-term impacts of decisions must be understood-environmental health and human health determine the available quantity and quality of natural, human, and social capital necessary for sustainable communities.(US-EPA, 2010)

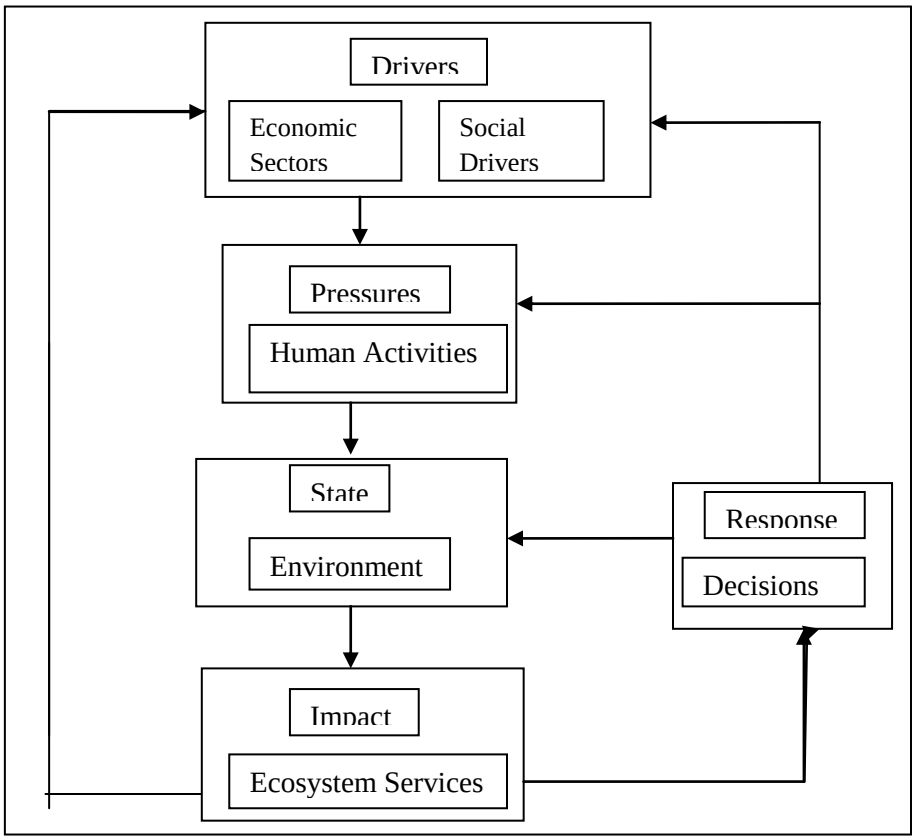

Figure 2: Integrated Theoretical Framework (Source: USA-EPA-DPSIR Framework, 2010)

2.7.1 Driver-Pressure-State-Impact-Response (DPSIR) Framework

Drivers are the social, demographic and economic developments in societies and the corresponding changes in life styles, overall levels of consumption and production patterns.

Drivers function through human activities which may intentionally or unintentionally exert pressures on the environment. The pressures exerted by society may lead to unintentional or intentional changes in the state of the ecosystem. Changes in the quality and functioning of the ecosystem have an impact on the welfare or well-being of humans through the provision of ecosystem services. Humans make decisions in response to the impacts on ecosystem services or their perceived value. Responses are actions taken by groups or individuals in society and government to prevent, compensate, ameliorate or adapt to changes in well-being due to the state of the environment or condition of human health. Decisions that benefit one economic sector may lead to environmental degradation that weakens another economic sector. For example, impacts on ecosystems services and human well-being will affect the quality and quantity of natural capital and human capital available to economic sectors. By linking Impacts back to socio-

economic Drivers (left, upward arrow), tradeoffs in the system can be identified. (US-EPA-DPSIR, 2010)

This model clearly portrays the interaction between the independent, intervening and dependent variables of this study to achieve the desired end-state as shown on the conceptual framework. The drivers (Economic sectors and the social factors) refer to independent variables which are mainly tied to the socio-economic status of the flower farm workers. Human activities on the environment (large scale flower farms) coupled with weak policies has a direct impact on the state of the environment. Interventions (responses) at this stage are necessary in order to restore and maintain the integrity of the ecosystem. Measures such as trainings in order to enhance capacity are therefore adopted to create awareness among flower farm workers. These are the responses applied in order to reduce the impact of human activities on the environment. These measures will contribute towards achieving the desired end state which is sustainable development and sustainable use of pesticides within the Lake Naivasha Basin.

Driver-Pressure-State-Impact-Response (DPSIR) framework competes with the integrated model on sustainable development known as Butterfly Model of Health.It places humans inside the ecosystem (especially applicable in ecosystems with extensive human influence, such as urban ecosystems and agro-systems), the boundary of which is shown as a broken line because both natural and human made influences move in and out of ecosystems routinely. Humans act as intermediaries, individually and collectively, between the two environments of the ecosystems: the biophysical (BP) environment and the socio-economic (SE) environment. Policies generated in the SE environment usually have equally important impacts on the BP environment, and vice versa. For example, if economic decisions are made to allow further use of prime agricultural land for industrial development, the economic benefits of such actions must be weighed against the short and long term additional pressures on forest and wetland utilization to maintain food production.

However, the US-EPA (DPSIR framework) is still superior to the Butterfly Model of Health for an ecosystem context.The DPSIR framework clearly defines the various measures that can be applied in order to regain the integrity of the ecosystem. The Butterfly Model focuses on the well being of an individual as opposed to the ecosystem as a whole.

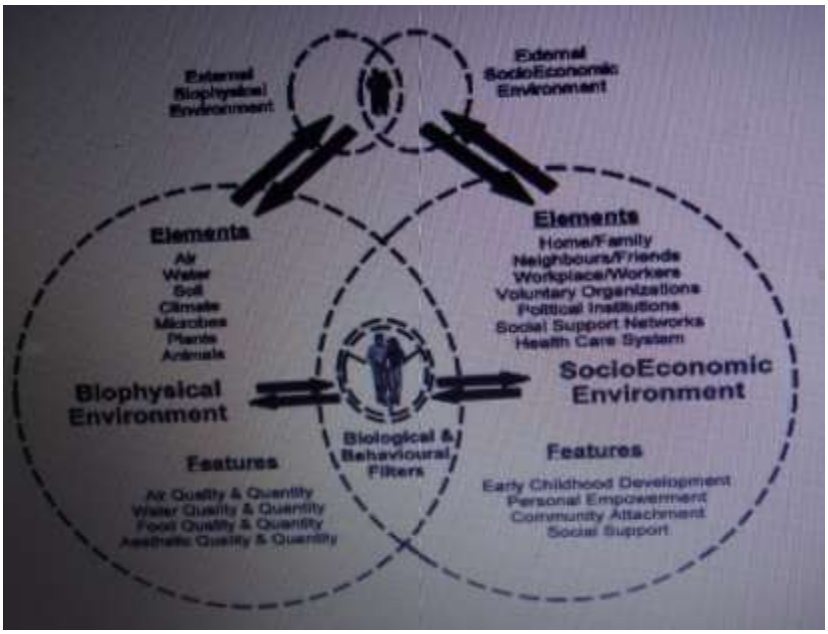

Figure 3: Butterfly Model of Health (Source: Ecosystem Health Journal Vol.5)

The DPSIR framework integrates human and ecosystem health and links environmental degradation to human health. Responses refer to interventions that can be adopted in order to reduce environmental degradation as a result of misuse of pesticides in L. Naivasha Basin. Regular trainings to increase awareness among flower farm workers and improved practices in pesticide handling and storage will contributes to the overall goal of sustainable development. The framework clearly highlights the various interactions in the environment and the overall effects if no proper mechanisms are put in place.

2.8 Gaps in the Literature

While groups like the Ethical Trading Initiative (ETI) stress that conditions are better than they once were, there is still a long way to go in achieving safety on pesticide handling and storage in Kenya and Colombia. With increasing pressure from consumers to embrace methods of production that are less harmful to both the environment and the flower farm workers, it is expected that growers will meet the set social and environmental standards. From the analysis of various studies conducted in different parts of the world, a number of factors have been identified that influence practice in the use of pesticides notably; poor policies, such as; Structural Adjustment Programmes, lack of institutional framework charged with the mandate to ensure implementation of the existing laws, low level of knowledge, cultural practices, poor attitude and

perceptions towards the use of personal protective gear (Mbakaya *et al*, 1994). There exists an obvious gap between what is known and what is practiced. Most studies (Mwanthi and Kimani,1995) conducted to determine practices in the use of pesticides among flower farm workers have focused largely on the economic, environmental and societal costs of pesticides. The health impacts imposed on the flower farm workers has also been well tackled. Knowledge, attitude and practice in use of pesticides remain unexplored especially in the East African countries, although few studies have been done in Tanzania and Ethiopia. This research therefore aimed at establishing baseline information on knowledge, attitude and practice of agrochemical use in the Lake Naivasha basin, Kenya. Findings generated from this study will be of great importance to policy makers, in ensuring that proper and comprehensive policies have been formulated and are adhered to, in order to increase public awareness and reduce pesticide poisoning.

2.9 Conceptual Framework

Heavy use of pesticide may lead to chronic and acute exposure of farm workers to pesticides, some of which are known for their carcinogenic and teratogenic effects. Consequently, this compromises the health conditions of the workers. The key dependent variables in this research were the levels of awareness, attitudes and practices on pesticide use. Awareness included knowledge on pesticide route of entry, knowledge of alternative forms of pest control as well as consequences of mishandling pesticides. A high level of knowledge on the use of agrochemicals among flower farm workers was expected to increase proper practices and use of agrochemicals. Conversely, a less aware farm worker is less likely to employ proper practices in the use of agrochemicals. Willingness to wear and invest in PPE was not only an important measure of the attitude workers have towards achieving proper practices but also is important in reducing cases of pesticide poisoning among flower farm workers.

The independent variables that influence practice and use of agrochemicals were the socio-economic status of the respondent. The intervening variables are government policies and regulations in agrochemical use. The socio-economic status (education, income level and job experience) influence practice in handling of pesticides as financially able workers may easily invest in PPE in case the ones provided by the flower firms are worn out and/or not replaced. On

the contrary, a poor worker may be unable to meet the cost for PPE. In other words, the willingness to invest in PPE for poor flower farm workers is low. Education on the other hand plays an important role in contributing to proper practice. It is argued that the higher the level of education attained, the higher the level of awareness. Effectively implemented policies and regulations on pesticide use and adherence to labour laws, especially on issues of gender, encourages proper practices in the use of agrochemicals; thus promoting ecosystem health, sustainable development and sustainable utilization of pesticides (Figure 4).

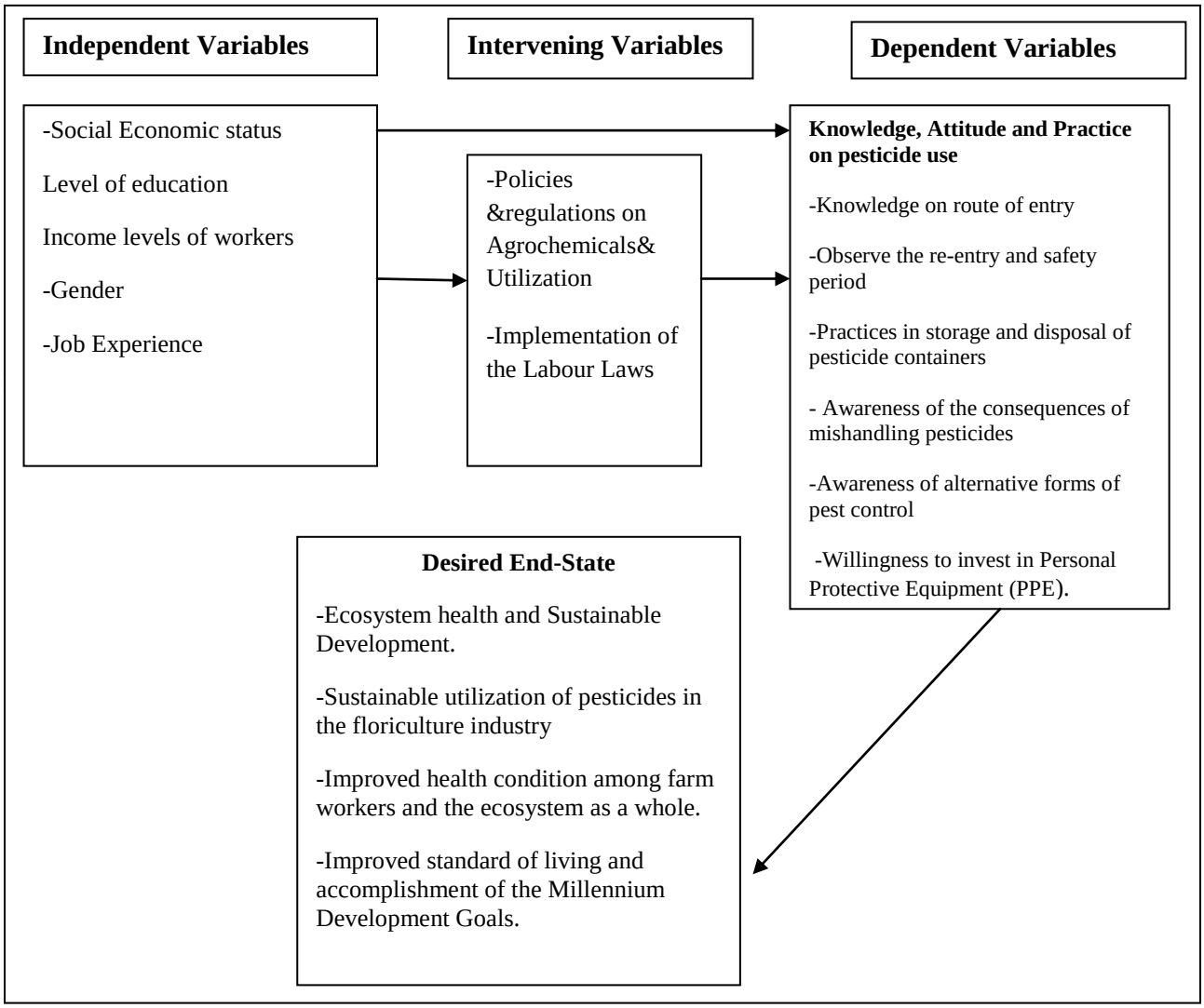

Figure 4: Conceptual Framework (Source: Derived from Literature Review)

CHAPTER THREE

MATERIALS AND METHODS

3.1 The Study Area

3.1.1 Location

Naivasha Sub-county is situated about 100 km northwest of Nairobi in the Great Rift Valley (See Fig. 5). Lake Naivasha which is approximately 150 km^2 in total area (Harper *et al*, 1990) was declared Kenya's second Ramsar Site in 1995. It is a unique freshwater lake in the Rift Valley of Kenya (Harper *et al*, 1990). It lies on the floor of the Eastern Rift Valley at a mean altitude of 1890 m a. s. l, Latitude $0^0$45' to 0^0 56' South and Longitude $36^0$22' to36^0 54' East (LNRA, 1999). The lake and its associated ecosystem fall under Eco climatic Zone IV, which is described as environmentally fragile and prone to land degradation (LNRA, 1999)

3.1.2 Climate

The climate of LNB is warm and semi-arid; receiving an average rainfall of 620 mm annually while the average annual evaporation is approximately 1,735 mm. The area experiences a double rainshadow effect from the flanking escarpment to the east and west. As a result, the basin receives less rainfall than the surrounding highlands. The rainfall exhibits a bimodal distribution with a major peak in April – May and a minor one in October – November. The mean annual temperature is around 26^0C. The coldest months are April and July with temperature ranging between 16^0 and 17^0C, while the hottest months are January to March with temperatures ranging between 28^0 – 30 ^{0}C (LNRA,1993b).

3.1.3 Vegetation and soils

The vegetation in LNB is heterogeneous from aquatic plants such as papyrus around the lake margins, submerged macrophytes to terrestrial vegetation comprising of grasslands, bushlands, woodlands and forests. Generally, savannah vegetation is predominant (Harper, 1990). The vegetation types and distribution patterns are strongly associated with the soil type that in turn is related to topography. Soils in the Lake Naivasha catchment area are generally developed from volcanic activity, and are of moderate to low fertility, deep clayish loam, greyish, brown to black in colour, often with poor drainage. The soils often degenerate into black cotton soils with

impeded drainage in low-lying areas (Harper, 1990). The general conditions of the lakeshore soil series are predominantly alkaline, sodic and lacking organic matter.

3.1.4 Administrative structure

According to the 2009 Population and Housing Census report, the population in Naivasha District was 376,243, with population growth at 3.5 %. According to 2005 Household Poverty Survey, Naivasha district had 39,692 individuals, (39%) living below the poverty line (Sparvs 2008). Naivasha Division has a total population of 180,012 with Mirera, Olkaria and Tarambeta sub-location having a total population of 75,345, a total area of 589.6 Km^2 with a population density of 509.7. Mirera, Olkaria and Tarambeta are sublocations within Naivasha division where most flower farms are located.

3.1.5 Social economic activities

Naivasha district is a vibrant economic hub. The mainstay economic activity being floriculture and horticulture farming. Presently, there are more than 5 large scale farms with a combined acreage of more than 4,000 ha. The area is a tourist destination earning foreign exchange from Hell's Gate and Longonot National Parks. The area is known to host a wide variety of birds, hippopotamus, waterbuck, buffalo, giraffes, Thompson's and Grant's gazelles. Naivasha has a thriving fish industry based entirely on introduced species of black bass, tilapia and crayfish. Geothermal power plants run by the state's power utility company-Kenya Power Generating Company (KenGen) are also a significant economic activity

3.1.6 Hydrology

Lake Naivasha is a unique ecosystem, in that it is the only fresh water lake in Kenya's Rift Valley floor, all others being salty (Gaudet, 1979). The lake has no surface outlet. It receives 90% of its inflow from the perennial Malewa and Gilgil rivers, which originate from Nyandarua ranges. Malewa River has drainage area of 1730 km^2 and that of Gilgil is 429 km^2 (Sikes, 1989). The remaining input comes from seasonal streams, direct precipitation and ground seepage (LNRA,1993b).The catchment is dominated by igneous rocks and a number of pyrodastic formations including basalts, pumice and tuffs as a result of volcanic activity (LNRA, 1999).

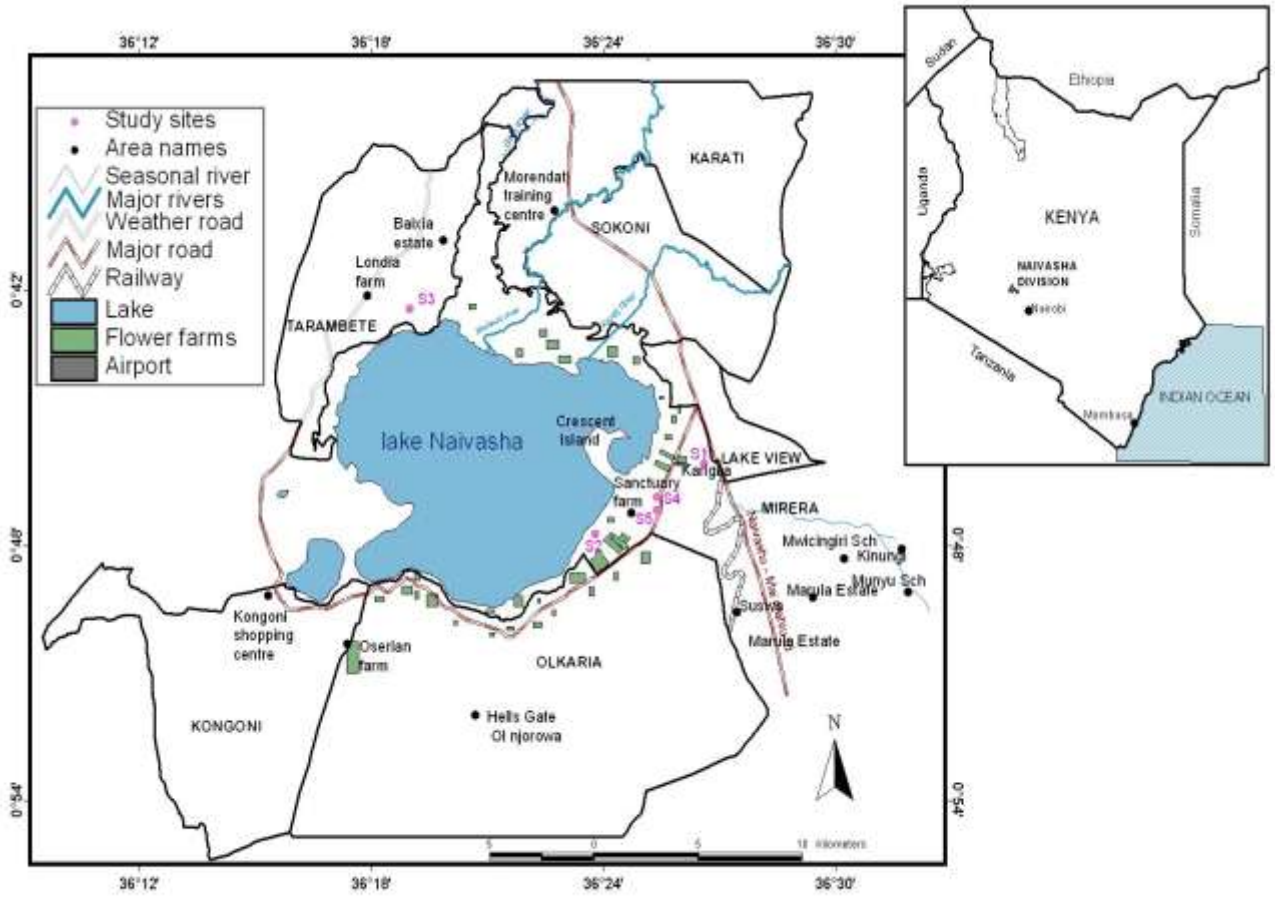

Figure 5: Study Area (Source: Department of Environmental Science, Egerton University, 2011)

3.2 Research Design

3.2.1 Sampling Frame and Sample Size

The research design used on this study was a cross sectional survey and the sampling frame comprised the population of Naivasha Division which had a total of 180,012. The target population was flower farm workers within Naivasha division working in flower farms and applying various types of pesticides in three sub-locations namely; Mirera, Olkaria and Tarambeta which have a total population of 75,345 (KNBS, 2009). A purposive random sampling was used to draw the sample of the flower farm workers in the six study sites, namely; Karagita, Kamere, Kwa-Muhia, Sher Karuturi Staff quarters, Diocese Church of Kenya (DCK) and Kasarani. Secondary data was obtained from publications and journals on occupational hazards, public

health offices in Naivasha and the Pest Control Products Board (PCPB) in order to have the total number of flower farms in Naivasha and the names of all registered products used in Kenya.

Using Kothari (2004) formulae the sample size was determined in the following way:

$n = Z^2pq/e^2$

Where: n = required sample size

Z = the standard normal deviate at the required confidence level. In this research Z=1.96 at 95% confidence level

p = the proportion in the target population estimated to have characteristic being measured. P is taken in this research as 0.75; since ¾ of the sample depend directly or indirectly on flower farms

q = 1-p;1-0.75= 0.25

e = the acceptable Error. In this research it is 0.03

$n= (1.96)^2(0.75)\ (0.25)/(0.03)^2= 780$

3.2.2 Data Collection

Primary data was obtained through administering of structured questionnaire, scheduled oral interviews and focused group discussions. The structured questionnaire was administered among flower farm workers. Scheduled Oral Interviews were conducted among all agrovets in Naivasha town while focused group discussions were held among key informants. This was meant to capture the views of these institutions on the effects of pesticide use in the country on human health and the environment.

The following tools were utilized in obtaining data namely;

Structured questionnaire (Appendix 1).This was used to collect data on knowledge of the flower farm workers on pesticide use, practices in handling, storage, disposal of agrochemicals and attitude that influence proper practice in handling of agrochemical. Scheduled oral interview (Appendix 2) was conducted among all Agrovets in Naivasha town to collect information about disposal of expired pesticides, knowledge of the law governing distribution of pesticides, knowledge of PCPB and use of PPE. Focused Group Discussion (Appendix 3) was held among key informants from PCPB, NEMA, Public Health, Lake Naivasha Growers Group (LNGG) and Directorate-Occupational Health and Safety. Information from these institutions was collected in

order to capture views on the status of pesticide use in the country and the effects of pesticide use on human health and the environment. Observation Schedule (Appendix 1; Part III) was used to record observable practices in techniques of mixing, spraying and storage, along with the availability, condition and use of PPE, cleaning and repair of application equipment, disposal of excess pesticides and empty containers.

3.2.3 Questionnaire Design and Administration

The questionnaire consisted of both open and closed ended questions. The questionnaire included questions on background information, such as: location, age, education, and marital status; the health impact of exposure to pesticides (self-reported toxicity symptoms associated with pesticides use); knowledge of the acute and chronic toxicity of pesticides, prohibited pesticides, effect of pesticides on human health, other alternatives to pesticides, the route of pesticide entry into the human body, names of pesticides used; and attitudes regarding the use of pesticides and protective equipment or clothes during preparation and application of pesticides.

Practice questions included: wearing of protective clothes; following label instructions and agronomist guiding; observing re-entry period after applying pesticides; smoking, eating, drinking water, or chewing gum during application of pesticides; whether they take a water bath after application; and if they comply with the safety period and concentration recommended, either by the agronomist or by the pesticide label. Respondents were asked if they ever had pesticide poisoning and if so, what the frequency of occurrence was, including the pesticide responsible for poisoning. Further questions were asked on who makes the decision on the type of pesticide to use on the crops, the precautions while handling the chemicals, storage practices and disposal of expired chemicals and empty chemical containers.

Before administering the questionnaire it was pre-tested at Briss Flora Flower Farm in Belbur/Sunrise area in Njoro Sub-county. Thirty questionnaires were administered among flower farm workers with an aim to collect and analyze data which would help refine the questionnaire to be used in the study area. Questions seeking information on practice included; the disposal of empty pesticide containers and personal hygiene practices. Respondents were asked whether agrovets provided instructions on the safe-use of pesticides. Observations on the following were made; techniques of mixing, spraying and storage of pesticides, availability, condition and use of

personal protective equipment, cleaning and repair of equipment, disposal of excess pesticide and empty containers as well as personal hygiene practices.

3.2.4 Data Analysis

Data collected was cleaned and analysed using Statistical Package for Social Sciences (SPPS) version 12.0 software. Distribution of the study variables (mean, standard deviation), correlation, cross tabulation, and chi-square tests were conducted. These tests were used to identify the significance of the relations, associations and interactions of knowledge, attitude, practice towards pesticides, and the prevalence of self-reported toxicity symptoms. Association and interactions of the study variables were tested using correlation and chi-square test, respectively (Table 3).

Table 3: Data Analysis Matrix

Specific Objectives	**Statistical Methods employed**	**Data Output**
1. To assess the level of knowledge and awareness of pesticides use among FFW's in LNB.	• Descriptive statistics: percent distribution of FFW's with knowledge on safe use and handling of pesticides-route of entry of pesticide. Knowledge on alternative to pesticides • Cross-tabulations, Correlation and Chi-Square Analysis	• Tables, Bar graphs, Pie-Charts, • Measures of central tendency (Percentage, Mean, Median)
2. To examine attitudes and perceptions towards pesticides use among various pesticide handlers and distributors within the LNB	• Descriptive statistics: percent distribution of FFW attitudes towards the use of pesticide, their willingness to use alternative forms of pest control, FFW's that take a bath after spraying. • Chi-Square Analysis	• Measures of central tendency -Percentage
3. To evaluate practices in pesticide handling, storage and Use of pesticide among FFW's in LNB	•Descriptive statistics: percent distribution of FFW's using PPE's, practice proper disposal of expired pesticides; observe re-entry period and safety period. • Cross-tabulations ,Correlation and Chi-square statistics,	• Tables • Bar Graphs and Measures of central tendency (Mean, Median, Standard Deviation)

3.2.5 Operationalization of Variables

The independent variables in this study included: level of education, income levels and gender. The dependent variables were aimed at determining the knowledge, attitude and practice in the use of agrochemical among flower farm workers. The dependent variables included; knowledge on route of entry, awareness of alternative forms of pest control and willingness to invest in personal protective equipment.

The indicators used to determine the levels of knowledge of the farm workers, included the level of awareness on the consequences of mishandling pesticides, if the workers had undergone training on alternative forms of pesticides control, knowledge on the entry routes of pesticides into the human body, their awareness on the names of pesticides used in the farm, international prohibited pesticides and if they are aware of the existence of residue on fruits and vegetable. The score attained in each of this indicator variable determined whether the flower farm workers had a high or low level of knowledge on pesticides.

To establish the type of practices and use of pesticides, workers were asked the following: if they wore personal protective Equipment (PPE), if they followed instructions on pesticides use, and if they knew the sources of instructions. Further they were questioned on how they stored chemicals, disposed of the pesticide containers, whether they strictly adhered to instructions on the re-entry period, safety period, the precautions they exercised during spraying, and if they had access to First Aid.

Indicator variables used to establish appropriate attitudes and perceptions were; if workers had knowledge on the importance of Personal Protective Equipments (PPE); if PPE could protect them from pesticide poisoning; if the health conditions they lived in were related to exposure to pesticide use; their opinion on whether or not pesticides use should be discouraged; and if all pesticides had the same adverse health effects on human health and the environment. The average percentage score on each indicator variable was used to establish whether flower farm workers have a high or low level of knowledge, type of practice and attitudes of the flower farm workers.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This study was carried out in Naivasha Sub-county, Malewa West and Hell's Gate locations, Malewa, Olkaria and Mirera sub-locations. The study sites included Karagita, Kwa Muhia, Kamere, Sher Karuturi Limited Staff Quarters, DCK and Kasarani. The total number of questionnaires administered was 780.

4.1.1Age and Education level of the study population

The sample comprised of males and females who made up 49.2% and 50.8% of the total respectively. The mean age was 31 years with the minimum age of 16 years and a maximum age of 82 years. The highest response was recorded in Karagita at 49.8% while the lowest response was recorded in Kwa-Muhia at 4.9%.

Analysis of the educational status of the respondents showed that 6.6% had been to tertiary institutions, 44.5% through secondary school, 40.9% had completed primary school, 4.4% had gone through primary school but dropped out. Only 3.7% had no formal education. Karagita and Kasarani recorded the highest number of respondents who had completed primary and secondary school at 78.6% and 72% respectively. The percentage of literate respondents with a minimum of primary education was 94.4%. The literacy level of the respondents in the study area can therefore be said to be high. This was higher than the national average of adult literacy of 74% in Kenya (UNICEF, 2009). The data also shows that the level of education among respondents is high. This has positively influenced the level of awareness in the use of pesticide in the study area.

4.1.2 Family size and income level

The mean family size for the surveyed households was 3 with a minimum of 1 and a maximum of 14 with a standard deviation of 1.9. The average number of children in most households was 2, with a minimum of one and a maximum of 12 and a standard deviation of 1.5. Two out of 3 children in every household were under 5years old. 71.2% of the respondents were married. Questions relating to the respondents' main occupation and the length of time they have worked

in their current positions showed that 63.7% were flower farm workers undertaking various duties within the flower farms and had worked in their current employment for an average of 4.8 years. 20.5% were self-employed and doing their own business, 15.9% were government and private sector employees. The average number of years respondent had lived in the area was 8yrs, 76.7% of the respondents live in rented permanent houses and pay an average rent of Kshs 1,230 per month.

The data shows that majority of the flower farm workers earned an average salary of Kshs 6,700 per month, with 26.3% earning below Kshs 5,000 per month. Overall, wages were seen as inadequate, even though they were typically above the Government minimum wage which is Kshs 3,765. The research findings agree with a study done in Lake Naivasha (Dolan *et., al*, 2003) which indicates that, even on the more wealthy farms, workers were not earning a living wage. Nearly all workers interviewed (74%) claimed that their wages did not meet their basic needs (defined by workers as enough for a worker and his/her dependants to feed, clothe and house themselves). Government interventions in the recent past have however been commendable with efforts to increase the minimum wage by the local leaders. For instance in 2012, The Daily Nation, December 26th, 2012 noted the following;

> "Naivasha MP Mr. John Mututho proposed amendments to Section 47 of the Labour Institutions Act of 2007 to raise the minimum wage of certain categories of workers in the country's agricultural and floricultural sector from the current KES 3,765 to a consolidated salary of KES10, 000, about 166 per cent increase. The amendments aimed at controlling the wages of the flower farm and other workers in the agricultural sector".

4.2 Flower Farm Workers' knowledge on pesticides

The first objective of the study sought to assess the level of knowledge on pesticide use among flower farm workers in Lake Naivasha Basin. The major findings under this objective are as follows. Results show that 77.6% of the respondents were aware of the adverse effects of pesticides on human health and the environment. Concerning the degree of health impact of pesticides, 55% of the respondents stated that not all pesticides had the same adverse health effects. Results further show that 10.6% of the respondents could identify the pesticides they were using by the chemical names, chemical groups and the trade name/common names. A significant

number of respondents (53.1%) had no knowledge of internationally prohibited pesticides either by their chemical name, common name or classification. Lack of knowledge of internationally prohibited pesticides is of great concern as most flower farm workers might be using prohibited pesticide without their knowledge and thus exposing themselves further to pesticide poisoning.

The study further shows that an average (48.7%) of the flower farm workers had undergone training on handling and use of pesticides. An average training session ran for two days as reported by most of the workers. Trainings are usually conducted within the flower farms. Results similar to this were found in Lesotho where flower farm workers that had received some form of training indicated that the training was short term, that is, it ranged from two days to two weeks (Mokhele, 2011). Short training sessions organized by flower farms are important as farm workers are trained on pesticides and there effects, however these training sessions should be organized frequently in order to ensure that farm workers are constantly reminded of the safety precautions while handling pesticides. Training is normally conducted by flower farm personnel such as the Training Manager, Health and safety personnel and the company doctors. Amiran, Dudutech and other agrochemical suppliers were reported to conduct frequent training sessions for the flower farm workers as well as holding field days for farmers. Results similar to these had been reported in other developing countries.

In the Gaza Strip, an assessment of knowledge, attitude and practice was done on 189 farm workers who reported high levels of knowledge of pesticides, but the use of protective measures was poor (Yassin *et., al,* 2002). Very few respondents (29.3%) reported to have been trained on alternative forms of pest control, biological control (use of *Phytoseiulus* and *Bacillus thuringiesis*) and cultural control were some of the methods reported to be in use by most of the respondents. Workers were asked to state possible routes of entry of pesticides to the human body. Majority of the respondents (77.4%) stated inhalation followed by 73.9% who reported skin contact, while 64.2% cited ingestion, ears and open wounds; as possible routes of entry, while 33.3% mentioned eyes. (Table 4)

In terms of knowledge regarding pesticide residues, 74% of the respondents reported that pesticide residues can be detected in the air, followed by 71.4% who stated that pesticides residues may be found in the soil. Residues in vegetables, groundwater and fruits came in 3rd, 4th

and 5th respectively; whereas 36.1% (6th) reported that pesticide residues may be detected in seeds.See Table 5.

Table 4: Respondents' Knowledge of Pesticides Use

Items	**n**	**Frequency**	**Percent**
Knowledge of the name of pesticides used	496	83	10.6
Knowledge of the adverse health effects of pesticide exposure on human health	499	387	77.6
Not all pesticides have the same adverse health effects	666	366	55
Awareness of the consequences of mishandling pesticides	502	427	85.1
Knowledge of internationally prohibited pesticides	501	235	46.9
Trained on handling and use of Pesticides	478	233	48.7
Trained on alternative forms of pest control	382	112	29.3

Source: Derived from Research Data, 2011

Internationally prohibited pesticides mentioned by most respondents included Karate, DDT, Methyl Bromide, Sulphur, Orthane, Meltatok, Vydate and BN3. Notably, most of these pesticides were reported to be in use in most of the flower farms, with some respondents claiming that sulphur-based chemicals were sprayed at night.

However, most of the pesticides used in the flower farms are registered for use in Kenya under various classes by the Pest Control Products Board (PCPB).These included the ones reported to be prohibited. Dichlorodiphenyl trichloroethane (DDT) is an insecticide registered as a restricted product by the Ministry of Health for indoor residual spray for mosquito control. This notwithstanding, flower farm workers reported that DDT was in use in the flower industry despite having been banned for agricultural use in Kenya in 1986.

A cross-tabulation between the level of education and use of PPE by flower farm workers showed that most respondents (86.8%) who had attended formal education reported to be using protective clothing while working. There was no relationship between the level of education and the number of flower farm workers that use PPE (χ^2=3.561, d.f. =4, P>0.05).

These results suggest that increased level of literacy is an important factor but not the only one to be considered to ensure improved practice in the use of pesticides. Pesticide safety education and constant training is vital in order to cultivate proper protective behaviour among flower farm workers in Lake Naivasha Basin. These results corroborate with those from an earlier study conducted in Lebanon which found out that, the preventive measures flower farm workers took were low, and the low their knowledge was, the lower the preventive measures applied (Salameh *et., al,* 2003).This underscores the need to constantly train the flower farm workers in order to ensure proper practice in pesticides use.

Table 5: Respondents' Knowledge on Biological Control and Route of Entry of pesticide

Biological and natural control	**n**	**Frequency**	**Percent**
Knowledge of biological control	106	71	67
Knowledge of cultural control	106	11	10.4
Knowledge of biological and cultural control	106	15	14.2
Route of pesticide entry into body			
Inhalation	641	496	77.4
Skin	598	442	73.9
Mouth	514	322	64.2
Fate of pesticide residues			
Air	481	357	74.2
Soil	472	337	71.4
Ground Water	457	246	53.8
Seeds	432	156	36.1

Source: Derived from Research Data, 2011

There was a strong association between the use of PPE and training on pesticide use (χ^2=59.263, d.f.=1, P≤0.001). This might be explained by the fact that most flower farm workers may be keener on using PPE once they have undergone training on safe use and handling of pesticides as they are made aware of the importance of PPE and the effects of pesticides to their health. A strong correlation (r=0.365, P=0.001) was found between using PPE and training on safe handling of pesticides.

A cross-tabulation between the workers who wore protective clothing and their awareness of the consequences of improper handling of pesticides revealed that awareness of the effects of

pesticides significantly influenced the use of protective clothing. The relationship between the use of protective measures and awareness of the consequences of mishandling pesticides showed that most flower farm workers were aware of the importance of using protective gear during application of pesticides and also while carrying out other duties within their work environment. Proper practices contribute greatly to the well-being of flower farm workers. However, awareness of the possible effects of the pesticides does not necessarily translate into use of protective measures (Table 6)

Table 6: Use of Protective Clothing vs. awareness of the consequences of Pesticide Use

Protective measures in use	Awareness		χ^2Value	P.Value	d. f.
Wear gloves(n=355)	Yes	No			
Use gloves	266	24	11.895	0.001	1
Do not use gloves	50	15			
Wear Goggles(n=334)					
Use Goggles	181	14	9.189	0.002	1
Do not wear goggles	114	25			
Wide brimmed hat (n=332)					
Wear hat	178	16	5.514	0.019	1
Do not wear hat	115	23			
Wear Mask(n=340)					
Use mask	218	19	10.586	0.001	1
Do not use mask	82	21			
Wear Gumboots(n=355)					
Wear boots	274	21	30.051	0.00	1
Do not wear boots	41	19			
Wear Overall(n=345)					
Wear overall	250	25	12.049	0.001	1
Do not wear overall	53	17			

Source: Derived from Research Data, 2011

It is observed that a total of 82.3% of flower farm workers were aware that gloves offer protection to their hands from the adverse effects of pesticides; while 58.9% reported that goggles could protect their eyes from the adverse effects of the pesticides. A total of 59.4% and 83.7% flower farm workers respectively, believed that wearing a wide brimmed hat and special boots could protect the head and the feet from harmful pesticides. It may further be noted that 70.3% of the respondents stated that wearing an oral-nasal mask could prevent entrance of the pesticide residues into the human body through the mouth or the nose. Finally, a total of 80.6% reported

that wearing protective gear such as overalls could protect the whole body from exposure to pesticide (Table 7).

Table 7: Knowledge of Flower Farm Workers on Protective Gear

Protective measures in use	**Frequency**	**Percent**
Wear gloves	316	82.3
Wear goggles	205	58.9
Wear wide brimmed hat	208	59.4
Wear oral-nasal mask	251	70.3
Wear gumboots	323	83.7
Wear overalls	295	80.6
Shower after application	292	91.5
Change clothing after application	101	58
Do not smoke during application	271	95.4
Do not eat during application	265	96
Do not drink during application	262	94.2
Do not chew during application	263	96.3

Source: Derived from Research Data, 2011

The results as shown in Table 7 indicate that a high percentage of flower farm workers who were aware of the inhalational and dermal absorption of pesticides (than other routes of exposure) agreed with a study in Philippines which found out that most occupational exposure to pesticides occured from skin absorption and through inhalation (Palis *et al.*, 2006). A study conducted by Ohayo- Mitoko in 1996 indicated that knowledge of the agricultural workers with regard to safe use of pesticides was very low in the then Naivasha, Wundanyi, Homabay and Migori districts of Kenya. Two-thirds of the respondents did not know the most important route for pesticide poisoning (Ohayo-Mitoko *et. al,* 1996). These findings are inconsistent with the findings from the present study, which indicate a high level of knowledge among flower farm workers in Naivasha. The inconsistence may be attributed to increased awareness through training among flower farm workers on the need to adhere to best practices in pesticide handling.

The present investigation showed a moderate to high awareness among flower farm workers towards pesticide residues in soil, air, on plants and in groundwater. This level of awareness is important as it reduces the risk of exposure when contact is made with pesticide residues on plants, in soil, and in dust particles after spraying.

In Naivasha, flower farm workers reported that pesticides can cause numerous adverse effects on health and the environment; similar findings were reported among farmers in Ethiopia. This

awareness should provide an opportunity to promote use of least hazardous pesticides and Integrated Pest Management (IPM). The use of IPM can dramatically reduce pesticide use while maintaining crop yields (Sherwood *et al*, 2002). As a result, introducing IPM could be the acceptable approach to reduce pesticide impacts on health and environment (Karunamoorthi *et al*, 2011). Knowledge of the names of pesticides used, biological and cultural controls was very low among flower farm workers. Information, instruction, and training on pesticides exposure among workers should be enhanced, since these activities are fundamental aspects of health protection. Education of flower farm workers on safe use of pesticide cannot be seen as a one-shot exercise that can be attained through the efforts of a single workshop. It should be a consistent and sustainable programme based on a reliable extension service infrastructure, which is lacking in Kenya (Ohayo-Mitoko *et al*, 1996)

4.3 Knowledge of Pesticide use among Agrovets and the general public

From a total of 14 agrovets who practiced in Naivasha town, 78.6% of them reported stocking acaricides and herbicides while 35.7% stock fertilizers. Less than 5% of the agrovets stock fungicides, seeds, dewormers, cattle feeds, nematicides, insecticides and mineral supplements in very small amounts (Figure 6).

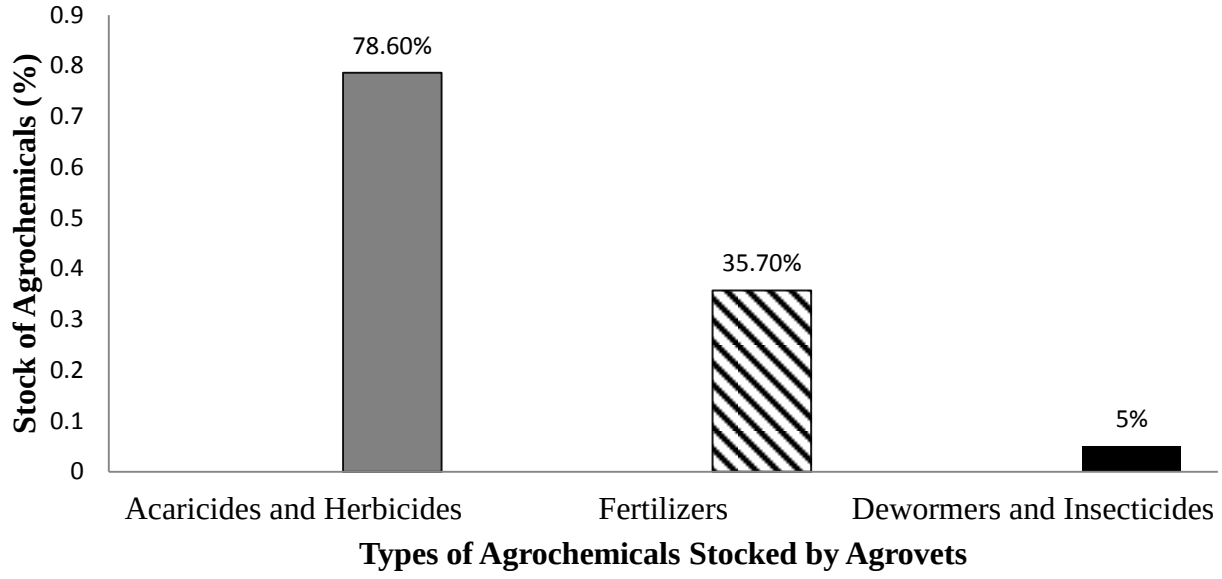

Figure 6: Pest Control Products stocked by Agrovets

These results indicate the high demand on agrochemicals among the local farmers in the Lake Naivasha Basin and hence the need to enhance public awareness on proper use of pesticides. (Table 8)

Table 8: Pest Control Products sold in Naivasha

Group	**Type of Pest Control Products**
Insecticides	Mospilan, Evisect, Mocap
Herbicides	Puma-complete, secure, gromoxin, catch down, Farmilon, Dimethoate
Fungicides	Daconil, saprol, Bayleton, Ridomil, Victory, Mistress 72
Nematicides	Furadan
Pesticides	Dimethoate, cyclone, polytrin, Danadin, Actara
Acaricides	Dominex, Sypertix

Source: Derived from Research data, 2011

Asked whether they cautioned their buyers about the effects of agrochemicals, 92.9% of the respondents stated that they informed their buyers of the various effects of agrochemicals. However, a small number of respondents (7.1%) admitted that they only caution the buyers who ask about the performance of a certain product. Most agrovets acknowledged that very few buyers are given information on pesticide use.

On issues of usage and disposal, agrovets stated that they actually inform farmers on the effects of improper use of pesticides, emphasizing the need to follow instructions, safe use and disposal of agrochemicals.

Most agrochemical companies used field days as fora to train agrovets and educate the general public on how to use agrochemicals. This played an important role in dissemination of knowledge and in creating awareness on proper use of agrochemicals.

It is worth noting that the World Health Organization (WHO) has recommended the use of pesticides only by trained people (WHO, 1991). However, this is not the case in Naivasha .The level of knowledge among members of the public in Naivasha town was very low as reported by agrovets. A total of 41.7% reported a low level of knowledge, 16.7% moderate-high, while 25% of the public buy pest control products based on experience (Figure 6).

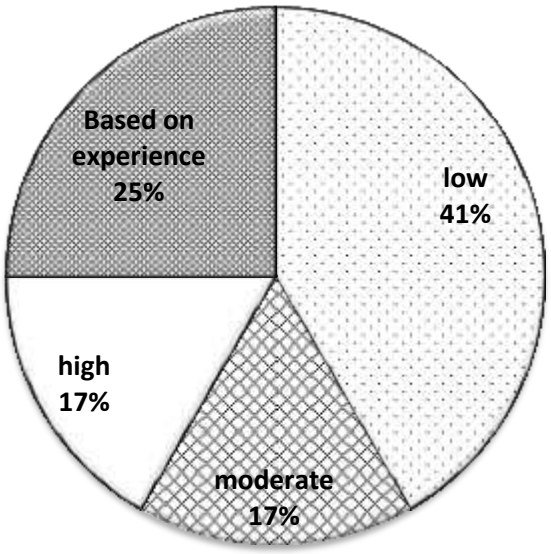

Figure 7: Level of Respondents' knowledge on agrochemical use in Lake Naivasha Basin

A relatively high level of knowledge in handling of agrochemicals was reported among agrovets, a total of 78.6% agrovets had undergone formal training on pesticides use, handling and storage. Results similar to these were found in Lebanon, where agrovets and other pesticide distributors were more knowledgeable on issues pertaining to pesticides than agricultural workers. In addition, both the agrovets and the flower farm workers had better knowledge regarding pesticides than the general population (Salameh *et al.,* 2003). Educating the general public would help them adopt proper practices in pesticides use and also take part in or give advice to the regulatory bodies on issues of pesticides toxicity control. Empowering the public with information helps with compliance in existing or new laws; informed people can even identify and solve local environmental problems without relying solely on government intervention and resources (EPA, 1997).

4.3.1 Use of Personal Protective Equipments (PPE's) among Agrovets

All respondents' use PPE's during their operations in their places of work, 71.4% of the respondents reported to use dustcoats, 21.4% use gloves, 14.3% used masks, while none of the respondents used gumboots (Figure 8).

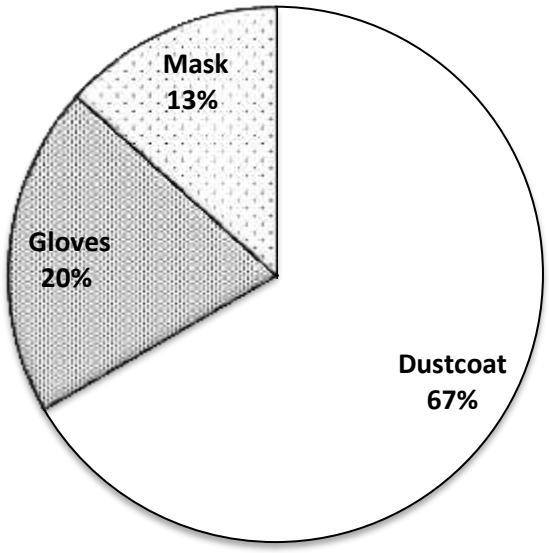

Figure 8: Use of Personal Protective Equipment among Agrovets

Some agrovets stock various PPE's for sale to the public; the PPE includes; goggles, gumboots, gloves, dustcoats and masks. Regarding their awareness on the routes of entry, most agrovets (71.4%) reported that inhalation is the most common form of contamination they experienced due to continuous inhalation of the chemical fumes. Skin contact and ingestion followed with 57.1% and 42.9% respectively. Agrovets had embraced the use of PPE which is an important safety measure whenever handling agrochemicals. Good practices in pesticides handling among the agrovets should therefore be encouraged and adopted with all users of agrochemical products (Figure 9)

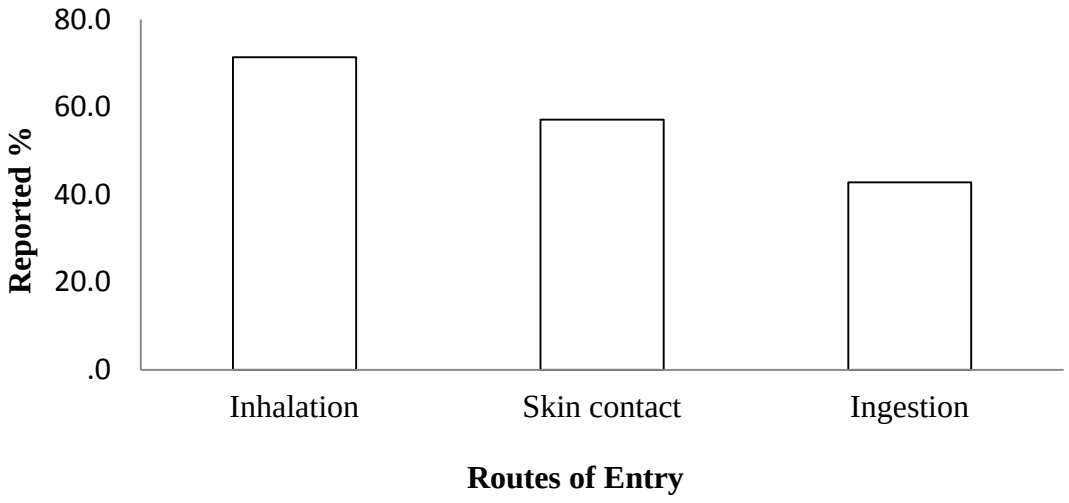

Figure 9: Possible routes of entry of chemicals

On issues pertaining to the disposal of expired agrochemicals, a total of 42.9% respondents reported that they returned the chemicals that were almost expired to the relevant company, 21.4% buried the containers after disposal of the content from the containers, while 14.3% reported to have either burned the expired products or disposed them off with other solid wastes. Spilling of chemicals poses a serious environmental challenge as this practice leads to contamination of both surface and ground water. Disposal of expired agrochemicals and their containers remained a great challenge among agrovets and flower farms in Naivasha. Proper methods should therefore be adopted to minimize air and soil pollution due to burning of the expired products (Figure 10)

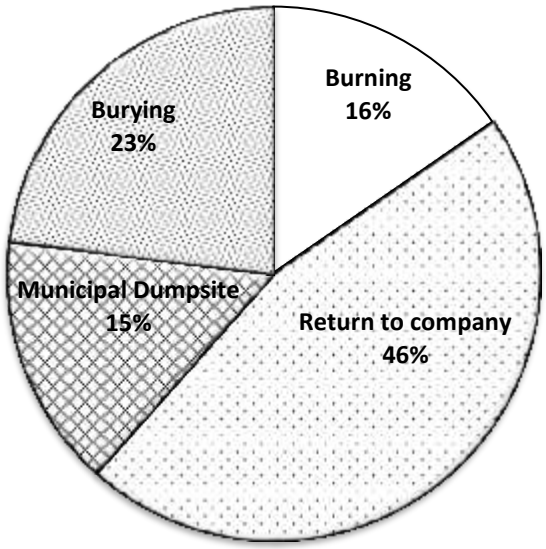

Figure 10: Disposal of expired pesticides by Agrovets

The Pest Control Products Act 1982 highlights various laws governing storage and handling of agrochemicals. Of the respondents interviewed, 64.3% were aware of the various laws and regulations governing the use and storage of agrochemicals. Most of the rules cited were given by Pest Control Products Board as a condition to owners of the premises before they are licensed (Appendix 4). Most agrovets (85.7%) reported that their products are registered by Pest Control Products Board for use in Kenya. However, during interviews some of the respondents in Naivasha town stated "I am not sure if the products are legally registered by PCPB due to increased counterfeit products with the same registration number as the one from PCPB, making it hard for us (owners) to distinguish between real and counterfeit products".

4.3.2 Knowledge about the role of Pest Control Products Board (PCPB)

The Pest Control Products Board aims to manage and control trade, manufacture, distribution and the use of pesticides in Kenya. In addition, it prohibits owners and operators of agrovets businesses against selling or stocking of expired and counterfeit products. Most of the respondents (85.7%) had heard of PCPB, and they cited a few functions of the authority including; issuance of license, inspection of the products and the premises to ensure safety of the

workers and the products arrangement on the shelves. A total of 85.7% of the respondents reported that PCPB conducted regular check-ups and inspections. Most agrovets believed that constant checkups were meant to protect farmers from buying low quality products or unregistered products. Of the respondents interviewed, a half (50%) reported that in case one was found with unregistered or expired products, the authority confiscated the stock and traced the source of the products. A few agrovets (21.4%) reported that the authority could withdraw the license and the operators stood the risk of being prosecuted under the Pest Control Products Act, 1982.

4.4 Attitudes and Perceptions of Farm workers towards Pesticides Use

The second objective in this study sought to examine attitudes and perceptions towards pesticide use among flower farm workers in Lake Naivasha Basin. This section presents an in-depth analysis and discussion of the evidence on this objective. A total of 90.7% flower farm workers reported that they understood the importance of wearing protective clothing while undertaking their duties in the flower farms; 81.7% mentioned that they used the various protective gear provided by the employers.

A small number of respondents (4.7%) claimed that they did not know the importance of wearing protective clothing, and 17.9% of the respondents did not use any protective measures as shown in the (Figure 11) below. These results may be attributed to various reasons such as the absence or lack of the protective gear at their place of work, with some of the flower farms failing to replace the worn out gear on time, thus forcing workers to work without them.

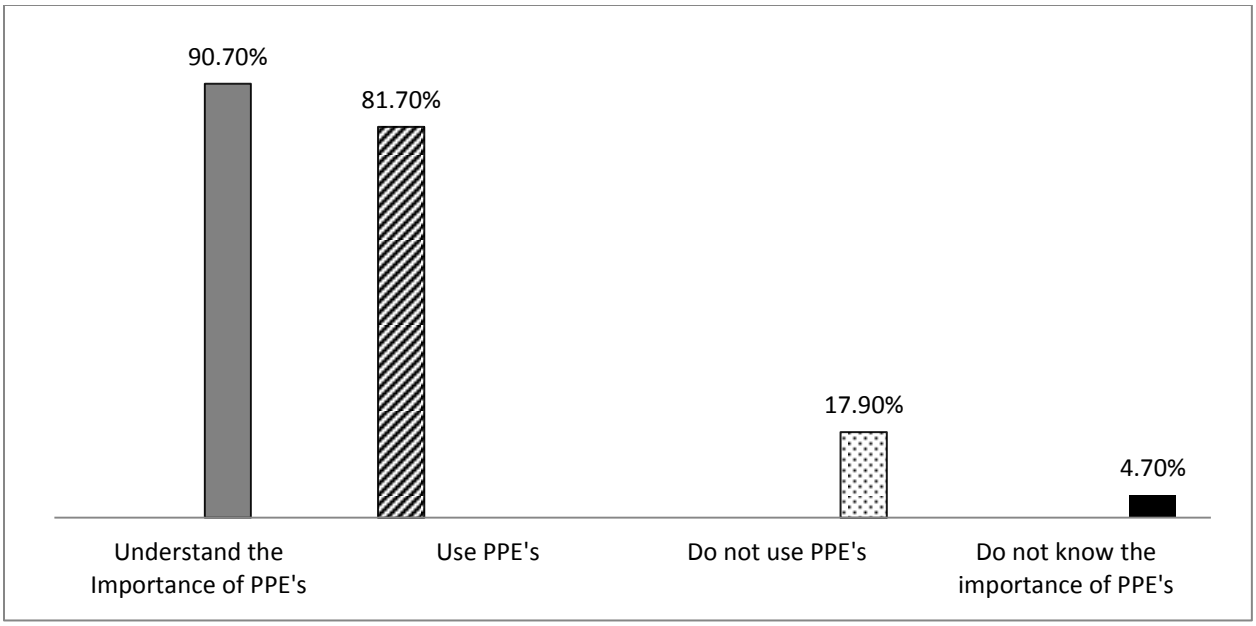

Figure 11: Use of Personal Protective Equipment among FFW's

Asked whether pesticide use should be discouraged, 42.6% of the workers answered in the affirmative. They expressed their dislike for the use of pesticides as a strategy of pest control citing various reasons. 25.9% claimed that pesticides affected human health leading to impotence, terminal illness and death, 5.9% mentioned that pesticide use should be discouraged in order to achieve environmental conservation, and indeed, suggested the use of alternative forms of pest control (biological control) in order to protect Lake Naivasha. Interestingly, some respondents justified the use of pesticides citing the absence of other effective and affordable alternatives to pest control such as biological control. In fact, a total of 43% reported that the use of pesticides is the best and most efficient way to control pests.

A total of 8.6% respondents feared that they would lose their jobs if pesticides use was discouraged in flower farms as this would result to closure of some farms. Flower farms are a source of livelihood for most of the flower farm workers -especially sprayers, flower farm workers therefore advocated for sustainable use of pesticide and adherence to instructions on re-entry and safety periods of the various pesticides used in flower farms. In addition, a high percentage of the interviewed flower farm workers believed that they could not influence the decision to use or not to use pesticides. Most of the respondents felt that such suggestions may not

be taken seriously by most employers. This perception by flower farm workers in Lake Naivasha basin, was shared by flower farm workers elsewhere, for instance in the West Bank, Palestine (Issa *et al.,* 2010) and in the Gaza strip (Yassin *et al.,* 2002)

Further collaboration is drawn from a study conducted in China, on knowledge, attitude, and practice regarding organic solvents among printing workers which revealed that workers expressed some anxiety about solvent exposure and burns but most felt that these hazards were "just part of the job" and little could be done to improve health and safety on the job (Tak-sun Yu, I. *et, al.,* 2005). Such attitudes may further encourage flower farm workers to continue working in hazardous environments despite the health risk involved.

Most of the respondents acknowledged that the flower industry depended heavily on pesticides and therefore complete eradication of pesticides use is almost impossible. Most respondents concurred that since pesticides have to be used, employers (flower farm owners) should improve the working conditions by providing high quality protective wear and ensure cautious use of pesticides to minimize effects on their health. Use of Class II and Class III pesticides which are known to have less harmful effects, adherence to instructions on re-entry, and observation of safety periods in order to reduce exposure, and in turn reduce the high incidence of ill health among workers, were suggested to be the most practical measures that should be embraced in order to reduce pesticide poisoning.

4.4.1 Poor Attitude towards the Flower industry

The respondents were asked whether they thought or believed that their health condition or that of their immediate family members was in any way related to their handling of agrochemicals. A total of 57.9% of the farm workers reported that their recent conditions were not in any way related to agrochemical handling. This was expected, as most flower farm workers believed that one could only experience pesticide poisoning if they were directly involved in spraying. Results similar to these were found in Tanzania, where farmers usually assumed that pesticides poisoning symptoms are normal so they get used to them (Kishii *et., al,* 1995). Similar studies carried out in Indonesia (Kishii *et., al,* 1995) and in Côte d 'Ivoire (Ajayi, 2000) reported that sprayers tended to accept certain levels of illness as an expected and normal part of work in farming and, thus did not report the symptoms in official health centres for formal medical assistance.

The results indicated that 42.1% of the farm workers (mainly sprayers, graders and harvesters) believed that their current health conditions were as a result of the agrochemical handling in their work places. The relationship between the health conditions of flower farm workers, and handling of agrochemicals showed a strong significance (χ^2 =27.510, d.f. = 9, p=0.001). This suggests that a strong relationship exists between the health condition of flower farm workers and handling of agrochemicals. The result confirms that exposure to agrochemicals whether directly or indirectly has an impact on the workers' health.

During the interviews, one of the respondents in Karagita stated as follows:

> "The people who own the flower farms are getting richer while the workers are becoming sick and poor, mainly because of use of pesticides".

These sentiments portray the negative attitudes and perceptions that flower farm workers have towards this industry. A total of 89.6% of the respondents were aware of the consequences of handling agrochemicals and therefore the reason they used PPE whenever working. However, 66.2% of the respondents were aware of the consequences but did not use PPE when working. This could be due to a number of factors such as: ignorance, lack of PPE and discomfort especially during the day and worn out PPE. The relationship between awareness of the consequences of improper handling of agrochemicals and flower farm workers' willingness to use PPE was strongly significant (χ^2=28.506, d.f=1, p≤0.001). This underscores the importance of awareness creation among flower farm workers and the need to adhere to good practices while handling pesticides.

In an effort to determine their willingness to use PPE, respondents were asked to mention some of the coping mechanisms they used in case they were not provided with PPE's. Of the respondents interviewed, 16.6% reported that they worked without PPE while others reported that they bought their own PPE's-such as gloves and gumboots. A total of 46.9% respondents believed that the pesticides used in flower farms were most likely unlawful (prohibited) due to the adverse health effects that they experienced. However, all pesticides reported to be in use in flower farms were actually registered under Class II or III for use in Kenya by PCPB. Use of PPE could therefore not be overemphasized because pesticides have adverse health effects on humans and the environment irrespective of the Class of the pesticides.

As noted during the focus group discussion, the flower industry has been associated with negative attitudes and perceptions. This is attributed mainly to the negative publicity by human rights activists, who paint a very bad picture of the flower farms, especially how they treat and handle their workers. The recent fish kill in Lake Naivasha (2010) was blamed entirely on the flower farms with claims that they discharged raw, untreated sewage into the lake. However, most of the participants in the focus group discussion felt that the flower farms were not entirely to blame, since this phenomena mainly happens during rainy seasons where water from rivers in the upper catchment areas drain water into the lake with loads of organic matter leading to an increase in the Biological Oxygen Demand (BOD) due to decomposition of organic matter resulting to reduced oxygen levels hence death of the large fish as they are mainly bottom feeders.

Questions were asked (to the respondents) as to why most of the flower farm workers were between 20-36 years. To this the respondents mentioned that most flower farm workers do not come from Naivasha, hence once they are out of gainful employment they either go back to their ancestral home or setup small businesses. This may explain why most of the respondents interviewed were between the age group 20-36years old, where literacy levels were very high, which translates to increased level of awareness in the use of pesticides.

4.5 Practices towards Pesticides Use among Flower Farm Workers

The third objective in this study sought to evaluate methods of pesticide handling, storage and use among flower farm workers in various departments within the flower farms. Let us now review the evidence on this objective.

There are various departments in a flower farm, including: irrigation and fertigation, grade house, cold room, harvesting, production (weeding, desuckering), general workers and maintenance. A total of 34 horticulture and flower farms were reported to have used pesticide for an average of 4.8 years, with a minimum of 3 months, a maximum of 20 years and a standard deviation of ± 4.6. The most commonly reported insecticides in use were; herbicides, carbamites, organochlorines and organophosphates, other types of chemicals used include acids, cleaning reagents and fertilizers. Of the respondents interviewed, 53.9% reported to use these chemicals: 32.2% used karate, brigade, apollo, nissorun, ridomil, malathion, dynamic, sealwet, nimrod, mancozeb, 12% of the respondent reported that fertilizers such as CAN, DAP, NPK, Urea, TSP, MKP were in use, while 4.1% reported to use cleaning agents such as Teepol and Spore kill. Respondents knew

of internationally prohibited pesticides either by their chemical name, common name or classification. Some of the reported prohibited pesticides included: rugby, furadin, evisect, nemacur and apollo, these pesticides are suspected to be prohibited or classified under Class 1, which most respondents believed to have been banned due to their adverse health effects on flower farm workers once they are sprayed. Strict observation of the re-entry time and safety periods will help reduce the effects of pesticides on FFW's. Methods of pesticide handling and storage in flower farms are dictated mainly by the rules and regulations in the farm and influenced by farm workers' attitude towards pesticide use.

4.5.1 Storage and Disposal of Empty Pesticide Containers in flower farms

Most flower farms (89.6%) had designated areas where pesticide containers were stored within the farm, whereas 10.1% of the respondents who have their own farms stored pesticides within the houses. In addition, 65.4% of the respondents' burned empty pesticide containers; 27.3% indicated that they buried them, 40.8% reported that the empty containers were collected by private collectors or sold in wholesale. Proper practise in storage and disposal of empty containers should be enhanced in LNB, burning of pesticide containers contribute greatly to air pollution and respiratory infections due to the fumes released during such activities, burying of these containers contaminates underground aquifers due to seepage of surface water into the aquifers. Disposal of contaminated solid waste should be controlled and handlers of this waste licensed in order to ensure accountability. Majority of the respondents (76%) did not use the empty pesticide containers, 26.3% of them used empty acid gallons and cleaning agents containers for water storage. The most commonly used acids were Nitric and Sulphuric acids. Such practices may have a long term effect on the health of the people using this water due to contamination from acid compounds. A few respondents (5.5%) used empty fertilizer sacks for grain storage. Some flower farms used empty pesticide containers to store other pesticides; while others recycled the containers as buckets for carrying flowers. In addition, 11.8% of the respondents reported that most flower farms sell the empty acid containers to a local retailer. (Table 9)

Table 9: Storage and Disposal of Empty Containers

Variable	Frequency	Percent
Storage of pesticides		
Store on the farm site	329	89.6%
In the house	37	10.1%
Disposal of empty containers		
For food/water storage	58	31.8%
Storage of other pesticides	27	15.3%
Collected by private collectors/sellers	59	57.8 %
Burying	54	27.3%
Burning	183	65.4%

Source: Derived from research data (2011)

4.5.2 Types of PPE's` and Frequency of Use among FFW's.

A small percentage of the farm workers (5.2%) reported to be working in the flower packing section house (cold room), 21.6% worked in the spraying, irrigation and fertigation sections. Grade house workers, harvesters and general workers were 8.8%, 20.8% and 15.1%, respectively. Very few respondents (5.7%) worked in the maintenance section.

The type of PPE's and the frequency of use of PPE's varied from one worker to the other depending on the section one worked in 74.2% of the respondents reported to wear gloves, at all times while executing their duties, 75.6% of the respondents (mainly harvesters), reported wearing gumboots during harvesting. The use of gloves during harvesting in Lebanon is reported to have reduced cases of exposure as compared to non-use of gloves (Woodruff *et., al,* 1994). Flower farm workers using protective measures result to a decrease in exposure. This could contribute to a decrease in pesticide related effects.

Dustcoats, goggles and masks were reported to be the most commonly used PPE's in the main sections within the flower farms at 67.7%, 42.2%, 44.8%, respectively. In addition, overalls were reported to be the most commonly used PPE's among the spraying team. Eighty eight point three percent of the farm workers reported to be wearing overalls during preparation and application of pesticides. Thirty four point one percent (34.1%) of the respondents reported to use PPE's at all times claiming that employers were strict in the use of PPE's while working within the flower farm.

The frequency of replacement of worn out PPE's depended on the company and therefore the rate of replacement varies from one company to another. Of the respondents interviewed, 34.1%

reported that their PPE were replaced immediately after one reported to the management. However, 45% of the respondents reported that it took 2-6 months before their worn out PPE's were replaced. Results similar to these were recorded in a study conducted in Naivasha which found out that provision of protective equipment was reported as inadequate by half of the workers interviewed (Dolan *et., al*, 2003). Generally casual workers were hardly given protective clothing and when it was provided, it took long before replacement:

During the interview, one of the respondent commented as follows,

> ''the person responsible for replacing gloves deliberately delays, sometimes taking up to one month or more to replace them, by which time our fingers have really been pricked by thorns''.

Similar complaints were also raised by sprayers who underwent intense exposure to chemicals. Spray suits were said to be so worn out allowing chemicals to easily penetrate into their bodies. Majority of the interviewed flower farm workers knew the value of wearing PPE's. They gave examples of the following: avoiding adverse health effects, but very few respondents took precautions unless they knew about the measures (Yassin *et., al,* 2002). It was concluded that some flower farm workers knew the importance of using protective gear, but did not always use protective gear. Some of these reasons given included: carelessness, discomfort in hot and humid weather conditions, cost or unavailability of protective devices. Flower farm workers in Lesotho cited similar reasons for not using protective equipment and clothing (Mokhele, 2011).

Plate 1: Flower farm workers wearing Personal Protective Equipment

4.6 Safety Precautions in Handling of Pesticides

Precautions are vital in ensuring the safety of workers while handling pesticides. Best practices translate to safety for the flower farm workers hence reduced incidence of pesticide poisoning. Majority of the respondents (94.2%) mentioned that they did not drink anything during application of pesticides, 96% reported that they did not eat, while 95.4% and 96.3% of the respondents interviewed mentioned that they did not smoke neither chew gum during application of pesticides. Majority of the flower farm workers (91.5%) took a bath immediately after spraying pesticides while 58% of the respondents changed clothes immediately after spraying. To reduce the effect of pesticide poisoning, especially among sprayers, 22.7% of the flower farm workers took milk, drunk soup or porridge immediately after spraying.

A closer look at the various activities of flower farm workers with potential for exposure to pesticides showed the following 89.7% used the recommended concentration of pesticides and routinely followed instructions; very few respondents (10.3%) did not follow instructions on how to use pesticides. Further inquiry about the source of instructions on agrochemical use revealed that 76.3% of the respondents with their own farms reported to follow instructions as provided for on package materials/bottle; 35.5%, followed instructions from the strockist while others (31.7%) reported to get directions on how to use pesticides from agricultural officers.

The most common method of pesticides application reported by most respondents (90.9%) was spraying which was done routinely, followed by dusting and dripping at 23.7%, 3.7%, respectively. Estimation, use of weighing machines and advice from the agricultural officers were some of the techniques used in order to measure quantity of pesticides to be used in the farm for various crops. Moreover, 78.1% of the respondents observed the safety period (period between the last spray and the time for harvesting). A total of 69.4% flower farm workers had access to first aid kits within the flower farms; and in the event of accidents, most of the farm workers interviewed reported that their fellow workers who are trained first aiders could offer first aid services to them.

Regarding the re-entry period, the average re-entry time reported by all respondents was 5.5hrs. 4.5% of the respondents re-entered the greenhouses within an hour, 27.4% re-entered the greenhouses between 2–6 hours while 19.9% re-entered the greenhouse more than 12 hours after

spraying, the re-entry period depends on the type of pesticides used. Different pesticides have different re-entry time due to varying action of the pesticide on the plant.

Plate 2: Notice on a Green House Entrance to observe Re-entry Time

4.7 Toxicity Symptoms related to Poor Pesticide Handling and Practices

Poor use and handling of pesticides is known to affect both human health and the environment. Respiratory and reproductive health issues were reported by an overwhelming 80% of the respondents, to be the most common effects experienced by flower farm workers. Other reported effects included air pollution, water pollution and soil pollution at 72.8%, 66.5% and54.3%, respectively. Minimum effects of pesticides were reported on flora and fauna within the basin. About 36% of the respondents, who knew of the adverse health effects of pesticides, were questioned about the toxicity symptoms and the various health conditions they have experienced in person or by their immediate family members in the last one month. The recall period was shortened to one month preceding the interview to minimize the possibility of (recall) bias. Only 36% of the farm workers had toxicity symptoms related to pesticide use, with chest related problems (coughing, difficulty in breathing) being the most common at 24.4%, followed closely by skin rashes and burning sensation in the eyes/face at 18.5%, pregnancy failure was the least common at 8.3% (Figure 12)

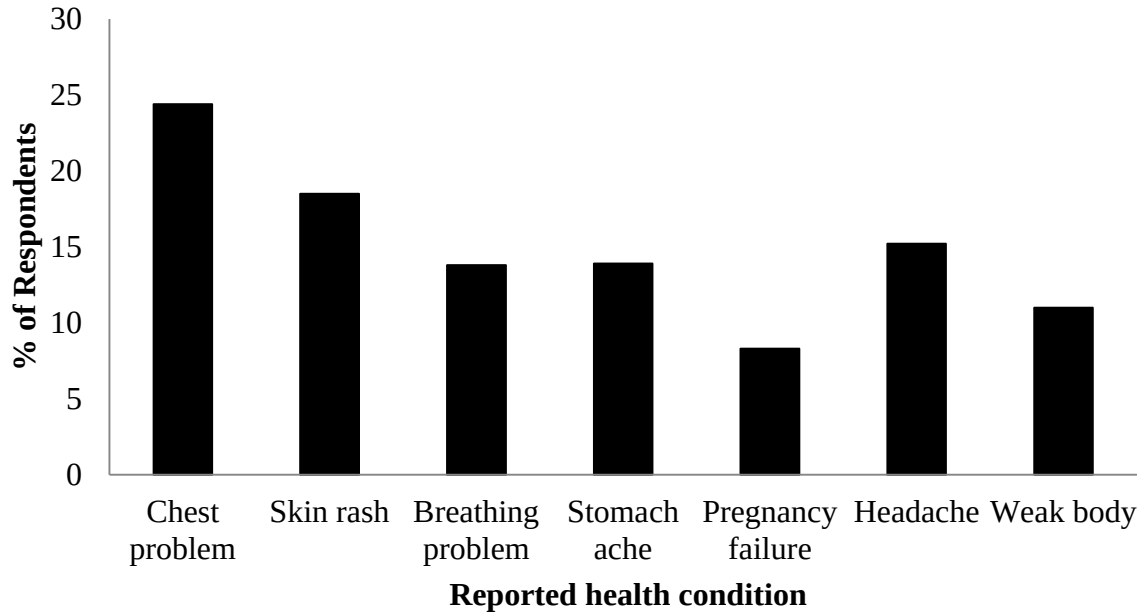

Figure 12: The percentage prevalence of reported symptoms related to pesticide use.

As noted during the focus group discussion, the Directorate of Occupational Safety and Health Service, under the Ministry of Labour, deals with issues of occupational hazards which involve the physical environment and exposure to various hazardous chemicals in the work place. The Directorates' office helps in ensuring that workers are aware of the various hazards they are exposed to at their work places through training on safety measures. A study conducted in Naivasha, however, indicated that a majority of workers are ignorant about their rights and the relevant national legislation that protects them in their work place. They are also unaware of the codes of conduct despite the fact that the research was conducted on farms that had a comparatively long history of using the codes (Dolan *et., al,* 2003). This confirms a deep problem of communication between management and workers, and hence the need for training on the significance of codes of conduct

Various policies that address issues of safety at any work place include; The Occupational Safety and Health Bill and Hazardous Substance rule (GoK, 2009). The Hazardous Substance rule addresses issues on medical examination which is meant to be done before, during and after employment. This is a practice observed by very few flower farms as reported by flower farm workers. The explanation may be due to the cost involved. The routine medical examination done after every 4 months is meant to ensure that the exposure levels of all the workers is kept below

the recommended limits- Occupational Exposure Limit-Recommended Limit (OEL-RL) as stipulated in the occupational safety and health bill. Those found to show abnormal results are immediately deployed to other work areas where exposure is believed to be minimal. However, those employees who worked as sprayers claimed that although cholinesterase testing takes place regularly, none of them are transferred to other work sections on the basis of test results. Some employers, on their part, do not see it fit to invest time and money in pre-employment screening, periodic health examinations, or hygiene surveys (Ecobichon, 2000). Similar concerns were also reported by workers in Naivasha.

4.7.1 Chi-square test between reported Symptoms and Re-entry time

A chi-square test was carried out to determine whether an association exists in the prevalence of chest problems between farm workers who follow instructions and those that do not follow instructions. Results show a significant difference in prevalence of symptoms between the two groups (χ^2 =6.474, d.f =1, P<0.05). This suggests that farm workers who follow instruction exhibited fewer symptoms as compared to those that do not follow instructions while using pesticides. Similar results were observed in the prevalence of skin rashes. A significant difference between the two groups was established (χ^2=6.860, d.f =1, P<0.05).This suggests that flower farm workers who follow instructions exhibited fewer symptoms of skin rashes compared to those that did not follow instructions. A Chi-square statistic revealed that prevalence of general body weakness among those that followed instructions to be significantly low compared to those that do not follow instructions (χ^2=181.938, d.f=1, P≤0.01). Interestingly, no significant difference existed between the two groups in terms of prevalence of breathing problems (χ^2=1.585, d.f=1, P>0.05).This may imply that breathing problems which is as a result of air pollution affects everyone in the area. (Table 7)

The prevalence of reported toxicity symptoms was high among the interviewed flower farm workers and correlated with short re-entry periods. Poor practices in handling and use of pesticide among 128 West Bank farmers were evaluated, and results similar to those from our study were reported; short re-entry periods and low use of protective measures was very high, resulting to dangerous exposures (Richter *et., al,* 1997).The highest percentage of toxicity symptoms were reported among farm workers who returned to sprayed fields within 5 hours of applying pesticides. The relationship between re-entry period and the prevalence of skin rashes was

established by a chi-square test. There was no significant difference between the re-entry period and the prevalence of skin rashes (χ^2= 12.348, d.f=17, P >0.05).This was probably due to the fact that very few farm workers re-enter the farms within 5 hours, most of the workers observed the set time which varies depending on the chemicals sprayed. The prevalence of the 4 main toxicity symptoms by locality established that Karagita had the highest prevalence in chest problems, breathing problems and skin rashes. Kwa-Muhia had the lowest prevalence in all the reported symptoms. This can be explained by the fact that very few flower farm workers lived in the area hence a few respondents were sampled from the area resulting to low prevalence.

Table 10: Chi-square Values of Reported Symptoms and following instruction

	Follow instructions		**χ^2 Value**	**P Value**	**df**
Chest Problem	Yes	No			
Have chest problem	59	91	$\chi^2 = 6.474$	0.011	1
Do not have chest problem	4	24			
Skin Rashes					
Have skin rashes	45	99	$\chi^2 = 6.860$	0.009	1
Do not have skin rashes	2	26			
Breathing Problems					
Have breathing problem	34	100	$\chi^2 = 1.586$	0.208	1
Do not have breathing problem	4	24			

Source: Derived from Research Data, 2011

4.7.2 Age and Reported toxicity symptoms

Flower farm workers were classified into four age groups in order to establish prevalence of reported symptoms across various age groups: those below 25 years of age, those between 26–35 years, those between 36-45 years and those above 46 years old. The highest number of reported symptom-chest problems (50.2%) was recorded in the 26-35 years age group, and the least number of symptoms (5.7%) were found in the group aged more than 46 years old. This can be explained by the fact that most of the flower farm workers are young men and women aged between 26-35 years. The explanation forthwith could be employers tend to go for the young and strong persons who are able to carry out heavy tasks within the farms. A chi-square statistic was performed to establish distribution and prevalence of reported symptoms among the various age

groups. A significant difference exists between two main symptoms; chest problems (χ^2=59.638, d.f=39 P<0.05,) and breathing problems (χ^2=60.286, d.f=40 P<0.05).These results indicate that these two symptoms were found to affect individuals between 26-35 years of age.

To determine the length of time respondents had been exposed to pesticides and the prevalence of symptoms across the categories, the length of time was classified into 3 categories depending on the length of time flower farm workers have been working in the farms. Those that had worked for less than 5 years, between 6-10 years and those that had worked for more than 11 years. The highest reported toxicity symptoms (56.25%) was found in the group that has worked for less than 5 years while the lowest toxicity symptoms (12.5%) were found in the group that had been working for over 11 years. A chi-square test performed to determine whether prevalence of reported toxicity symptoms increased with longer periods of pesticides exposure, revealed that there was no significant difference (χ^2=28.235,d.f=27, P>0.05) between reported toxicity symptoms and periods of pesticides exposure . Results suggest that the four main symptoms across the group that had worked for more than 11 years were not significant, this can be attributed to the fact that very few workers have actually worked for more than 11years in any of the flower farms.

Results from data analysis has shown that younger people who also have higher levels of education were more willing to use PPEs, practice personal hygiene, and had knowledge on important routes of pesticide poisoning. These results corroborate the findings of with a study by Mwanthi and Kimani (1993) who found that the level of education significantly correlates with the preparation of agrochemicals according to instructions. Similarly, the relationship between the level of education and use of personal protective equipment (PPE's) while spraying pesticides was found to be statistically significant. Anon (1992a) reported that low levels of education and training of the agricultural workforce made the workers particularly vulnerable to the risks of accidents and occupational diseases.

4.7.3 Flower Farm Workers' Health Care

The flower farm workers most affected by pesticide exposure (56.9%) were women while (43.2%) were men. Most of the duties in the farms are carried out by women hence their large numbers as observed. Cases of poisoning and death associated with pesticide use were reported by the interviewed farm workers. A total of (40.4%) of the respondents reported that some of their

colleagues had passed on due to pesticide poisoning while 59.1% mentioned that fellow workers had been affected by pesticides. Majority of the respondents claimed that a significant number of workers die of pesticide related diseases, but once the workers started getting sick they are laid off before they become worse off. Some flower farm workers (23.7%) had been affected by pesticides more than twice but less than 10 times, very few workers (1.6%) reported to have been affected by pesticides more than 10 times.

Majority of the flower farm workers (83.8%) were reported to have sought medical services from the company's health clinic, while 23.8% sought medical services from the public hospitals. Private hospitals were least visited due to the high medical cost charged by such hospitals. A significant proportion of respondents (76.2%) reported that they were allowed by the company to seek medical services from other hospitals (apart from the company's clinic). Asked whether the company paid medical bills for workers when they sought medical services from public or private hospitals, 59.3% of the respondents reported that the company paid for such medical bills if the person had been referred to go for further check-up, but 40% of the respondents reported that the company never paid for any extra expenses incurred by workers while seeking health care. In some flower farms, respondents claimed that one might even be laid off if the management gets to know that a worker has gone to another hospital.

Results further shed light on the commonly reported toxicity symptoms among flower farm workers. These include burning sensation in the eyes/face, dizziness, cold/breathlessness/chest pain, itching/skin irritation and headache. Such revelations suggest that farm workers experienced these symptoms *in situ*- (while at their places of work). Most of these symptoms were considered to be common manifestations of acetylcholinesterase inhibition-presence of the acetyl an active ingredient in most pesticides. This finding was not altogether unexpected as earlier studies in Naivasha and Wundanyi showed similar results among farmers who used pesticides in their farms without observing proper protective practices (Ohayo-Mitoko *et al.,* 1997).

Further corroboration of the research findings are reported as follows; India (Kumar *et al.,* 2010) and Ethiopia (Karunamoorthi *et al.,* 2011). Although a low percentage of the interviewed flower farm workers stored pesticides at home, this practice put children and adults at risk.

A study conducted in Occupied Palestinian Territory found that the farmers' family members, could be exposed to pesticides indirectly due to the take-home exposure or para-occupational

exposure pathways, which include returning home with working clothes, washing and cleaning contaminated clothes in the home laundry, mixing and storing pesticides at home, and cleaning equipments used for application at home (Issa *et al*., 2010). These findings were consistent with other studies conducted among Palestinian farmers and in other parts of the world (Issa *et al*., 2010).

In conclusion, the high percentage of interviewed agrovets who disposed off empty containers on the garbage site could put the general population at risk. Such a practice is considered to be one of the main problems associated with pesticide use and its management in developing countries. In most developing countries, a number of obstacles to agrochemical safety can be identified: there is insufficient legislation for pesticide use, registration and lack of technical regulatory research facilities to monitor pesticide residues and effects (Mwanthi and Kimani, 1995).

CHAPTER FIVE

SUMMARY OF KEY FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the key findings

This research was carried out in Naivasha district which has several environmental challenges, such as; concerns about the effects of pesticide in the agricultural sector. The pesticide problem has been identified as a major environmental challenge in Lake Naivasha basin. The nature of green-houses favours the prevalence of diseases, and therefore the extensive use of pesticides, which puts the flower farm workers at high risk of pesticide poisoning. The study focused on three main objectives namely: to assess the level of knowledge and awareness of pesticides use among workers in floriculture industry in Lake Naivasha Basin. Secondly; to examine attitudes and perceptions towards pesticides use among various pesticide handlers and distributors within Lake Naivasha Basin and lastly, to evaluate practices in pesticide handling, storage and use of pesticide among agricultural farm workers in Lake Naivasha basin against the best management practices proposed by Kenya Gap.

The research came up with the following key research findings: it is clear that the flower farm workers in the floriculture/horticulture industry possess a high level of knowledge on pesticide use. Most small scale farmers and flower farm workers have undergone training offered in various fora and are well informed on best management practices in handling and disposal of pesticides and pesticide related waste. Despite the training and increased level of awareness, poor practices were still observed.

Flower farm workers in Lake Naivasha basin have a negative attitude and perception towards the flower industry. This may be due to many compounding factors such as poor remuneration, poor working conditions, poverty, poor laws and regulations that fail to protect them. These factors contribute directly and indirectly to the negative attitudes that most flower farm workers have towards the flower farms which remain to be a source of livelihood to most of the residents in Naivasha. Current trends indicate an improvement in work conditions for FFWs. This is largely due to pressure from the civil society. In addition flower farms are obligated by market forces to

adhere to quality standards of the European market. This has necessitated significant investments in a skilled and well trained workforce to perform value-added work in the floriculture industry.

Finally, flower farm workers' methods of pesticide handling, storage and application as well as use of personal protective equipment were positively influenced by high level of education, awareness of the consequences of mishandling pesticides and training on alternatives to pesticide use.

5.2 Conclusions

From the research findings, it is clear that most flower farm workers have been trained on the adverse health effects brought about by mishandling of agrochemicals. However, there still remains a gap between FFWs knowledge of the dangers of poor handling of pesticides and implementation of safety practises as a mitigation measure. Consequently, pesticide poisoning is still a big challenge in Lake Naivasha basin. Moreover, there is no active authority that ensures that farm workers operate in proper conditions. In lieu of this, most flower farms management treat their workers as they deem fit. However, there are exceptions with some flower farms adhering to the set standards. With little or no ability to ensure that proper conditions are maintained, farm workers are forced to work in these conditions increasing the risk of long-term exposure to pesticides.

It may also be concluded from the key findings that flower farm workers in Lake Naivasha basin have high levels of knowledge and awareness on pesticide and pesticide use. This is important as the flower farm workers and the communities at large are aware of the effects of mishandling pesticides and other chemicals that they get into contact with while at their work place. However, some farmers reported to apply agrochemicals based on their personal experiences; gaps in knowledge obtained through these avenues may reduce the efficiency and safe-handling of pesticide applications.

A majority of the FFWs know that the pesticides used are highly poisonous, with most of them having been banned. However, these pesticides are still in use in order to increase yield, in total disregard to the health of the workers. Flower farm workers reported that despite their complaints nothing has been done as these farms belong to very rich people, whose priority is to increase

yield other than ensure the safety of the workers. It is evident from the facts above that attitudes directly affect practices. Negative attitudes leads to poor practices among flower farm workers.

The management in most of the flower farms limit the use of appropriate PPE at work. However with the increase in international pressure to adhere to good agricultural practice, flower farms are forced to ensure workers' safety while using pest control products. However, some flower farms do not adhere to the set standards and practices, thus exposing the consumers and the workers to pesticide poisoning. Some flower farm workers knew the importance of using protective gear but choose not to use protective gear, because of a number of reasons namely: carelessness, discomfort in hot and humid weather conditions, cost or unavailability of protective devices.

However, a high level of awareness has contributed to change of attitude among the flower farm workers in Lake Naivasha Basin as more farm workers acknowledge the need to use PPE's as most of them understand the effects of pesticides poisoning on their health and that of the environment.

5.3 Recommendations

In line with the key research findings and conclusions, the following recommendations are made. These recommendations aim at promoting efficient dissemination of information on pesticide use as well as promoting best management practices in pesticide handling

5.3.1 Policy Recommendations

It is recommended that an environmental awareness programme tailored for flower farm workers be established. This will help alleviate pesticide associated problems in Lake Naivasha basin. Pesticide safety education is necessary in order to inculcate protective behaviour among flower farm workers. The community at large may also benefit due to increased awareness regarding pesticides. Government organizations such as PCPB, AAK should be proactive in creating public awareness and champion extension programmes in pesticide safety.

To ensure proper practice is adhered to, institutions such as National Environmental Management Authority (NEMA) and Occupational Health and Safety, charged with the mandate to ensure occupational safety should be well equipped. Improved monitoring and regular checkups of the flower farms activities will ensure compliance by the farm owners to laid down rules and

regulations so as to guarantee the safety of flower farm workers as stipulated in the Environmental Management and Co-ordination Act, Environmental Management and Co-ordination Act (EMCA) 1999. National Legislations-Water Act (2002), International Laws, Conservation Treaties and Conventions-Ramsar Convention on Wetlands and Convention on Biological Diversity (CBD) should be upheld in order to protect biodiversity and ensure the conservation of fragile ecosystems.

Reduction in quantity of pesticide used, especially in WHO Class I and II, should be a priority in the Lake Naivasha Basin. Although reduction may mean fewer applications, the major concern in pesticide use is occupational safety-the safety of the worker while applying pesticides. It is, therefore, necessary to invest in the development of non-chemical alternatives which promote sustainable agriculture. IPM companies such as Dudutech should be encouraged and promoted by the Ministry of Agriculture in order to achieve sustainable development while at the same time ensuring ecosystem health.

Implementation of GAP and GMP are primary steps in reducing the risks associated with fresh fruits, flowers and vegetables. Training of producers in GAP at every level of the production chain and education of consumers is the key element in reducing hazards associated with fresh fruits, flowers and vegetables. The Kenya Flower Council (KFC) and Fresh Produce Exporters Association of Kenya (FPEAK) should take a lead role in ensuring consumer education and adherence to Good Agricultural Practices (GAP).

The introduction of administrative controls whereby sprayers take turns applying pesticides does reduce overall population exposure to poisonous chemicals. This could reduce individual exposures in occupational settings and in turn improve flower farm workers attitudes. Ministry of Labour-Directorate of Occupational Health and Safety should see to it that the requirements clearly stipulated in the Act on acceptable limits of occupational exposure are adhered to and perpetrators are brought to book in order to reduce public health risks and hazards.

Proper mechanisms should be put in place to minimize the adverse effects of pesticides on both the human population and the environment. This will require efforts in all areas of pest management and pesticide control. In addition, emphasis should be placed on the occupational health of workers in the agricultural sector by the Ministry of Health, with appropriate medical surveillance and record keeping. The Human Right activists groups, Civil Society Organization,

Environmental Working Groups and Non-governmental Organizations-LNGG and LNGA should work towards achieving environmental protection. Flower farms should be encouraged to embrace production methods that are environmentally friendly in order to reduce pressure on the scarce water resources and ensure the safety of the workers with clear focus on peoples' health and the safety of the environment.

5.3.2 Recommendations for further research

- This study did not explore why awareness does not necessarily translate into proper practice. This aspect therefore needs further investigation and could be the subject of future research.
- A replication of this study in other geographical areas is recommended to verify findings from this study. General guidelines drawn from this study can be applied and replicated in other areas with large scale farming operations that intensify the use of pest control mechanisms.
- Studies on knowledge, attitudes, and practices indicate that unsafe use of pesticides is common in developing countries. There is need for further research focusing on prevalence of unsafe use of pesticides as this exposes flower farm workers to pesticide poisoning.

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APPENDICES

APPENDIX 1: LAKE NAIVASHA BASINSOCIO-ECONOMIC SURVEY

Respondent name and Signature (optional) _____

Interviewer _____

Date _____ Place of interview_____

Time of interview _____

1. Name of Enumerator_____
2. Code of Household/Individual:……
3. Area of residence Sub-Loc Location Division
4. Age of respondent:
5. Sex:Male (1) Female (2)
6. Marital status : Married(1) Divorced (3)
   Single (2) Widowed (4)

   If not currently married go to Q 9
7. If married do you live with your spouse?Yes(1) No(2)

   If yes go to Q9
8. If no in 7 above,how often does s/he come home?

   Every week (1) 2-6months (4)

   Every 2weeks (2) Once a year (5)

   Every month (3) Other (specify)…….
9. Total number of people living in the household?
10. Total number of children in the household?
11. Total number of children aged 5years and below
12. Total number of other dependents in the household?
13. Level of Education?

    No formal education (1)

    Lower primary (2)

    Upper primary (3)

Secondary (4)

Tertiary (5)

14. If married, what is the level of education of your spouse?

No formal education	(1)	Secondary	(4)
Lower primary	(2)	Tertiary	(5)
Upper primary	(3)	don't know	(6)

15. What is your main occupation?

Self employed (1)

Government employee (2)

Flower farm worker (3)

Other private sector employees (4) (Specify employer)……..

Others (Specify)……

16. What are the main duties you undertake in this occupation? .....

17. How long have you worked in the present employment? .....

18. On average, how much do you earn per month? ……

Below 5000	(1)	20,001-30,000	(5)
5,000-10,000	(2)	30,001-40,000	(6)
10,001-15,000	(3)	40,001-50,000	(7)
15,001-20,000	(4)	Above 50,000	(8)

19. How long have you lived in the Lake Naivasha area? …….

20. Is the house you are living in

Rented? (1)

Care-taking? (2)

Owned? (3)

Other (Specify)…….

21. If rented, how much do you pay per month? Kshs…….

22. Type of house

Permanent (brick wall & iron/tile roof) (1)

Semi-Permanent (iron roof &mud wall/cement floor) (2)

Non-permanent (timber/mud/wall/iron-roof/earthen floor) (3)

Other (Specify)……..

PART II: PESTICIDE USE

23. What is the name of the flower farm in which you work ?.....

24. Using the Table below provide answers about the section of the flower farm you worked, period of time worked, and nature of work done

Section of the flower farm	Job undertaken	Length of time worked

25. Does your work involve the use of chemicals? Yes(1) No(2)

26. If answer to Q25 above is Yes,which of the chemicals below do you come into contact with?(Tick where appropriate and as many as may apply)

Pesticides (1)

Fertilizers (2)

Cleaning reagents (3)

Others (specify)……

If you use pesticides only go to Q51

27. What are the different fertilizer(s) and cleaning re-agents used on your farm? Fill the table below, with appropriate answers regarding fertilizers and reagents

Type of chemical	Different types used on the farm	Crop on which used
Fertilizer		
Re-agents		

Any other(specify)

28. What are the sources of your fertilizer(s)

29. Who makes the decision on the type of fertilizers/pesticides to be used?

Employer (1) Supervisor (3)

Manger (2) Self (4)

Other (specify)……

If not self go to Q49

30. If self, how do you decide on the quantity of fertilizer to use?

31. In your opinion, do you think the fertilizers you use have effects on the environment?

Yes (1) No (2)

If no go to Q51

32. If the answer is yes to Q31, List five effects of fertilizers on the environment?

33. How long have you been using pesticides in this farm or elsewhere?.....Years

If you do not use chemicals go to Q51

34. If you use pesticides (Q33) List the pesticide(s)used on your place of work.

Organophosphates	Yes(1)	No (2)
Organochlorines	Yes(1)	No (2)
Carbamites	Yes(1)	No (2)
Herbicides	Yes(1)	No (2)

Other (specify)……..

35. How do you apply pesticides?

Spraying	Yes(1)	No (2)
Dusting	Yes(1)	No (2)

36. How often do you apply pesticides?

Routinely (6-7times a week) (1) Occasionally (2-3 times a week) (3)

Most of the times (4-5times a week) (2) Rarely (1-2 times every 2 weeks) (4)

37. In the table below please list each pesticide used and state the crop for which it is used and duration of use.

Pesticide	**Crop for which it is used**	**Duration of use**

38. Do you follow any instructions when using pesticides?

Yes(1) No (2)

39. What is the source of instructions on pesticide use?

Bottle/package	Yes(1)	No (2)
Stockists	Yes(1)	No (2)
Agricultural officers	Yes(1)	No (2)

Other(specify)…….

40. If you follow instructions (Q38&39),how often do you follow the instructions?

Routinely (Always) (1) Occasionally (3)

Most of the times (2) Rarely (4)

41. Where do you store the chemicals after use?

Within the house	Yes(1)	No (2)
In the store outside the house	Yes(1)	No (2)

Other (specify)……

42. How do you use the containers after spraying?(Tick Appropriately)

Do not use Container	Yes(1)	No (2)
For water storage	Yes(1)	No (2)
For storage of food	Yes(1)	No (2)
To store other pesticides	Yes(1)	No (2)

Other (Specify)……..

43. Which of the following ways do you use to dispose the non-usable containers?

Throw in open pits	Yes(1)	No (2)
Farm site	Yes(1)	No (2)
By the road side	Yes(1)	No (2)
Bury	Yes(1)	No (2)
Burn	Yes(1)	No (2)

Other (specify)…….

44. Which of the following ways do you wear during preparation and spraying of pesticides?(Tick appropriately)

Do not use any protective gear	Yes(1)	No (2)
Gloves	Yes(1)	No (2)
Goggles	Yes(1)	No (2)
Wide brimmed hat	Yes(1)	No (2)
Mask	Yes(1)	No (2)
Special boots	Yes(1)	No (2)
Overall	Yes(1)	No (2)

Other (specify)……..

45. During spraying, do you do any of the following?

Smoke	Yes(1)	No (2)
Drink	Yes(1)	No (2)
Eat	Yes(1)	No (2)
Chew gum	Yes(1)	No (2)

46. What precautions do you take after spraying pesticides?List the precaution and state how soon you take them in the table below.

Precautions	How Soon? Immediately (1);Before leaving for home(2);At home(3);Specify any other
1. Showering	
2.	

47. After spraying, how long does it take before working in the same field again?

48. Do you have access to any first aid kit? Yes (1) No (2)

49. Have you ever been trained on handling hazardous pesticides?Yes (1)No (2)

50. If the answer to Q49 is yes,specify who trained you?

51.Have you ever been trained on alternative forms of pest control apart from use of pesticides?

Yes (1) No (2)

If no go to Q 53

52. If the answer to Q51 is yes. please specify the various methods/techniques of pest control other than the use of pesticides…….

53. Do you observe the safety period (the period between the last spraying and the harvesting)?

Yes (1) No (2)

54. In your opinion, do you think the pesticides you use have effects on the environment?

Yes (1) No (2)

55. Are you aware of any consequences of mishandling pesticides? ***If no go to Q57***

Yes (1) No (2)

56. If the answer to Q55 is Yes, List five (5) effects of pesticides that you are aware of on the environment.

57. Do you think or believe that the health conditions you and your immediate family members live in are in any way related to the use of pesticides?

Yes (1) No (2)

If no go to Q59

58. If the answer to Q57 is Yes, which health conditions have you and your immediately family members experienced in the last one month?

Health condition	Sex; Male=1;Female=2	Age

59. In your opinion, do all the pesticides have the same adverse health effects on human health?

Yes (1) No (2)

60. State three routes which pesticides may enter the human body?

61. If the answer to Q59 is yes, please specify the pesticide responsible by

a) Chemical name……. b) Group……

c) Trade name….. d) I don't know……..

62. How many times have you been affected by pesticide use?

63. In which of these could pesticides residue by existing?

Air	Yes (1)	No (2)
Soil	Yes (1)	No (2)
Ground water	Yes (1)	No (2)
Fruits	Yes (1)	No (2)
Vegetable Leaves	Yes (1)	No (2)
Seeds	Yes (1)	No (2)

64. Do you know that there are internationally prohibited pesticides?

Yes (1) No (2)

65.If the answer to Q64 is yes, specify one(1) that you are aware of……..

66. Should pesticide use be discouraged ?Yes (1) No (2)

67. Give reasons for the answer in the Q66.

68. In your own opinion, how important is wearing of protective clothing to the workers?

Don't know the importance (1) Slightly Important (3)

Not Important (2) Very Important (4)

69. Do you use protective clothing when working? Yes (1) No (2)

70. If yes in Q69, list the protective gear(s)you use in each farm sections and state how frequently you wear them during execution of duties(tick against the most appropriate answer in rating the frequency of use).

Section	**Protective Gear**	**At all Times**	**Most times**	**Once in a while**

PART III: OBSERVATION SCHEDULE

Instruction to the Investigator/Interviewer: Make Appropriate Observations and Record the Observations in the Questions below

1. How is the preparation of pesticides done

Use automated machines	Yes(1)	No(2)
Manual mixing in the room	Yes(1)	No(2)
Manual mixing in open space	Yes(1)	No(2)

2. What protective garment do the workers have when preparing chemicals?

How mixing is Done		
Use respirators	Yes(1)	No(2)
Use face mask	Yes(1)	No(2)
Use gloves	Yes(1)	No(2)

3. How are pesticides stored?

Storage of pesticides		
In a lockable store	Yes(1)	No(2)
In unlockable store	Yes(1)	No(2)
Store labeled with caution mark	Yes(1)	No(2)
Well-Ventilated store	Yes(1)	No(2)
Room for store keeper separate	Yes(1)	No(2)
Chemicals well labeled	Yes(1)	No(2)
Chemicals well sealed	Yes(1)	No(2)
Other(Specify)	Yes(1)	No(2)

4. How is empty pesticide containers disposed off?

Disposal of Empty containers		
Burn in open space	Yes(1)	No(2)
Incinerate	Yes(1)	No(2)
Throw in a pit	Yes(1)	No(2)
No observable evidence of how disposed	Yes(1)	No(2)

Are there washrooms/showers for workers on the farm**?**

Washrooms		
Showers at place of work	Yes(1)	No(2)
Hand washing facility at mixing site	Yes(1)	No(2)
Hand washing facility at spraying area	Yes(1)	No(2)

5. How are the equipment used on the farm cleaned?

Equipment cleaning		
Cleaner in protective clothing	Yes(1)	No(2)
Using water only	Yes(1)	No(2)
Using water and some detergent	Yes(1)	No(2)
Equipment not cleaned before storage	Yes(1)	No(2)

APPENDIX 2: Questions for the Scheduled Interviews (Agro vets)

1. What type of agrochemicals do you stock?

2. Do you mention effects associated with the use of agrochemicals to your buyers

3. Have you undergone any form of training to assist you in the handling and storage of agrochemicals?

4. a) Have you ever experienced pesticide poisoining

b) *If Yes,* what were the symptoms you experienced?

5. Do you use personal Protective Equipments (PPE) when handling agrochemical,*if no,*Explain why?

6. Are you aware of the routes through which chemicals can penetrate into the body?

7. Where do you dispose of expired chemicals?

8. Are you aware of any law governing storage, handling and disposal of chemical?

9. Are all of your products registered for use in Kenya?

10. Have you ever heard of the Pesticide Control Products Board? (PCPB), 1) Yes 2)N0

If yes, please answer the following questions

11. Do you know of its function? Please mention a few

12. Do PCPB/NEMA officials carry out regular inspection to inspect the products you sell? To check whether the products are expired or not? Whether the products are registered or not?

13. What action do such officials take in case one is found with expired products or unregistered products?

14. What are the levels of education of your buyers concerning use, handling and storage of pesticides?

APPENDIX 3: Questions for Focused Group Discussion (PCPB,NEMA)

1. Name:
2. Organization:
3. What is the core mandate of this organization concerning pesticide use in the country?
4. How does this organization carry out its functions?
5. What are the major challenges in carrying out these functions?
6. Are there any government policies/plans that hinder the organization from carrying out its function?
7. Do you conduct any training concerning pesticides to distributors and importers (PCPB) before licensing the agrochemicals?
8. How do you ensure that all agrochemicals used in the country are registered?
9. How do you ensure that pesticides placed under restricted or banned products are used for their specified functions or are completely removed from the market?
10. Do you carry out inspection on agro vets to ensure that all products in the market are actually licensed?
11. The use of DDT is said to have increased in the recent past, despite the fact that it's a restricted product only to be used in mosquito control;this has been confirmed by studies that show increased levels in the lake, how does this restricted product still find its way in the market?
12. In your opinion,what can be done to enforce the law governing the importation and licensing of agrochemicals in Kenya?

APPENDIX 4: LICENSING OF PREMISES

(A statutory Organization of Government)

TO: ALL OWNERS OF PEST CONTROL PRODUCTS PREMISES

In respect of licensing of premises, the Pest Control Products Act,1982;LN No.45) for manufacturing, formulating, packaging, selling or storing pest control products,the following requirements should be met:-

1. Suitable design, layout construction to facilitate the health of workers and to avoid contamination of the environment. Adequate ventilation must be provided.

2. Sufficient space for the placement of equipment and storage of materials which is necessary for the health of workers and operators.

3. Separate areas, either by partition, location or other effective means, for those operations which do not require workers to be exposed to the pest control products.

4. Workers must wear adequate protective clothing (Rubber gloves, masks, overcoats and gumboots).

5. First-Aid facilities must be available to cater for accidental poisoning (First Aid box, antidotes and fire extinguishers)

6. Operators in charge of premises for manufacturing, formulating and packaging of pest control products shall have adequate knowledge of chemistry, toxicology, efficacy and general use of products being dealt with in the premises

7. Operators in charge of stores and dispensing premises shall have adequate knowledge of the specific products namely, efficacy, uses, handling precautions and shelf life.

8. Stores dispensing pest control products should be physically separated from food stores by adequate partioning to avoid food contamination.

9. All pest control products must be labelled fully as required by law

10. Adequate water within the premises should be available to facilitate washing in cases of accidents.

11. Floors should be adequately polished to facilitate thorough cleaning of spills

12. Containers in storage should not be stacked on top of one another but should be accurately shelved.

13.All pesticides should be marked with the date of manufacture and date of formulation as most are known to have a shelf life of two years from the date they were manufactured.

14. Stock records should be kept and made available for inspection. They should be maintained for a minimum of five years.

15. Disposal methods should be outlined to avoid contamination of the environment. Provisions of concrete sumps to direct spills from stores are necessary. Saw dust or sand should be kept ready for decontamination of spills and easy sweeping.(Also provide dustbin for pesticide waste).

16. General cleanliness of the premises where pest control products are stored and dispensed should be kept at all time.

NOTE:

1. Failure to comply with the pest control Products Act.1982.Regulations (LN45; 46; 89; 145) constitute an offense punishable by law. It may lead to withdrawal of the license and subsequent prosecution under the Pest Control Products Act

2. All enquiries should be directed to: ***The secretary, Pest Control Products Board***

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