

Levels of Awareness on Safety and Health in Use of Agro-Chemicals among Large Scale Flower Farm Workers in Uasin Gishu County. Kenya

Eunice J.Saina* Kennedy N.Odimu Amos M. Otara
Department of Geography, Egerton University, P.O. Box 536-20115, Egerton, Kenya

Acknowledgement

I would like to express my sincere appreciation to Egerton University and to the Department of Geography for making this study possible, especially guidance given to me by my supervisors; Prof. Kennedy N. Ondimu and Dr. Amos Otara, all of whom gave professional assistance, support and encouragement during the study. My appreciation is further extended to my colleagues and above all Mrs. Chepkonga and Mr. Yatich for sharing ideas and support during the entire period of my study and research. Finally, I express my deepest gratitude to my dear husband Mark and son Finley for constant prayers, patience, support, encouragement and understanding during the time while I was away pursuing my studies.

Abstract

Flower farms play an important role in the horticulture industry which contributes about 10% of agricultural produce in Kenya. They create employment, earn foreign exchange through exports and improve infrastructure in the world. Despite these achievements agro-chemicals used in these farms to increase production pose a great danger to the health of the farm workers and the surrounding environment. The broad objective of this study sought to reduce the health impact of unsafe handling of agro-chemicals by assessing compliance with legal requirements by large scale flower farm workers in Uasin Gishu County. This study was guided by the following objectives, to assess knowledge, attitude safe handling and disposal of agro-chemicals as well as assess frequencies of self-reported health symptoms related to pesticide exposure among large scale private farm workers. The study employed cross sectional survey design, purposive sampling was used to get the sample from four large scale flower farms in Uasin Gishu County. Data was collected by administering questionnaires and analyzed using SPSS version 20 using descriptive and inferential statistics (percentages means and medians). The study findings have revealed that some of the agro-chemicals used are acephate, tetradifon, aldicarb and piperophos. Though majority of the respondents have participated in training courses related to the safe handling, a significant percentage of the respondents do not safe practice to reduce pesticide exposure. Despite this, the respondents were aware of other ways of pest control such as fostering beneficial organisms and disrupting pest's life cycle. The results indicate that agro-chemicals can have negative impacts on health. Therefore, both men and women should put on personal protective devices and ensure proper storage, handling and disposal of agro-chemicals. Workers that handled agro-chemicals had symptoms of skin rash, itch, running nose, burns, eye itching, excessive sweating, chest pains and pregnancy complications. Workers should undergo training on safe handling of agro-chemicals so that they can read and understand the information written on agro-chemicals; undergo medical checkups before and during work periods and have a positive attitude towards safe handling of agro-chemicals. There is also need for effective diagnosis and treatment of the symptoms brought by agro-chemicals in order to reduce fatality of acute poisoning.

Keywords: Agro-chemicals, awareness, safe-handling, attitude, health and safety, Uasin Gishu county- Kenya.

1.0 Introduction

Globally, agro-chemicals have been used increasingly since the 1940s. Their use leads to considerable health hazards for people, due to direct contact during application, pesticide drift from fields, or contamination of food or drinking water. The effects of the dispersal and inappropriate handling of agro-chemicals are a significant global health problem. In the European Union alone, more than 200,000 tonnes of agro-chemicals (active ingredients) are used annually (Eurostat statistical books, 2007). Africa on the other hand makes up 4% of global pesticide market, a rough estimate of about 75000-100000 tonnes of agro-chemicals (PAN, 2003).

Floriculture development has positive environmental impacts, and not limited to, creation of job opportunities, improved infrastructure, improved worker living standards' among others on the other hand negative impacts are illnesses among workers, occupational safety, sexual harassment, surrounding community health, compensation for previous land holders and social change among many people are major challenges (ILO,2006).

According to estimates of Environmental Protection agency EPA (1992), occupational exposure to agro-chemicals poisons as many as 20,000 farmworkers every year and causes farmworkers to suffer more chemical-related injuries and illnesses than any other workforce nationwide. Several factors contribute to the

underestimation of the problem, including the inability and apprehension of affected workers to get medical care, medical misdiagnosis, lack of training, inappropriate practices and the absence of a coordinated national incident reporting system (Calvert et al., 2008).

Agro-chemicals classified as being extremely or highly hazardous by FAO and WHO are used in developing countries causing 3.5 to 5 million acute poisonings a year (WHO, 2003). According to WHO, developing countries use about twenty-five percent of the agro-chemicals in the world, and the use is in increasing trend. Some of the agro-chemicals used in flower farms include DDT, chlordane among others. This essentially dangerous technology is being promoted in a setting without technical and human resources to control it properly.

Farmworkers are exposed to agro-chemicals in a variety of ways. Workers who perform hand labor tasks in treated areas risk exposure from direct spray, aerial drift, or contact with agro-chemical residues on the crop or soil. Workers who mix, load, or apply agro-chemicals can be exposed to agro-chemicals due to spills, splashes, and defective, missing or inadequate protective equipment (Lu, Fenske, Simcox and Kalman, 2006).

According to Di Renzo et al., (2015), exposure to toxic environmental chemicals and related health outcomes are inequitably distributed within and between countries; universally, the consequences of exposure are disproportionately borne by people with low incomes, discrimination, other social factors, economic factors, and occupation impact risk of exposure and harm. Documented links between prenatal exposure to environmental chemicals and adverse health outcomes span the life course and include impacts on fertility and pregnancy, neurodevelopment, and cancer. The global health and economic burden related to toxic environmental chemicals is in excess of millions of deaths and billions of dollars every year.

Agriculture work is one of the most prevailing types of employment in the world. Nearly 50 percent of the world labour is employed in agriculture directly and they carry significant risk for development of pesticide risk (Das et al., 2001). Agricultural development policies in many developing countries emphasize a lot on external inputs as means of increasing food production. This has led to a growth in the use of agro-chemicals, inorganic fertilizers, chemicals etc. and hence a substitution for natural processes and resources. Environment and Management Coordination Act (EMCA) 1999, states that it is the duty of workers to ensure that he /she wears or use any protective equipment or clothing provided by employer or farm and should comply with safety and health procedures requirements given by person having authority over him for his own or any persons safety.

In developing countries, the effects of acute poisoning due to exposure to dangerous levels of agro-chemicals in food are apparently more severe than in industrialized countries for example from Africa: in 2008 Nigeria reported that 112 people had been poisoned by pesticide. In some regions, direct contact with agro-chemicals used in agriculture is a widespread problem. Mixing and applying agro-chemicals has resulted in acute poisoning due to uptake via the respiratory organs or through direct contact with the skin or eyes. Agro-chemicals pose a further hazard for the residents of rural areas or surrounding communities for example air pollution, soil pollution when there is soil erosion from the farms and water contamination especially where water resources are shared with the communities (Organic Consumer Association, 2008).

According to EMCA Section 93 (1) states that no person shall discharge any hazardous substance, chemical, oil or mixture containing oil into any waters or any other segments of the environment contrary to the provisions of the Act. A person who discharges a hazardous substance, chemical, oil or a mixture containing oil into any waters or other segments of the environment contrary to the above subsection commits an offence (EMCA, 2000) Floriculture development has positive environmental impacts, and not limited to, creation of job opportunities, improved infrastructure, improved workers living standards' among others on the other hand negative impacts are illnesses among workers, occupational safety, sexual harassment, surrounding community health, compensation for previous land holders and social change among many people are major challenges (ILO,2006).

However, according to WHO (2006), health hazards as a result of agro-chemical use are not understood by workers, also the communities living around the farms may be unaware of health hazard; however it is known that extensive use of agro-chemicals has adverse effects on health and surrounding environment and studies show that one in five children die in poorest areas of the world. United Nations, World Bank and World Resource Institute show that pesticide poisoning, malaria and respiratory infections contribute to 11 million childhood deaths every year.

According to Occupational Safety and Health Act (OSHA, 2007), employees are required to provide information, training and supervision to workers as it is necessary in order to ensure that safety and health at workplace. The act also provide that risk assessment should be carried out in relation to safety and health of persons employed and at same time adopt preventive and protective measures e.g. sending a copy of assessment report to the area occupation, safety and health officer stopping any dangerous operation on activity that exposes persons health risks.

Although there are now some 500 commercial flower growers in Kenya, approximately 75% of Kenya's cut flower exports are grown by about two dozen large and medium scale producers. Such operations range in size from 20 to over 100 hectares, with workforces of between 250 and 6000 (Thoen et al., 2000). Large scale farms

are found in areas like Rift Valley region like Naivasha, Uasin Gishu and Central region of Kenya for example Kiambu. Much of the remaining flowers production is grown by smallholders in open plots of less than half a hectare.

Some of the major problems encountered by floriculturists include pests, disease and growth control. Agro-chemicals play a big role in increasing crop yields as well as controlling insect vectors that cause diseases like Yellow fever and Malaria. The use of agro-chemicals that have been restricted and banned in industrialized countries are mainly used in many developing countries (Wessling et al.,1997), farm workers engage regularly in spraying agro-chemicals applied in different formulations and stages.

Agro-chemicals have replaced biological, cultural, and mechanical methods for controlling pests, weeds and diseases. On the other hand, in most cases information for the management decisions on agro-inputs comes from input suppliers, researchers, and extension workers rather than from local indigenous sources. It is, therefore, necessary to make better use of indigenous resources in sustainable agricultural production and for health maintenance. Industrialized countries have been taking significant steps to reduce pesticide use, while use in developing countries is on the increase (Wessling, 2003).

It is clear that there is still a wide overuse of agro-chemicals by farmers applying them as a preventive measure, or without considering recommended doses or synergetic effect, (Barrow 1995; Pretty 1995). To achieve the preferred effect and to avoid risks, the pesticide industry and scientists recommend that the most appropriate pesticide should be applied in accurate amounts, at the right time, and with appropriate precautions in terms of storage, handling, use, preparation and application, and the cleaning of equipment and disposal (Sweet et al., 1990)

1.1 Knowledge on Safe Use of Agro-chemicals

Agro-chemicals have a capacity to contaminate organisms, soil and water, Due to its high volatility, it is estimated that only 0.1% of total applied agro-chemicals attains its intended goal while the other 99.9% is discharged as an air pollutant. The agro-chemicals applied in the green houses travels an average distance of 1500 miles, adding significantly to global warming and air pollution (Anon, 2003). According to Royal Horticultural Society (2004), most of the agro-chemicals can give rapid control of pests and diseases which can in turn destroy some of the plants and harm human beings. When used they improve the quality and yield of flowers, fruits and vegetables.

According to study conducted in Gaza strip, Palestine, When the farm workers were questioned about their knowledge regarding pesticide associated toxicity symptoms, most knowledge was of a burning sensation in the eyes, face, watering of eyes, chest pain, itching/skin irritation, headache, and dizziness (Safi and Yassin, 2002). Most men and women denied having received formal training on the use of pesticide; such knowledge suggests that farm workers experienced these symptoms in situ. Most of these symptoms are considered to be common manifestations of acetyl cholinesterase inhibition. (ATSDR, 1993)

The majority of the interviewed farm workers in Gaza strip knew that wearing protective gear can protect the body from the adverse health effects of agro-chemicals, but no one took precautions unless they knew about the measures. As concluded by the interviewer, the reason for not using protective gear, among farm workers who knew the benefit of the gear, could be attributed to carelessness, discomfort, cost, or unavailability of protective devices. These findings are in consistent with the study done from Sri Lanka and USA, whereby the percentage of the farm workers who are against the use of agro-chemicals are higher than those who agreed with agro-chemical use (Sivayoganathan et al., 1995). Similarly, lack of knowledge of the other alternatives for pest control was the justification for the continuous use of agro-chemicals. Although a low percentage of the interviewed farm workers store agro-chemicals in the home, this practice still puts children and adults at risk.

Wessling (1997) reported that the high percentage of farm workers who dispose of the empty containers on the garbage site or along the street could put the general population at risk. Such practice was considered to be one of the main problems associated with pesticide use and its management in developing countries .The prevalence of mixing two or more agro-chemicals was high among the interviewed farm workers and correlated with the prevalence of self-reported toxicity symptoms associated with agro-chemicals. Similarly, younger farm workers reported the highest self-toxicity symptoms, the younger farm workers often express themselves better than older ones, who sometimes hesitate to complain. However, huge percentage of men and women denied to having received formal education with the percentage within sex accounting for (80%) who denied in men and 85% in women. It can be concluded that lack of formal education has contributed greatly to the misuse of agro-chemicals and their applications.

According to study done at Lake Naivasha basin, a high percentage of the interviewed flower farm workers believed that they could not influence the decision to use or not to use agro-chemicals as most of them felt that such suggestions may not be taken kindly by most employers. Similarly, workers expressed some concern about solvent exposure and burns but most felt that these hazards were “usual part of the job” and little could be done to improve health and safety on the job (Kahiu, 2011).

Kenya Economic Survey, 2013, indicates that horticultural sector has slightly increased 3.9% in terms of commodity production for the last two years therefore a lot of emphasis is done to ensure that every county increases its production this means a lot of inputs including agro-chemicals will be used. Mwanthi (1993) reports that pesticide labels are not a guarantee to safe use of agrochemicals by farmers, they are always printed in wrong language or English and many farmers are illiterate. Most of symbols or instructions are not clear to users and are therefore ignored unless a knowledgeable person or pays attention to them. As many as 60% of Kenyan farmers in Kiambu who are illiterate could not read and understand instructions given on pesticide containers.

Therefore findings of these studies clearly suggest that it is necessary to reduce possible health and environmental risks associated with pesticide use by documenting risk perceptions and knowledge as well as developing ways to address safe use storage handling and disposal of agro-chemicals in order to at least minimize the hazards of occupational pesticide exposure especially in developing countries.

1.2 Practices on Safe Handling of Agro-chemicals among the Farmers

A broad variety of factors play a role in shaping farmers' actual agro-chemicals practices since they act rationally within the context of their available resources and socioeconomic objectives (Rola and Pingali, 1993). Presently, chemical agrochemicals are currently the cheapest and most effective means to for pest control in the short run. The supply agents have been subsidized by the government to accelerate national crop production. Moreover, the popularity of chemical agrochemicals stems from their rapid action and prolonged duration (Food and Agriculture Organization of the United Nations, 2008).

In less developed countries, adequate protective clothing is often neglected for reasons of discomfort and/or high cost. No national regulations require farmers working with agro-chemicals to observe specific precautions (Wilson and Tisdell, 2001). Proper pesticide waste disposal is also an important part of responsible pesticide use. Release or uncontrolled discharge of pesticide waste into the environment can harm people and contaminate environment (Damalasb et al., 2008). Empty pesticide containers may often retain unacceptable quantities of pesticide residue if not rinsed properly (Miles et al., 1983).

Ngaruiya (2004) asserts that farming of flowers employs many people on aspects of floriculture, such as spacing, spraying, and pruning plants for optimal flower harvest; and post-harvest treatment, storage, preservation and packaging. Nyakundi et al.,(2011), concludes that farmers rely mainly on commercial sources for information about agro-chemicals, along with the influence of suppliers, whose goal is to maximize their sales volumes, resulting in down -playing the negative impact of agro-chemicals.

In addition, survey from selected areas of Rift and Central provinces of Kenya shows that personal protection equipment is inadequate and personal hygiene is poor (Nyakundi, 2011). This finding indicates a correct knowledge of pesticide routes of absorption, where skin absorption, not inhalation has been reported to be the most important. This finding is consistent with many other studies regarding handling of pesticide by rural farmers (Burleigh et al., 1998; Berg, 2001; Matthews et al., 2003; Isin and Yildirim, 2007).

As in many other developing countries where empty pesticide containers are highly valued and sold or exchanged as storage containers for other materials, the majority of farmers sell containers to buyers who picked up the waste from the community. It is unclear what the buyers do with such containers. Damalasb et al., (2008), strongly against such practices, recommend puncturing empty containers to prevent reuse.

In regards to pesticide acquisition, proximity to stores is most important factor influencing farmers' practices. The most frequently mentioned source of agro-chemicals are mainly agro-chemical shops in the community. Contrary to concerns regarding the influence of commercial personnel on farmers' pesticide use patterns, salespersons from agro-chemical companies are rarely mentioned as a source of pesticide information. This may be because of the small size and isolation of the farm area surveyed, which makes the survey areas unattractive for company sales persons. Unfortunately, knowledge alone rarely translates into practice (Murray and Tayler, 2000).

Research done in British Columbia indicates that farm workers frequently do not use personal protective equipment (PPE) often because it is not provided (Moore2004; Quandt, Hernandez Valero, Grzywacz, Hovey, and Gonzales 2006).Verduzco and Lozano (2003) found that 4 percent of Mexican respondents who had applied agro-chemicals during their last season in Canada did not wear a respirator and that almost half did not wear protective clothing.

Farm workers are often ignorant of potential health risks of pesticide exposure to, sometimes because employers fail to inform and educate their workforce (Arcury et al., 2001; Hennery, 2008; Sakala1987). In addition to occupational exposure, farm workers are also exposed to potentially harmful chemicals because they are housed in locations that expose them to drift or over spraying as well as and to residues taken home on skin, clothing, etc. (Arcury et al.,2005; Quandt et al.,2006). Much remains unknown regarding the extent and impact of acute and prolonged chemical exposure among farmworkers due to poor reporting systems, the reluctance of farmworkers to report poisonings, barriers to seeking medical treatment, and a lack of physician training in recognizing and treating pesticide - related illnesses(Hansenan Donohue, 2003).

1.3 Farmers' Attitude on Handling of Agro-chemicals

Lack of adequate knowledge, practice and attitude on pesticide classification systems, application rates, in efficiency of combining agro-chemicals, re-entry periods, mixing and storage of agro-chemicals farmers are unable to make good crop decisions and exercise proper practices (Sekiyama et al., 2007).

Research shows that health and environmental hazards of agro-chemicals can be evaded by awareness, education and changing farmer's attitude and behaviour concerning pesticide use (Dasgupta, et al., 2005). Therefore, the first step in developing pesticide's health and environmental hazard reduction policy is to set up the extent of the problem by investigating farmer's attitudes and behaviour regarding pesticide use. (Koh and Jeyaratnam, 1996); Dasgupta (2005).

According to (Hayes and Laws, 1991), inappropriate use of agro-chemicals can seriously affect human health and the environment. According to estimates by the World Health Organization and United Nations Environment Program, pesticide poisoning injuries affects 1.5 million agricultural workers a year. At least 20,000 workers die from exposure to agro-chemicals every year, most of them in developing countries. Chemically polluted run-off from fields has contaminated surface and ground waters, damaged fisheries, destroyed freshwater ecosystems, and created growing "dead zones" in the ocean (World Bank, 2004).

High percentage of farmworkers interviewed in Gaza Strip believed that their bodies could develop resistance against agro-chemicals. This is not only the attitude of farm workers in the Gaza Strip, but also the attitude of farm workers in the West Bank (Saleh, 1995). Such attitudes may further encourage farm workers to be insensitive towards the use of protective measures.

Ward (1993, 1995) and Beck (1992) suggested that use of agro-chemicals is a social fiction. Moreover, there are no objective or agreed restrictions of safety in relation to agro-chemicals, because of the infinite number of possible combinations of agro-chemicals in the human body, including those of farmers who are directly exposed to them, or consumers who ingest them in food and water.

The criteria for the safe and effective use of agro-chemicals established through research in laboratories tend to be far-removed from the farmer's everyday decisions and practices in both industrialized and less industrialized countries. In addition, the recommended levels of pesticide use does not allow for the complex social factors that influence their actual use (Wynne, 1996).

1.4 Health Problems Associated with Agro-chemicals

The health effects associated with agro-chemicals are divided into acute poisoning and chronic effects. Acute pesticide poisoning is health effects or sickness appearing just after a single or multiple doses of agro-chemicals. This includes a variation in reactions of different target organs for example neurological, dermal or respiratory. Chronic poisoning occurs steadily after prolonged exposure to agro-chemicals. Development of cancer and reproductive abnormalities has been evident among many people who have gone through a long-term exposure to agro-chemicals (Yan et al., 2002).

Agricultural workers are exposed to a variety of chemical, physical, and biological hazards in the process of cultivating and harvesting crops and/or raising livestock (Litchfield et al., 1999). In addition to agro-chemicals, occupational exposure to solvents, metals, engine exhaust, welding fumes, and grain dusts are prevalent in agriculture (Coble et al., 2002; Shaver and Tong 1991). However, the potential health effects of agricultural pesticide exposures are of particular interest, as these chemicals are designed to have adverse biological effects on target organisms. A July 2007 study conducted by researchers at the Public Health Institute, the California Department of Health Services, and the UC Berkeley School of Public Health found a six fold increase in risk factor for autism spectrum disorders (ADS) for children of women who were exposed to organochlorine pesticides. In February 2009, the Agency for Toxic Substances and Disease Registry published a study that found that children who live in homes where their parents use pesticides are twice as likely to develop brain cancer versus those that live in residences in which no pesticides are used.

The findings of Franc and Cruiz (2001) in a study in Ecuador indicate that one of the reasons for rising conflicts between flower farms and surrounding communities were the smell released from the floriculture industries during the application of agro-chemicals. This led to passing into law a requirement that flower farms or companies must be distance of 1000m from the residential areas and 20% of their lands be set aside for green areas and fences. The introduction of strict laws such as EU Directive 91/4/EEC which emphasizes the requirement of Maximum Residues Levels (MRL's) for specific acting ingredients combination of horticultural crops that enter EU member states.

To address this concern, the Agricultural Health Study (AHS) was initiated in 1993 to explore the potential health effects of pesticide exposures in commercial pesticide applicators in North Carolina. Physical injury, mortality, respiratory disorders, neurologic symptoms, retinal degeneration, diabetes, menstrual cycle characteristics, hearing loss, Parkinson's disease, changes in serum androgen are some of the results from AHS and other researches done so far in developed countries (Hoppin et al., 2002).

According to research done in agricultural area of Missouri, fertile men who handled pesticides have been

shown to have sperm counts about 40% lower than men in three urban US areas, and to also have higher urinary concentrations of atrazine, alachlor and diazinon (Swan et al. 2003, Swan 2006). Differences among the groups remained significant after controlling for potential confounders such as abstinence time, smoking, and age, which suggest that these chemicals may have contributed to the reduced semen quality seen in the men

Majority of the agro-chemicals for killing pests in agricultural activities have elevated anxiety that they are agents of human diseases and environmental pollution. It has been observed that their long term, low dose exposure is increasingly linked to human health effects such as immune-suppression, hormone disruption, disabilities, diminished intelligence, reproductive abnormalities and cancer (Wiles, Davies and Campbell, 1998). Pesticide residues in food are also common global problems (Abinash and Singh 2009).

Ministry of public health in Thailand reported pesticide related health effects in most parts of the world in the year 2007, of about 1,452 pesticide poisoning incidents. The true number is likely to be higher as reported incidents include only those individuals with symptoms severe enough to require medical attention and with access to healthcare. Majority of farmers using agro-chemicals tested by the Ministry of Public Health in 2006 had unsafe levels of cholinesterase depression, a marker of pesticide exposure (Thailand National Statistical Office, 2003). In addition, under diagnosis and under reporting of acute pesticide poisonings are well-recognized issues in developing countries and may also contribute to higher than recorded pesticide poisoning incidents (Ngowi et al., 2007). Engel et al., (2005) examined breast cancer incidence among farmer wives in Montreal, Canada. They found out that breast cancer incidence was common among women who reported ever applying agro-chemicals relative to the general population and strong associations were not detected for specific agro-chemicals. However, other women, who were matched for age and date of diagnosis, had a range of other cancer.

Research undertaken in Pakistan on pesticide use by farmers indicate that 82% of Farmers experienced health impairment after mixing and spraying pesticide and that they believed that they are at risk while using pesticide. The common symptoms included eye irritation, neurological headaches, vomiting, skin irritation, respiratory infections and reproductive impairment, cancer, fever among others. Therefore many people are not aware of these hazards and measures to reduce chances of further poisoning (Habeeb, 1996).

Exposure to agro-chemicals and other chemicals, plants and infectious agents, as well as chronic exposure, contributes to a high incidence of skin problems and disease among farm workers (Arcury and Quandt 2007; Larson 2001). A lack of protective clothing and the absence of hand washing facilities at worksites also contribute to skin disorders (Hansen and Donohue 2003; Hennebray 2008)

Article 4 of ILO convention states that employer shall carry out appropriate risk assessment in relation to the safety and health of workers and on the basis of these results adopt preventive measures to ensure that under all conditions of their intended use, all agricultural activities and comply with prescribed safety and health standards. Employer should ensure that adequate training and comprehensive instructions on safety and health including information on hazards and risks associated with their work.

According to study conducted in Gaza strip, regarding toxicity symptoms associated with agro-chemicals, results show that common self-reported toxicity symptoms among farm workers were burning sensation in the eyes and face, dizziness, breathlessness and chest pain, itching/skin irritation, and headache. Similar data were reported in many countries, including the neighbouring ones. Cole, (1997) and Gomes, (1998)

Studies conducted in Ugandan small scale farmers indicate that the main symptoms reported were skin irritation, headache, extreme tiredness, blurred vision and dizziness which are consistent with other studies (Matthews, 2007). Moreover many of the farmers in Pallisa and Wakiso districts did not know enough about how to use and handle agro-chemicals. As seen in other studies the small scale farmers have some knowledge of the names and effects of the agro-chemicals they use but lack knowledge about mixing and of the color coding of agro-chemicals (Jors et al., 2006)

According to research carried out in northern part of Tanzania, 68% of farmers reported having felt sick after routine application of agro-chemicals. Pesticide-related health symptoms that were linked with agro-chemicals use included skin problems and nervous system disturbances (dizziness and headache). The study concluded that there is a wide range of agro-chemicals being used for pest management and vector control in agricultural areas, but many farming communities in northern Tanzania are not adequately informed about the hazards associated with the agro-chemicals. Therefore farmers use agro-chemicals without full understanding of their impact on human health and the environment (Ngowi et al., 2007).

Nyamu et al., (2012) identified in a study of patients admitted at Kenyatta National Hospital (KNH) with poisoning over the period between January 2002 and June 2003 that, agro-chemicals and industrial chemicals were the two most important poisoning agents, accounting for 43% and 24% of poisoning, respectively with Organophosphates accounting for 57.4% for most cases. Data analysis showed that 58.9% of poisoned patients were males and the rest being females and at least two cases of poisoning are seen daily. The higher incidence may be because males are more exposed to strain and occupational hazards compared to females. Similarly, the major organophosphate encountered was Diazinon; however poisoning cases as a result of amitraz also formed a significant portion. In terms of age most poisoning cases occur among young adults (ages 21-30) followed by

children aged 0-5 years.

Similarly, Pregnancy involves the transfer of lipids and lipoproteins from maternal tissues through placenta to fetus. This process results in carry-over of persistent organochlorine agro-chemicals through the placenta and their presence in lipid-rich tissues of the fetus. The subsequent metabolic transformation in the fetus is low, due to poor enzymatic activity in the developing organism. Due to the estrogenic and anti-androgenic activity of DDTs, their passage through the placenta and the subsequent fetal exposure can be considered a risk factor to the fetus, which can contribute to congenital malformations of external genitalia. The obtained correlations confirm that the placenta does not retain small molecules dissolved in blood serum components, such as organochlorine, and explain our previous determination of 102 mg/kg of total DDT detected in adipose tissue obtained during the autopsy of a still-born baby (Waliszewski, 1994).

1.5 Gender and Exposure to Agro-chemicals

Agro-chemicals exposures in developing countries are aggravated by economic policy changes associated with structural adjustment programs and globalization. Majority of women in these countries, particularly in the agricultural sector, are increasingly exposed. Since they are concentrated in the most marginal positions in the formal and informal workforces, and production is organized in a gender-specific way, opportunities for women to control their exposures are limited.

According to article 18 of ILO (2006), states that measures shall be taken to ensure that the special needs of women agricultural workers are taken into account in relation to pregnancy, breastfeeding and reproductive health. However data from developing countries show that: women's exposures to agro-chemicals are significantly higher than is recognized; poisonings and other pesticide-related injuries are greatly underestimated for women; for a given adverse outcome from exposure, the experience of that outcome is gender-discriminatory; erroneous risk perception increases women's exposures. The gap in knowledge of gender-specific exposures and effects is related to gender biases in the nature of epidemiologic inquiry and in the literature, and the gendered nature of health workers' practices and surveillance (Leslie et al., 2002).

In tropical countries like Mexico, the extensive use of Organochlorine has great implications regarding their persistence in the environment and subsequent human contamination. DDT is useful in sanitation as the insecticide of choice in the combat of susceptible malaria vectors. Because of DDT's volatility and widespread propagation, the main route of human exposure in tropical areas consists of inhalation of contaminated air and skin contact. An alternative route of human exposure consists of consumption of contaminated food during handling of agro-chemicals and especially food of animal origin

According to Bellingham (2013), preconception and prenatal exposure to toxic chemicals is a critical for both women and men of childbearing age. Similarly, men and women of reproductive age can encounter toxic chemicals at home, in the community, and in the workplace. Chemicals get into the body through breathing, eating, drinking, and/or penetration of the skin. Furthermore, once toxic chemicals enter the body, the reproductive health impacts can be varied, and can manifest across the lifespan of individuals and future generations.

Organochlorine agro-chemicals, due to their lipophilic nature and high persistence, accumulate in food chains and in the human body, especially in lipid-rich tissues, such as adipose tissue. The presence of organochlorine pesticide residues in human adipose tissue has recently caused concern due to their anti-androgenic and estrogenic properties and their effects on sexual activity and development of breast cancer (Waliszewski, 1988). Organochlorine when absorbed by expectant women are distributed almost uniformly in the bloodstream of the maternal organism and pass through the placenta to the developing fetus, where they accumulate in the lipid-rich tissues and form the first contamination source for the developing organism.

1.6 Laws/Policies Governing Agro-chemicals Use

Entrenched in Section 42 of Constitution of Kenya (2010), every person has the right to a clean and healthy environment which includes a right to have environment protected for the benefit of present and future generation through legislative and other measures. In addition to this the International Federation of Gynecology and Obstetrics (FIGO) joins other leading reproductive health professional societies in calling for appropriate action to prevent harm. FIGO recommends that reproductive and other health professionals advocate for policies to prevent exposure to toxic environmental chemicals, work to ensure a healthy system for all, make environmental health part of health care, and champion environmental justice (Di Renzo et al., 2015).

Recently there has been little legal guidance on protecting the environment. However, in 1999 new legislation was enacted to cover a wide range of environmental issues. Implementation of the act has yet to take place and the extent to which it will affect the KFC code has yet to be fully gauged. The Kenyan flower industry continues to come under considerable criticism from environmentalists worried that pollution and over-exploitation of natural resources will permanently degrade the natural environment.

ILO convention Article 16 states that employers shall be required to ensure that, so far as is reasonably

practicable, the workplaces, machinery, equipment and processes under their control are safe and without risk to health, ensure that, so far as is reasonably practicable, the chemical, physical and biological substances and agents under their control are without risk to health when the appropriate measures of protection are taken and provide, where necessary, adequate protective clothing and protective equipment to prevent, so far as is reasonably practicable, risk of accidents or of adverse effects on health. Similarly employers shall be required to provide, where necessary, for measures to deal with emergencies and accidents, including adequate first-aid arrangements.

Workers on the other hand according to Article 19 of ILO Convention, states that representatives of workers in the undertaking co-operate, get appropriate training and give information to employer in the field of occupational safety and health; and may consult their representative organizations about such information provided they do not disclose commercial secrets In addition, workers are enabled to enquire into, and are consulted by the employer on, all aspects of occupational safety and health associated with their work; for this purpose technical advisers may, by mutual agreement, be brought in from outside the undertaking.

It is of importance that a worker reports to his immediate supervisor any situation which he has reasonable justification to believe presents an imminent and serious danger to his life or health; until the employer has taken remedial action, if necessary, the employer cannot require workers to return to a work situation where there is continuing imminent and serious danger to life or health.

Investigations involving possible health and environmental hazards, have led governments of many countries to ban DDT, or to restrict the minimum accepted values of their residues in food stuffs (PAHO, 1995). In the 1980's, banned DDT reappeared, being recommended by WHO as the pesticide of choice in the combat of malaria vectors susceptible to DDT in tropical areas (WHO, 1984).

In Kenya, Pest Control Products Board (PCPB) was formed in 1983 through an act of parliament to regulate the distribution use, sale, storage and licensing of manufacturers handling agro-chemicals. Some of the regulations include safe ways of disposal, storage design and layout of premises as well as testing and providing assistance as well as training to staff in relevant work (Kenya, 1985). Packaging should not mislead the use on concerning handling agro-chemicals, value, safety, quality or composition.

2.0 Methodology

2.1 Study Area and Sampling

Uasin Gishu County lies in the mid-west of the Rift Valley between longitudes 34 degrees 50" east and 35 degrees 37" West and latitudes 0 degrees 03" South and 0 degrees 55" North. The county shares common borders with Trans Nzoia County to the North, Elgeyo Marakwet County to the East, Baringo County to the South East, Kericho County to the South, Nandi County to the South West and Kakamega County to the North West. It covers a total area of 3,345.2 Sq. Km with arable land covering 2,995 Km², 332.78 is non-arable (hilly and rocky). The County is a highland plateau ranging from 1500m – 2700m above sea level and soils range from red brown loam to clay. Rainfall averages 900mm to 1200mm per annum with its peak in May and October, temperatures range from 8.40 c to 26.20 c (a mean of 180c). Figure 3 below shows selected flower farms in Uasin Gishu County and also the total number of workers in each farm.

This was a cross-sectional survey conducted in December 2015 - January 2016. The researcher was assisted by one assistant to collect information from 133 respondents using standard questionnaire. The instrument used for this study was closed ended questionnaire which was administered to respondents including large scale farm workers in order to achieve the objectives of the study. The questionnaire was used to solicit background information, knowledge, attitude and practices on safe use of pesticide. The last section was designed to record some of the self-reported health symptoms of large scale farm workers as result of agro-chemical use.

Two stage sampling design was used; stage one was purposive sampling that targeted the scale large private flower farms located in Uasin Gishu County. Stage two was probability sampling to select a sample of respondents from a list of employees in each farm. The total number of Farm workers who work in different departments in the farm were approximately 700. It is from this list that those who handle agrochemicals were selected using the following formula in each farm.

2.2 Sources of Data

The instrument used for this study was closed ended questionnaire which was administered to respondents including large scale farm workers in order to achieve the objectives of the study. The questionnaire was used to solicit background information, knowledge, attitude and practices on safe use of pesticide. The last section was designed to record some of the self-reported health symptoms of large scale farm workers as result of agro-chemical use.

2.3 Data Analysis

Data was analyzed by both descriptive and inferential statistics. Primary data was coded entered and analyzed

using computer package SPSS version 20 and descriptive as well as inferential statistics Pearson Chi-square was used to analyze independent and dependent variables as shown in table below.

Table 1: Summary of Data Analysis

Research question	Key variables	Analysis
1. To assess knowledge possessed by large scale private farm workers on safe handling of agro-chemicals	<ul style="list-style-type: none"> ❖ Agro-chemicals used ❖ Training ❖ Handling, ❖ Storage and ❖ Disposal of unused, containers or expired agro-chemicals. 	<ul style="list-style-type: none"> ❖ Descriptive statistical analysis to identify knowledge possessed by large scale private farm workers on safe handling agro-chemicals
2. To assess practices among large scale farm workers while handling agro-chemicals.	<ul style="list-style-type: none"> ❖ Cleaning ❖ Use of PPD ❖ Washing clothes, ❖ Disposal of waste containers 	<ul style="list-style-type: none"> ❖ Descriptive and inferential statistical analysis to assess practices among large scale private farm workers on safe handling of agro-chemicals
3. To assess attitude among large scale farm workers on safe use of agro-chemicals	<ul style="list-style-type: none"> ❖ Women and use PPD 	<ul style="list-style-type: none"> ❖ Descriptive statistics and Likert scale on attitude of large scale farm workers on safe handling agro-chemicals
4. To assess frequencies on self-reported symptoms among large scale farm workers related to pesticide use.	<ul style="list-style-type: none"> ❖ List of problems like ❖ eye itching, ❖ respiratory infection ❖ Pregnancy problems etc. 	<ul style="list-style-type: none"> ❖ Descriptive and inferential analysis to assess frequencies of self-reported symptoms reported by large scale farm workers.

Source: Author

3.0 Results and Discussion

3.1 Knowledge on safe handling of agro-chemicals among large scale private farm workers

These studies findings have revealed that some farm workers are aware of the agro-chemicals used are acephate, tetradifon, aldicarb and piperophos. Though majority (53.6%) of the respondents has participated in training courses related to the safe handling, a significant (46.4%) percentage of the respondents have not received training. Despite this, the respondents were aware of other ways of pest control such as fostering beneficial organisms, disrupting pest's life cycle, modifying climate and genetic resistance. Moreover, on a positive note, the respondents have knowledge on the necessity of undertaking medical checkups during working period.

3.2 Attitude on safe handling of agro-chemicals among large scale private farm workers

The results of the analysis have established the respondents' attitude on safe handling of pesticide. The results indicate that agro-chemicals can have negative impacts on health. Therefore, both men and women should put on personal protective devices while handling agro-chemicals. Also, proper storage of pesticide helps in reducing health risks. As well, the use of PPD can reduce pesticide exposure. However, farm workers disagreed that women are more exposed to agro-chemicals than men and that they always sneeze/have chest problem while spraying. In a nutshell, the health risks posed by agro-chemicals can be reduced if proper practices are implemented.

3.3 Practices on safe handling of agro-chemicals by large scale private farm workers

The study assessed practices on safe handling of agro-chemicals by the large scale private farm workers. It is clear that the respondents have spilled agro-chemicals before. They are also aware of how to help a colleague during pesticide spill. Some of the ways to help those that have spilled pesticide on their body include giving them water to drink and taking them to the health center. Knowing the importance of wearing protective gear, the respondents made use of protective equipment such as gloves, coveralls, boots and hats in order to protect themselves from the adverse health effects of agro-chemicals. However, most of this equipment is not used by the workers. Other than the use of protective equipment, the respondents were able to read and understand information written on agro-chemicals since some were trained on handling of agro-chemicals.

3.4 Frequencies of self-reported health symptoms related to pesticide exposure among large scale private farm workers

Majority 94% of the respondents believe that agro-chemicals can have negative effect on their health. This

suggests that the farm workers were aware of the health risks posed by exposure to pesticides. Farm workers that handled agro-chemicals or sprayed experienced symptoms of skin rash (6.4%), itching, irritation and color change (59.2%), running nose (15.2%), burns, eye itching (16.4%), excessive sweating (9.6%), cough (1.6%), chest pain and pregnancy complications (1.6%). There was however no symptom of diarrhea and vomiting. The farm workers who had these symptoms seek medical treatment while others change duties. For women of productive age, 1.6% suffered from miscarriage, still birth, inability to conceive and conceived children with deformity.

4.0 Conclusion and Recommendation

Knowledge on safe handling of agro-chemicals is of essence to any farmer that uses agro-chemicals. Despite this, a number of the farmers have not undergone training related to safe handling of agro-chemicals. They are therefore at risk of exposure to hazardous agro-chemicals such as aldicarb. Besides, farmers had knowledge of other alternative methods of pest control such as disrupting pest's life cycle and modifying climate though they continued to use agro-chemicals. Nevertheless, the farmers were aware of the importance of undertaking medical checkups during work periods.

The attitude of farmers on safe handling of agro-chemicals may either encourage them to adopt protective measure or be insensitive towards protective measures. Based on the study findings, it is still uncertain whether women should not put on personal protective devices while handling agro-chemicals. In fact, certain farmers denied that women are more exposed to agro-chemicals than men. However, the farmers believe that proper storage of pesticide help in reducing health risks as well as the use of PPD.

Furthermore, it is clear that private farm workers practice safe handling of agro-chemicals. This is evidenced by use of protective equipment such as gloves, coveralls, boots and hats. The protective equipment protects the farmers from the adverse health effects of agro-chemicals. In addition, farmers' training on safe handling of agro-chemicals has enabled farmers to read and understand information written on agro-chemicals.

There is need for intensive training on safe handling of agro-chemicals so that farm workers can read and understand the information written on agro-chemicals as well as training on proper handling of agrochemicals. This can be achieved through continuous education about pesticide safety and health. Farm workers at large should be offered additional education on appropriate methods that can be necessary to prevent or reduce pesticide exposure. With this in place, farm workers will be able to practice proper storage of agrochemicals as well as putting on personal protective devices while handling agro-chemicals.

With reference to safe handling practices of agro-chemicals, there should be a strict enforcement and supervision of set regulations to reduce cases of exposure while handling agrochemicals. Medical check-ups should be consistent during working period in order to treat illnesses caused as a result of agrochemical exposure.

It is recommended that studies be done to assess emergency preparedness among flower farms to handle accidental exposure during working period among farm workers.

Also, in order to reduce the adverse effects of agro-chemicals, it is important to assess level of monitoring of safety procedures of any regulatory body i.e adherence to policies for farmers and farms to be used in day to day activities especially where safe handling of pesticides is concern and observe specific precautions such as wearing protective equipment.

Similarly, Medicals check-ups should also be consistent and illnesses suffered be treated to save life especially reproductive illness. There should be also change of duties to reduce prolonged exposure to agrochemicals which can cause major harm.

Finally, the study has established that exposure to agro-chemicals results to symptoms such as skin irritation, headache, extreme tiredness, blurred vision and dizziness. Other than that, exposure to agro-chemicals has brought about reproductive abnormalities such as miscarriage, still birth and inability to conceive among female farm workers.

5.0 Reference

- Abinash, P.C. and N. Singh, (2009). Pesticide use and application: An Indian scenario. *J. Hazard Mater*, 165(1-3): 1-12
- Agency for Toxic Substances and Disease Registry. (1993). Case studies in environmental medicine: cholinesterase inhibiting pesticide toxicity. California: Department of Health and Human Services 1993:3-8.
- Alavanja MCR, Sandler DP, Lynch CF, Knott C, Lubin JH, Tarone R, (2005). Cancer incidence in the Agricultural Health Study. *Scand J Work Environ Health*
- Arcury, Thomas A., Sara A. Quandt, Altha J. Cravey, Rebecca C. Elmore, and Gregory B. Russell. (2001). "Farm worker reports of pesticide safety and sanitation in the work environment." *American Journal of Industrial Medicine* 39:487-- 498.
- Bandura, A. (1977). *Social Learning Theory*. Newyork: General Learning Press
- Beck, Ulrich (1992). *Risk Society Towards A New Modernity*. London: Sage Publications.
- Bellingham M, Sharpe RM, Royal College of Obstetricians and Gynaecologists (2013) *Chemical Exposures*

- During Pregnancy: Dealing with Potential, but Unproven, Risks to Child Health. In: Scientific Advisory Committee, ed. Scientific Impact Paper No 37. London: Royal College of Obstetricians and Gynaecologists
- Berg H. (2001). Pesticide use in rice and rice-fish farms in the Mekong Delta. *Vietnam Crop Prot.*, 20, pp. 897-905.
- Burleigh J. R., Vingnanakulasingham V., Lalith W. R. B. (1898). Pattern of pesticide use and pesticide efficacy among chili growers in the dry zone of NE Sri Lanka (System B): perception vs. reality. *AgrEcosystEnviron*, 70, PP 4960.
- Calvert, G.M., Karnik, J., Mehler, L., Beckman, J., Morrissey, B., Sievert, J., Barrett, R., Lackovic, M., Mabee, L., Schwartz, A., Mitchell Y., and Moraga-McHaley, S. (2008). Acute pesticide poisoning among agricultural workers in the United States, 1998-2005. *American Journal of Industrial Medicine*, 51(12), 883-898;
- Coble J, Hoppin JA, Engel L, Elci OC, Dosemeci M, Lynch CF (2002). Prevalence of exposure to solvents, metals, grain dust, and other hazards among farmers in the Agricultural Health Study. *J Expo Anal Environ Epidemiol*
- Cole DC, Carpio F, Math JJ, (1997). Dermatitis in Ecuadorian farm workers. *Contact Dermatitis* 1997; u 37:1-8.
- Constitution of Kenya (2010)
- Das, R., A. Steege, S. Baron, J. Beckman & R. Harrison. (2001). Pesticide related illness among migrant farm workers. United States *Int J. Occup Environ Health Oct-Dec 7(4): 303-12*
- Dasgupta, S. & C. Meisner (2005). Health Effects and Pesticide Perception as Determinants of Pesticide Use: Evidence from Bangladesh. (World Bank Policy Research Working Paper.3776).
- Di Renzo GC, et al, International Federation of Gynecology and Obstetrics opinion on reproductive health impacts of exposure to toxic environmental chemicals, *Int J Gynecol Obstet* (2015), <http://dx.doi.org/10.1016/j.ijgo.2015.09.002>
- Donohoe, M. & Hansen, E. (2003). Health issues of migrant and seasonal farmworkers. *Journal of Health Care for the Poor and Underserved*, 14(2), 153-164.
- Environment and Management Coordination Act (EMCA) 1999.
- Eurostat statistical books (2007): The Use of Plant Protection Products in the European Union – Data 1992 – 2003, Luxembourg
- Food and Agriculture Organization of the United Nations, Agriculture and Consumer Protection Department, 2008. Welcome to the page on Integrated Pest Management (IPM). [Cited 2008 Aug 15]. Available from: URL: <http://www.fao.org/ag/AGP/AGPP/IPM/Default.htm>
- Frank B and Cruz E. (2001). Flower for justice, implementing the international code of conduct; Friedrich Ebert.
- Gomes J, Lloyd O, Revitt DM, (1998). Morbidity among farm workers in a desert country in relation to long-term exposure to agro-chemicals. *Scand J Work Environ Health* 1998; 24:213-19
- Green, L. W. (2010). Health Belief Model. Available: <Encyclopedia of Public Health>: retrieved on 16-06-2010
- Habeeb, N. (1996). Invisible farmers, Lahore, Pakistan: PAN Malaysia and Khoj, Research and Publication Centre.
- Harris, J., (2000). Chemical Pesticide Markets, Health Risks and Residues. CABI, Wallingford.
- Hayes, W. Jr. and E. Laws, Jr. (Eds). (1991). *Hand book of Pesticide Toxicology*. Vol.1 General Principles. San Diego: Academic Press.
- Hennebry, Jenna L. (2006). Globalization and the Mexican-- Canadian Seasonal Agricultural Worker Program: Power, Racialization and Transnationalism in Temporary Migration Doctoral Thesis, Sociology, University of Western Ontario, London
- Hoppin JA, Umbach DM, London SJ, Alavanja MCR, Sandler DP. (2002). Chemical predictors of wheeze among farmer pesticide applicators in the Agricultural Health Study. *Am J Respir Crit Care Med* 165
- International Labour Organization (2006), Summary of study report on decent work in floriculture: Ethiopia, National consultation workshop.
- Isin S, Yildirim I. (2007). Fruit-growers' perceptions on the harmful effects of agro-chemicals and their reflection on practices: the case of Kemalpaşa, Turkey. *Crop Prot.*, 26, pp. 917-22.
- Jors E, Morant RC, Aguilar GC, (2006). Occupational pesticide intoxications among farmers in Bolivia: a cross-sectional study. *Environ Health*
- Kahiu Dorothy, (2011). Knowledge, Attitude and Practice of Agrochemicals in Lake Naivasha Basin. Department of Environmental Science, Egerton University, Njoro, Kenya.
- Kenya (1985). *The Pest Control Act*. Government Printer, Nairobi.
- Koh, D. & J. Jeyaratnam (1996). Pesticide Hazards in Developing Countries. *Science of the Total Environment* 188(Suppl. 1), S78-S85
- Lesmes-Fabian, Camilo; Binder, Claudia R. (2013). Pesticide Flow Analysis to Assess Human Exposure in Greenhouse Flower Production. *Int. J. Environ. Res. Public Health* 10, no. 4: 1168-1185.

- Lichtenberg, E. & R. Zimmerman (1999). Adverse Health Experiences, Environmental Attitudes, and Pesticide Usage Behaviour of Farm Operators. *Risk Analysis* 19:2.
- Lu, C., Fenske, R.A., Simcox, N.J., and Kalman, D. (2006). Pesticide exposure of children in an agricultural community: Evidence of household proximity to farmland and take home exposure pathways. *Environmental Research*, 84(3), 290-302.
- Matthews GA. (2007). Attitudes and behaviours regarding use of crop protection products— A survey of more than 8500 smallholders in 26 countries *Crop Protection*
- Miles J. R., Harris C. R., Morrow, D. C. (1983). Assessment of hazard associated with pesticide container disposal and of rinsing procedures as a means of enabling disposal of pesticide containers in sanitary landfills. *J Environ Sci Heal B*, 18, pp. 305-15.
- Moore, Graeme. (2004). "Hand-- - Harvesters of Fraser Valley Berry Crops: New Era Protection of Vulnerable Employees." BC Federation of Labour, Vancouver, BC
- Munro, S., S. Lewin, T. Swart, & J. Volmink (2007). A Review of Health Behaviour Theories: How Useful are these for Developing Interventions to Promote Long-term Medication Adherence for TB and HIV/AIDS? *BMC Public Health* 7, 104.
- Murray D. L., Tayler, P. L. (2000). Claim no easy victory: evaluating the pesticide industry's global safe use campaign. *World Devel*, 28, pp 1735-49.
- Mwanthi M.A and V.N. Kimani. (1993b). Agrochemical: A potential health hazard among Kenyan's small scale farmers in Forget, T. Goodman, A. De Villiers edits impacts of pesticide use on health in developing countries. International Development Centre, Ottawa.
- Nejad, L. M., E. H. Wertheim, & K. M. Greenwood (2005), Comparison of the Health Belief Model and the Theory of Planned Behaviour in the Prediction of Dieting and Fasting Behaviour. E- Journal of Social Psychology: *Social Section* 1:1, 63–74.
- Ngowi (2007). Agro-chemicals use by smallholder farmers in vegetable production in Northern Tanzania (PUBMED: *Crop Prot.* 2007 November; 26(11): 1617–1624). Occupational Safety and Health Act (OSHA, 2007)
- Ngowi A.V.F., Wesseling C., London L.(2007). Health Impacts in Developing Countries. In: Pimentel D., editor. *Encyclopedia of Pest Management. Vol. 2.* Taylor & Francis; New York, NY, USA: 2007. pp. 228–231.
- Nyakundi W.O, G. Magoma, J.Ochora and A.B Nyende. (2011). Pesticide Use and application patterns among farmers. Institute of Jomo Kenyatta University of Agriculture and Technology. Nairobi, Kenya.
- Nyamu, D.G, Maitai C.K, Mecca,L.W,and Mwangangi E.M.(2012).Trends of Acute Poisoning Cases Occurring at the Kenyatta National Hospital, Nairobi, Kenya. *East and Central African Journal of Pharmaceutical Sciences Vol.15* (2012) 29-34
- Organic Consumer Association (2008): 30 Agrochemical Products Banned in Nigeria after Deaths, Finland
- Perry MJ, Marbell A, Layde PM. (2000).Association of pesticide safety knowledge with beliefs and intentions among farm pesticide application. *J Occup Environ Med* 2000; 42:187–93.
- Quandt, Sara A.,Maria A. Hernandez-- - Valero, Joseph G. Grzywacz, Joseph D. Hovey, and Melissa Gonzales.(2006). "Workplace, Household, and Personal Predictors of Pesticide Exposure for Farmworkers." *Environmental Health Perspectives* 14:943 - 952.
- Rola A. C., Pingali P. L. (1993). Pesticide, rice productivity, and farmers' health: an economic assessment. Laguna: International Rice Research Institute, Philippines.
- Royal Horticultural Society (RHS),(2004). The use of garden chemicals. The Royal Horticultural Society's Garden, Wisley, Woking, Surrey.
- Sakala, Carol. (1987). Migrant and Seasonal Farmworkers in the United States: A Review of Health Hazards, Status, and Policy. *International Migration Review* 21:659-- - 687.
- Saleh A, Neiroukh F, Ayyash O, (1995).Agro-chemicals usage in the West Bank. Palestine: Applied Research Institute, Jerusalem, 1995:17.
- Sekiyama M, Tanaka M, Gunawan B, (2007).Pesticide usage and its association with health symptoms among farmers in rural villages in West Java, Indonesia. *Environ Sci*2007; 14
- Sivayoganathan C, and Gnanachandrn S, Lewis J. (1995).Protective measure use and symptoms among agro pesticide applicators in Sri Lanka. *SocSci Med* 1995; 40: 431–6.
- Strecher, V. J. & I. M. Rosen stock (1997). The Health Belief Model In K. Glanz, F. M. Lewis, & B. K. Rimer (eds.) *Health Behaviour and Health Education: Theory, Research, and Practice*. San Francisco: Jossey-Bass.
- Swan SH. (2006).Semen quality in fertile US men in relation to geographical area and pesticide exposure.Int J Androl.29 (1):62-8; discussion 105-8.
- Swan SH, Kruse RL, Liu F, Barr DB, Drobnis EZ, Redmon JB, Wang C, Brazil C, Overstreet JW. (2003). Semen quality in relation to biomarkers of pesticide exposure. *Environ Health Perspect*.111 (12):1478-84.

- Tak-Sun Yu,I, Lee,N.L and Wong.T,W(2005) Knowledge, Attitude and Practice regarding Organic solvents among printing workers in Hong Kong, *Journal of Occupational Health*,2005;47;305-310
- Thailand National Statistical Office. (2003). Agricultural Census. Ministry of Information and Communication Technology; Bangkok, Thailand: 2003.
- Thoen, R., Jaffee, S. & C. Dolan (2000), Forthcoming, 'Equatorial Rose: The Kenyan- European Cut Flower Supply Chain', in R. Kopiki (ed.), Supply Chain Development in Emerging Markets: Case Studies of Supportive Public Policy, Boston: MIT Press.
- U.S. EPA (1992).Regulatory impact analysis of Worker Protection Standard for agricultural agro-chemicals. Washington, DC: U.S. Environmental Protection Agency, Office of Pesticide Programs
- Uasin Gishu County Integrated Development Plan 2013-2018
- Uasin Gishu County Health Strategic and Investment Plan 2013-2018
- Verduzco, Gustavo and Maria Isabel Lozano. (2003)."Mexican Workers' Participation in CSAWP and Development Consequences in the Workers 'Rural Home Communities. "North-- - South Institute, Ottawa
- Ward, Neil. (1993). The agricultural treadmill and the rural environment in the post-productivist era." *Sociologia Ruralis* Vol.33 (3/4):348-364
- Wesseling C, McConnell R and Partanen T. (1997). Agricultural pesticide use in developing countries: health effects and research needs. *Int J HealthServ*1997; 27:273–308
- Wesseling C, Ruepert C, &Chaverri F. (2009) Safe use of agro-chemicals .A Developing country's point of view. Encyclopedia of Pest Management, p1-4. *Marcel Dekker Inc.*
- WHO (2003), The WHO Recommended Classification of Agro-chemicals by Hazard. In: World Health Organization, ed. Stuttgart, Germany: Wissenschaftliche VerlagsgesellschaftmbH 2009
- WHO (2006),World Health Organization. Sound management of hazardous wastes from health care and from agriculture. New Delhi; WHO South- East Asia Regional Office, 2006.
- WHO (2003).Pesticide residue in food: International program on chemical safety Joint FAO/WHO meeting on agro-chemicals results evaluations2002, *part 2 Toxicology*
- Wiles, R. Davies, K. and C Campbell, (1998).Ever exposed organophosphate insecticides in children's food. Environmental working group, Washington.
- Wilson C. Tisdell C. (2001). Why farmers continue to use agro-chemicals despite environmental, health and Sustainability costs? *Ecol Econ.*, 39, pp. 449-62.
- World Bank, 2004, <http://econ.worldbank.org/view.php?id=11803>
- Wynne, Brian. (1996). *May the sheep safely graze, A reflexive view of the expert-lay knowledge divide.*In Lash, Scott, Bronislaw Szerszynski and Brian Wynne (eds.) Risk, Environment and Modernity. London: Sage Publications.
- Yamane Taro. (1967). *Statistics: An Introductory Analysis*, New York, Harper and Row.
- Yan e L, Ortiz D, and Calderon. (2002), Overview of human health and chemical mixtures: problems facing developing countries. *Environ Health Perspect* 2002; 110 Suppl 6:901-9.
- Yassin MM, Mourad TA, and Safi JM. (2002). Knowledge, attitude, practice, and toxicity symptoms associated with pesticide use among farm workers in the Gaza Strip. *Occup Environ Med* 2002; 59 (6):387-