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Review Article

Adverse Effect of Pesticide on Top Ten Importers of African Countries: Systematic Review

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Abstract

Background: As agricultural production in African intensifies; pesticide utilization becomes more widespread and the users are extremely exposed to these pesticides due to lack of pesticide registration scheme; importing highly toxic banded pesticides; no national plan for monitoring pesticide residue; involvement of children and women in farm work.

Objective: To review adverse effect of pesticide on top ten importers of countries from five sub regions of African Countries.

Methods: Top ten imported African countries were selected based of imported amount for ten years. The articles were searched from PUBMED, GOOGLE SCHOLAR and MEDLINE and EMBASE engines and imported into Mendeley software.

Result: The review indicates the first leading three continents for pesticides exported were European (48.2%), Asian (33.7%) and North America (12.7%), while the countries were China (14.3%), Germany (11.8%) and United States (11.5%) at the end of 2017. The first three leading importer of African countries were South Africa shared (25.7%), Nigeria (15.8%) and Ghana (14.5%). The three major imported pesticides were Fungicides, herbicides and insecticides. Of 3796 pesticide users, South Africa (269), Nigeria (200), Ghana (354), Morocco (542), Egypt (102), Cameroon (241), Ethiopia (827), Tanzania (360) and Kenya (801) users. The review also found that farmers were faced with many health problems like endocrine disruption, carcinogenicity, mutagenicity, teratogenicity, neurotoxicity, cancer, cardiovascular, dermatitis, birth defects and allergy within farm. The main associated factor for these problems were low awareness, improper handling of pesticide and lack of training, lack of information and careless disposal of empty pesticides containers.

Conclusion: The study concluded that more than one billion US$ of pesticides sales was carried out into ten African countries. The farmers and users were faced different health problems due farmers themselves and poor legislation within each country. Thus, provide training and education for pesticide users and strengthen legislation for pesticide management should be advised.

Keywords: *Adverse Effect; African Countries; Import; Pesticide*

Introduction

Over the past era there has been an increase in the development of pesticides to target a broad spectrum of pests, which is a major challenge to the targeted pests causing them to either disperse to new environment and/or adapt to the novel conditions [1]. In fact, pesticides assist farmers to minimize potential crop yield loss due to pests, but they may also pose potential hazards to them [25]. Various studies revealed that effects of pesticides on farmers and users is common in developing, which have been documented in Asia [2]; in Africa [3,4]

and Latin America [5]. The other study also revealed that African countries are known to consume less than 20% of the world production of agrochemicals, which are responsible for as much as 1.1 million (70%) of the total cases of acute poisoning in farm [6].

As literature indicated only less than 1% of the total amount of pesticides applied for weed and pest control reach the target pests. A large quantity of pesticides is lost via spray drift to farmer if they do not wear personnel protective equipment/PPE/, the other will be off-target deposition, run-off, and photo degradation, for instance, which can have undesirable effects on some species, communities [7]. Another relevant factor is that low concentrations of many chemicals may not elicit acute detectable effects in organisms, but they may induce other damage, like genetic disorders and physiological alterations, which reduce life span in the long run. This exposure can cause neuropsychiatric sequelae (mood disorders, depression, and anxiety), because many pesticides underlie changes in the function of the central, peripheral, and autonomic nervous system [8]. As study reported, only one third of applicators read the instructions for pesticide use marked on the containers; even fewer (2.5%) take steps to follow those instructions and almost two third of them didn't read the instructions labeled on pesticide. These are due lack of education, lack of training and inadequate PPE [9].

Now a day developing countries use only 20% of the world's agrochemicals, yet they suffer 99% of deaths from pesticide poisoning. Exposure to pesticides can be may occur through harvesting tasks that may require direct contact with such agents; while, non-occupational pathways may manifest due to direct environmental exposures from heavily contaminated air, water, and soil; or through dietary pathways [13]. The World Health Organization estimates that at the global level, 3 million severe pesticide poisoning episodes occur annually, and of these, a minimum of 300,000 people die, with 99% of cases being from low- and middle-income countries. The study revealed that pesticides are often poorly controlled and widely available, particularly in countries of low and middle income [10]. Based on these evidences, the implication of pesticide use and spraying practices on users' health is particularly important in agriculture production systems because it is the smallholder farmers' use substantial proportion of pesticides [11].

Moreover, the other study reported that farmers are mixing and spraying pesticides that share a common active ingredient developing countries. Majority of pesticide sprayers mixing of pesticides may alter chemical properties, result in potentiation, and thereby increase detrimental effects [14]. One of the efforts to improve farmers' pesticide handling practices and reduce potential hazards of the chemicals is to fix safety labels on pesticide containers to alert users of potential risks. It is expected that strict compliance with the instructions conveyed by the labels will reduce potential negative effects on human health [15]. Farmers are also occupationally exposed to several potentially harmful environmental agents other than pesticides [16]. As various studies indicated countless pesticides chemicals are environmentally stable, prone to bioaccumulation and toxic to human and other living organisms and environmental contamination or occupational use can expose the general population to pesticides residues, including physical and biological degradation products present in the air, water, and food [17].

Some Pesticides, example, insecticides combat insect growth or survival, herbicides act against plants, weeds, and grasses, rodenticides tight against rats and other rodents, avicides act against bird populations, fungicides attack fungi, and nematicides combat nematodes [18]. The global pesticide market divided according to the type of pesticide is as follows: 42.48% herbicides, 25.57% insecticides, 24.19% fungicides, and 7.76% other types of pesticides [19]. Pesticides grouping can also rely on their chemical structure and they are belonging to different chemical classes but which have similar toxic effects, such as the ability to induce oxidative stress and act as endocrine disrupters [20]. These chemicals were used as control of pest, which was highly expanded over the two decades of the last years in Africa. Pest management of fruits and vegetables by small farmers in Africa have developed anarchically in a fuzzy regulation framework [21].

In Africa, surveys indicate that a small number of farmers consistently use appropriate PPE due to cost and hot humid climate that make wearing such PPE uncomfortable; as well, accidental ingestion of contaminated crops is a major source of accidental poisoning as reported many African countries [22]. In addition, different risk factors have been declared that increase toxicity of pesticides especially in developing countries including: lack of pesticide registration scheme; importing highly toxic banded pesticides; no national plan for

monitoring pesticide residue; lack of safeguards and poisoning surveillance systems; misuse and improper handling of pesticides; ignoring of re-entry and pre harvest intervals; involvement of children and women in farm work; illiteracy regarding the basis of good agriculture practice; excess use of household pesticides; infectious and parasitic diseases; multiple exposure to toxic chemicals; and poverty [23]. These risk factors could either increase the like hood of higher exposure to pesticides or increases the toxic effects on human body [7,12]. Thus, the reviews found that there were health problems within African countries due different associated factors. Therefore, the objective of review is to pursue the adverse effect of pesticide on top ten imported African countries farmers.

Methods

Selection criterial of sites

Top ten importers of African Countries were selected based on Food and Agriculture Organization Statistical database [24]. By default five sub regions of African were included: from North African countries: Egypt and Morocco; from Western Africa: Ghana and Nigeria; from East African countries: Ethiopia and Kenya; from Southern Africa countries: South Africa and from Central Africa countries Cameroon was selected review.

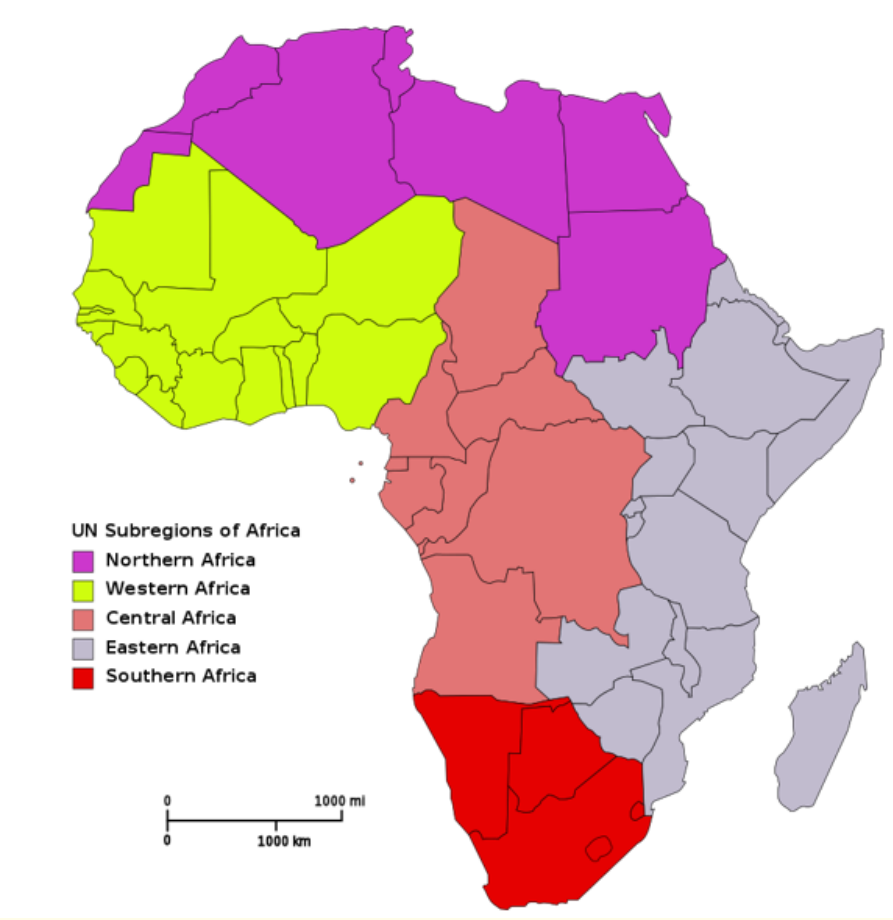

Figure 1: *Article review were retrieved from selected sub region of Africa adopted from UN.*

Article searched

Reviewers were selected all relevant studies with language restriction that is by English. Information reviewed and the bibliographies of articles were identified further eligible criterial in each countries. Then, the reviewers searched the following electronic databases in order to identify systematic reviews that assessed the adverse effect of pesticide. Thus, the international articles and texts extracted from the following virtual databases: Google Scholar, PubMed, Scopus, and Science Direct, Index Medicus/WHO/EMdR, Elsevier, Cochrane Library from 2003 to 2019.

Article screened process

Figure shows that a total of 210 articles and texts were collected based on the following key words: adverse, effect, pesticide, farmers and included African countries, and finally 43 articles and texts published between 2002 and 2019 were reviewed (Including introduction). From these articles, the list of 19 selected studies, classified according to the characteristics of the population and outcomes of each paper (PICO frame), was prepared (Table 1).

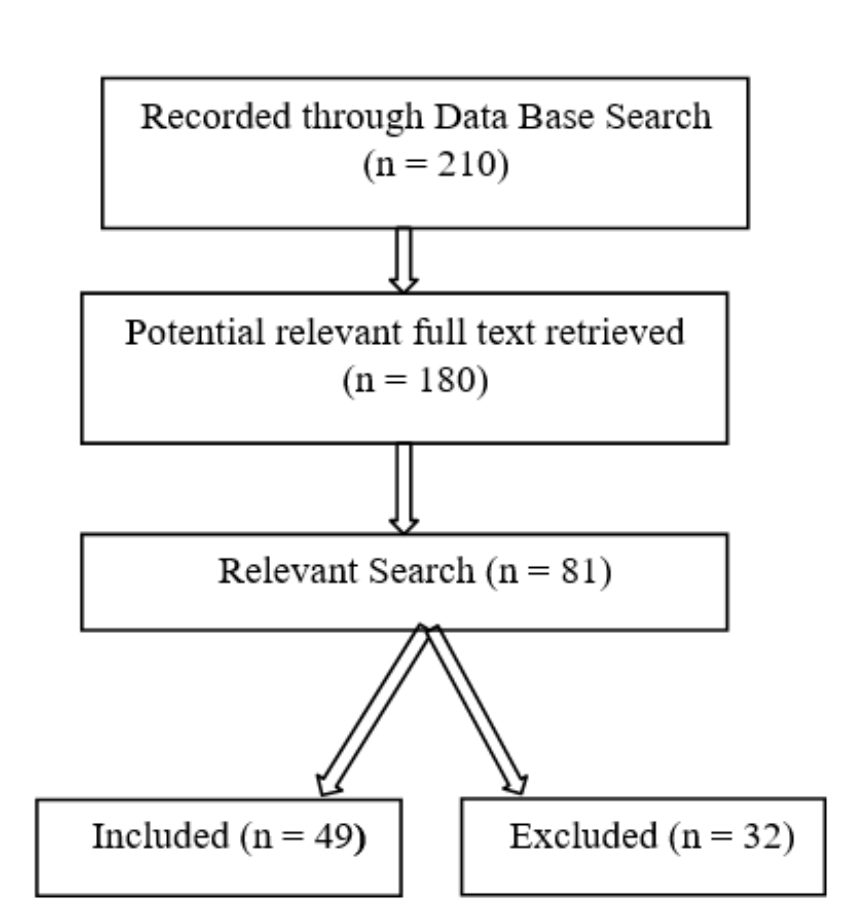

Figure 2: *Searching process of systematic review of pesticide effect on farmers of African countries.*

Validity assessment

From each country the report on compliance with supplementation as described by the authors of the studies and reviewed studies published only as abstracts and included them only if quality assessment could be completed from the given information. Thus, reviewers included only information available from publications and did not contact primary authors for additional data. Studies for which quality could not be determined were excluded. Thus, the data bases and the extracted documents were evaluated and checked by the authors in order to make the study more valid and reliable.

Methodologic quality

The reviewers independently assessed the methodologic quality of the studies using a predefined check-list, as suggested specially for the Cochrane Database of Systematic Reviews. This checklist assesses risk of bias in the categories of sequence generation, allocation concealment, blinding, attrition, selective reporting and other biases.

Data extraction and synthesis

The data were extracted from each eligible study using data-collection form resolved discrepancies by consensus. The original data were not modified. At times, calculations were required from available data. The reviewers calculated the mean differences or standardized mean differences as appropriate.

Result

Top exporters-importers of worlds' countries

Based on the Food and Agriculture Organization Corporate Statistical Database website disseminates statistical data collected and maintained by the Food and Agriculture Organization/FOASTAT/, European countries, Asian, North America, Latin America, Africa and Oceania were 48.2%, 33.7%, 12.7%, 3.8%, 1% and 0.6% exported pesticides, respectively to other countries during 2018 (Figure 3).

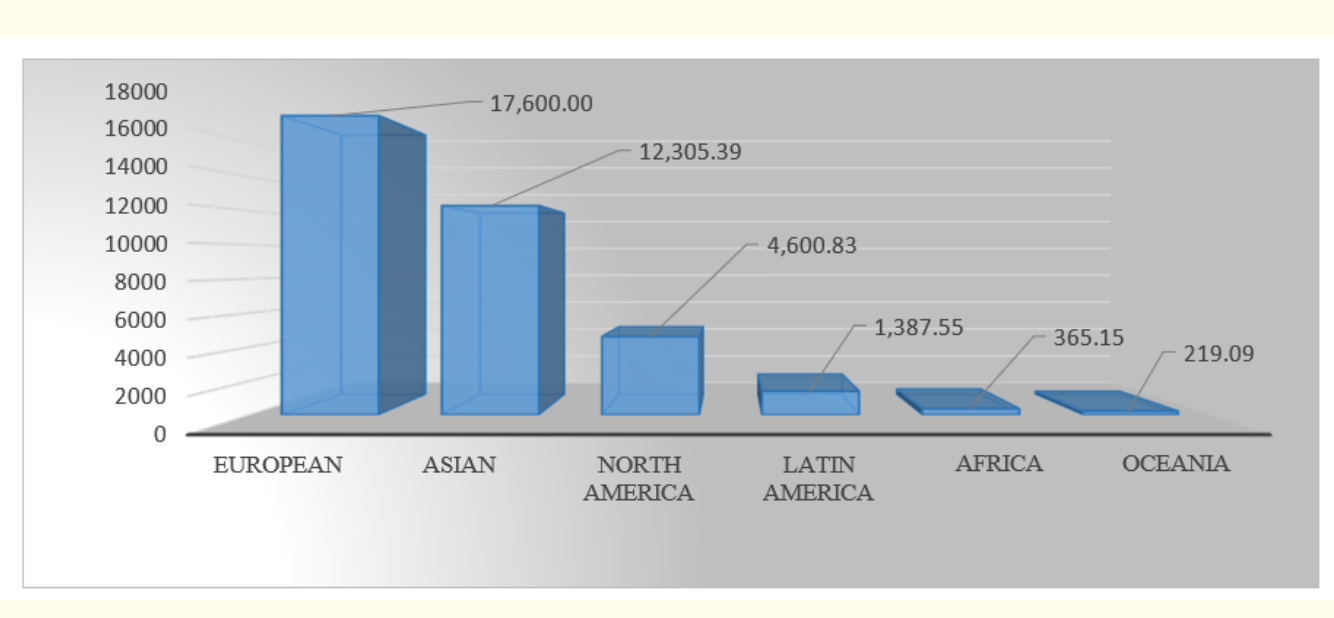

Figure 3: *Rank of continents for pesticide exporters during, 2018.*

When we compare all worlds countries those exported pesticide, the first ten top countries are China, Germany, United States, France, India, Belgium, United Kingdom, Spain, Israel and Italy, which were accounted 14.3%, 11.8%, 11.5%, 10.1%, 8.1%, 5.7%, 3.7%, 3.6%, 3.5% and 2.2% of a total exported pesticides during 2018, respectively in deceasing orders (Figure 4).

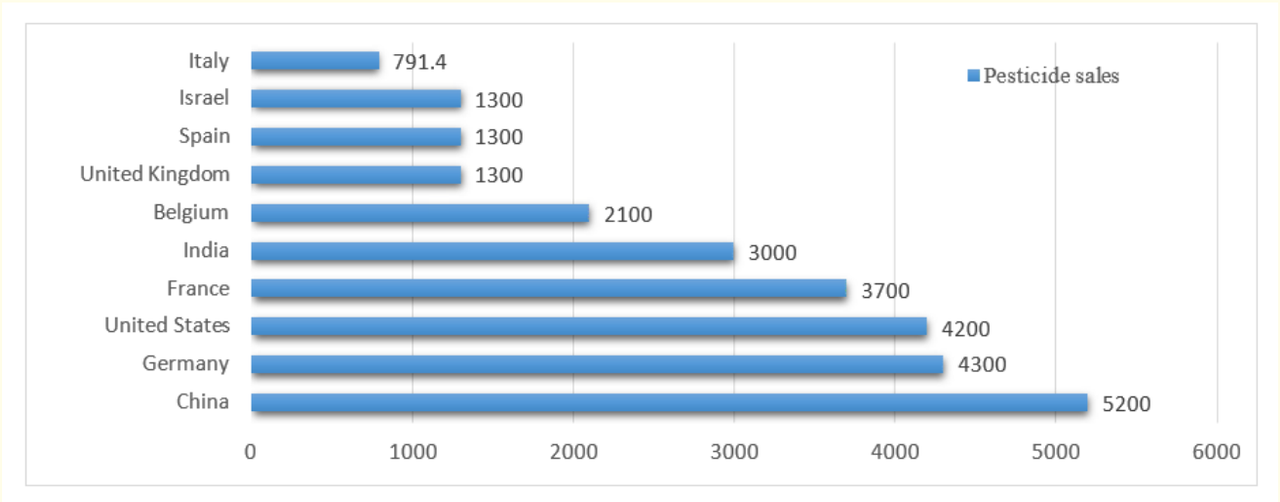

Figure 4: *Top ten exporters of pesticide to African courtiers by million dollar during 2017.*

Top ten African countries

All importers of African countries were compared using data from FAOSTAT data a time series from 2008 to 2017. The first ten leading importer of African countries (Total = 1,305,968,305$), about South Africa [3.356 million $ (25.7%)], Nigeria [2.060 million $ (15.8%)], Ghana [1.896 million $ (14.5%)], Morocco [1.496 million $ (11.5%)], Egypt [1.239 million $ (9.6%)], Algeria [0.861 million $ (6.6%)], Cameroon [0.58 million $ (4.5%)], Ethiopia [0.563 million $ (4.3), Tanzania [0.504 million $ (3.9%)] and Kenya [0.501 million $ (3.8%)] of pesticides were imported from 2008 to 2017 (Figure 5).

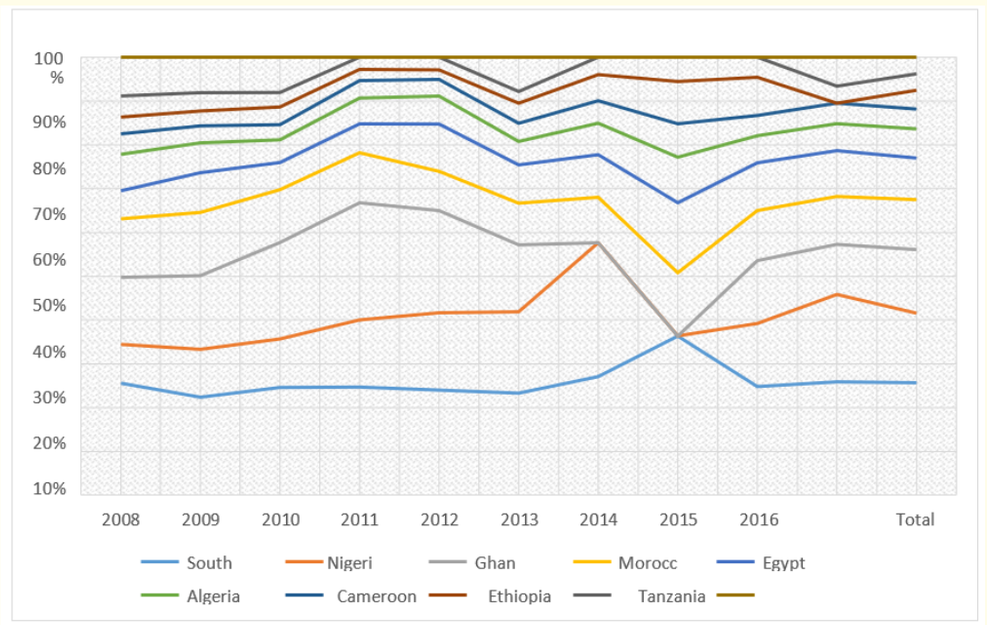

Figure 5: *Top ten importer of pesticide among African countries during 2008 to 2017.*

Health effect of pesticide among top ten importers African countries

Among all African countries, the first top ten were considered based on quantity of pesticide imported. In this section, health effect, the most pesticides used by farmers and associated factors, which were extracted. Farmer survey and some were conducted using of experiment analysis of pesticide residual from crops and blood serum). The review shows that about 3796 of sprayers, farmers and pesticide users were involved. Of these, South Africa (269), Nigeria (200), Ghana (354), Morocco (542), Egypt (102), Cameroon (241), Ethiopia (827), Tanzania (360) and Kenya (801) users.

Health symptoms such as malaise, headache, nervous system anxiety, depression, cardiovascular palpitations, swelling, respiratory cough, sneezing, dyspnea and wheezing, gastric heat burn and water brush gastrointestinal abdominal pain, vomiting, diarrhea, bloody, itchy painful ear, nose and throat, skin rash, itching or other skin conditions, eyes itchy painful [9]. As users reported they faced with endocrine disruption, carcinogenicity, mutagenicity, teratogenicity, neurotoxicity, cancer, cardiovascular, dermatitis, birth defects, impaired immune, neuro-disorder and allergy. The associated factors were low awareness, low attitude and poor practice of pesticide for pest management. Table 1 shows majority of the farmers' perception was less than half percent (50%) and lack of training, lack of information were observed. In addition to these factors, height and weight are the other associated factors. Majority of them used fungicides, herbicides and insecticides for protection of pest from their crops and residual of pesticides were found in crops and aquatic like fish (Table 1).

Country and Authors	Methods of study	Sampled population	Health related effect identified			Residual of pesticide found in:
			Identified health Problems	Associated Factors	Identified pesticide	
South Africa [25]	*CS	269 farm ers	• Asthma • Birth defect • Mutagenicity • Teratogenicity • Neurotoxicity	• Height • Weight • Income	• Not indicated	• Contaminated clothing • Container
South Africa [1]	Experiment	Not indicated	• Endocrine disrupting • Carcinogenicity • Mutagenicity • Teratogenicity • Neurotoxicity	Lack of Training, poor awareness and Improper utilization of pesticide	• Of total use, • Fungicides (41%) • Herbicides (50%) • Insecticides (8%)	The top five crop [26] • Maize (0.29) • Potatoes (0.23) • Citrus (0.11) • Grapes (0.06 • Sugar cane (0.06)
Nigeria [27]	Experiment	135 pesticide	• Cancer • cardiovascular • Dermatitis • Birth defects, • Morbidity • Impaired immune • Neuro-disorder • Allergy	• Lack of information, poor legislation or	5 top in aver. (μgkg^{-1}) 1. DDT (120.80) 2. Aldrin (44.13) 3. Dieldrin (92.50) 4. Heptachlor (1.6 5. DDE (77.69)	• Vegetable • Tuber • Cereals • Cow • Pig • Goat • Fish

Nigeria [28]	CS	200 farmer	• 184 (92%) of exposed • 145 (72.5%) became sick	• Only 35% could read instruction	• Insecticide • Herbicide • Inorganic fertilizers (74%) • Organic fertilizers (26%)	
Ghana [29]	1. CS for human study 2. Experiment for soil	1. 100 for human 2. Experiment analysis	• Bad Odor (37.9) • Runny nose (13.9 • Sneezing (27.6) • Headache (15.5) • Drowsiness (5.2)	• Low awareness and improper utilization of pesticide	Soil detection (ppm) • Allethrin (0.083) > 0.01 • Pyrethrin (0.000) < 0.01 • Deltamethrin (0.277) > 0.05 • Cypermethrin (0.167) > 0.02 • Acetamiprid (0.000) < 0.02 • Cyhalothrin (0.011) > 0. 01 • Bifenthrin (0.090) < 0.1	• Soil • Cacao
Ghana [30]	CS	154 farmers	• Not indicated	• K = 47.72 < 50% • P = 53.37 < 50% • Farm size • Age • Marital status • Size of family • Education	Not studied	Not indicated
Morocco [31]	CS	140 farmers	• Carcinogenicity • Mutagenicity • Teratogenicity • Neurotoxicity	• K = 80% • A = 33% < 50% • P = 66% • Lack education and Training	• Not indicated	• Not indicated
Algeria [32]	Experiment	160 samples	Not indicated	Not indicated	Residual Pesticide (mg/kg) • Chlorpyrifos-ethyl (0.028 ± 0.001)	• 13 types of fresh fruits and vegetables from domestic

					• Fenitrothion (0.68 ± 0.004) • Metalaxyl (0.048 ± 0.015) • Procymidon (0.046 ± 0.02) • Triadimenol (0.035 ± 0.003)	
Morocco [33]	CS	402 famers	• Allergies • Headaches, • skin irritation • Cancer	• Alcohol consumption • Smoking	• Insecticide (19%) • Fungicide (31%) • Herbicide (35%) • Acaricide (4%) • Nematicide (1%)	• Potatoes • Orchards
Egypt [34]	CS	170 users	• Not indicated	❖ P = 34%<50% ❖ Lack of training	• Insecticide (97.14 %) • chlorpyrifos & malathion (94.3%)	• Blood serum
Egypt [35]	Experiment	32 for 4 sampled sites	• Cancer • Endocrine Disrupting • Neurotoxic		The most detected (ppb) • Alachlor (165-254) • Metribuzin (0.6-47) • Metolachlor (6.6-12.5) • Atrazine, (2.5-7.3) • Malathion (1.5-5.7)	• Water bodies
Cameroon [36]	CS	104 farmers	• Skin irritation • Backache • Impairment of the central nervous system • Visual problems, and • Respiratory difficulties	• A = 69% • P = 50% • = 35% < 50% • Lack of Training	• Fungicides (40%) • Insecticides (28%)	Tomato, pepper, onion, cabbage, amaranth, okra, nightshade, Eggplant, mallow

Cameroon [37]	CS	137 Sprayers	• Nausea (29.9%) • Headache (12.4%) • Fatigue (12.4%) • Eye problem (16.8%) • Dizziness (8.7%) • Catarrh (1.4%) • Itches (4.4%) • Nervousness (12.4%) • Cough (4.4%) • Sweating (3.6%) • Vomiting (2.9%) • Diarrhea (7.3) • Restlessness (3.6%) • Anxiety (2.9%)	• K = 48.6%<50% • Lack of Training	• Fungicides (43.3%) • Herbicides (18.3%) • Insecticides (33.3%) • Molluscides (1.7%) • Nematicides (3.3%)	
Ethiopia [38]	CR	516 farmers	• I = 107(79%) • II = 55(40%) • III = 79(58%) • IV = 79(58%) • V = 73(54%) • VI = 69(51%)	• Age • gender • Education	Not indicated	Not indicated
Ethiopia [39]	CS	311 farmers	Not indicated	• K = 44%<50% • A = 23%<50% • P = 43%<50%	• Insecticide (66%) • Fungicide (33%)	• Tomato • Onion • Cabbage • Pepper
Tanzania [40]	CS	133 Sprayers	• Cough (33.8%) • Headache (30.1%) • Feeling weak (22.6) • Difficult in seeing (22.6%) • Dizziness (15%) • Abdominal pain (12.8%) • Sweating (12.8%) • Nausea (11.3%) • Excessive salivation (10.5%) • Diarrhea (8.3%) • Vomiting (6.8%)	❖ Lack of Training	• Herbicide • Carbamates • Pyrethroids • Organochlorine • Organophosphates	Not indicated

Tanzania [41]	CS	106	• Headache • Stomach pain	• A = 35%<50% • P = 38%<50%	• Insecticide (71%) • Herbicide (29%)	
Tanzania [42]	CS	121	• Not identified		• Organophosphates (42%) • Class II agents (77.6%)	Not identified
Kenya [9]	CS	801 Residents	• **I = 380(47.4%) • II = 39(4.9%) • III = 247(30.8%) • IV = 276(34.5%) • V = 193(24.1%) • VI = 237(29.6%) • VII = 62(7.7%) • VIII = 93(29.6%) • IX = 178(22.2%) • X = 190(23.7%) • XI = 34(4.2%)	• Lack of information regarding to pesticide utilization	• Not identified	Not identified
Kenya [43]	* * * E I Q Model	263 tons of pesticides	Carcinogens (43%) • Bad for health (60%) • Very harm full (47%)	Not indicated	• Insecticides (53%) • Fungicides (28% • Herbicides (16%) • Others (3%)	Not identified

Table 1: *Table health effect of pesticide among top ten importers African countries.*

**CS stands for Cross sectional study; **: Stands for type of health problems such as headache, loss of consciousness.*

****EIQ Model: To estimate the hazard to farm workers, consumers and ecological factors, the EIQ utilizes toxicological data.*

Discussion

Worldwide sales of pesticides exports by country totaled US$36.5 billion at the end of 2017. European countries generated the highest international sales from exported pesticides during 2018 (at the end of 2017) valued at $17.6 billion or almost half (48.2%) of the global total. In second place were Asian exporters at 33.7% while 12.6% of worldwide pesticides shipments originated from North America. Smaller percentages came from Latin America (3.8%) excluding Mexico but including the Caribbean, Africa (1%) and Oceania (0.6%) mostly Australia and New Zealand [44]. The Food and Agriculture Organization statistics/FAOSTAT/ revealed that China: US$5.2 billion (14.3% of total exported pesticides); Germany: $4.3 billion (11.8%); United States: $4.2 billion (11.5%); France: $3.7 billion (10.1%); India: $3 billion (8.1%); Belgium: $2.1 billion (5.7%); United Kingdom: $1.3 billion (3.7%); Spain: $1.3 billion (3.6%); Israel: $1.3 billion (3.5%); Italy: $791.4 million (2.2%) were the 10 countries, which were the highest dollar value worth of pesticides exported at the end of 2017 [45].

Food and Agriculture Organization statistics/FOASTAT/ reported that African countries did USD 548 billion import business and USD 476 billion export business at the end of 2017, as per our latest data. According to the export statistics from China Customs, export volume of pesticides (under HS code 29 and 38) during January to November in 2015, African markets represented 13.9% of the total export of pesticides from China and concerned 44 countries. The amount of export value for African countries

constitutes 85.9% of the total export value to Africa from China [12]. Majority of importers from are African countries [45]. Of these, the top 10 African countries by import value are South Africa, Nigeria, Ghana, Morocco, Egypt, Algeria, Cameroon, Ethiopia, Tanzania and Kenya, which were valued 3.356 million $ (25.7%), 2.060 million $ (15.8%), 1.896 million $ (15.5%), 1.496 million $ (11.5%), 1.239 million $ (9.5%), 0.861 million $ (6.6%), 0.58 million $ (4.5%), 0.563 million $ (4.3%), 0.504 million $ (3.9%) and 0.501 million $ (3.8%), respectively.

South Africa is the largest importer of pesticides from African countries. In this country, pesticides are used in almost every facet of our everyday lives; ensuring the quantity and quality of food we eat to managing the number of rodents and insects in our homes [46]. Literature shows that it is evident that there is a vast amount of pesticides present in the South African environment, there is very limited data on the production of pesticides. In the year of 2002, about 2800-tonnes of solid insecticides were produced [47]. Of total use of pesticide, 50%, 41% and 85 were accounted by herbicides, fungicides and insecticides, respectively. The residual of these pesticides was analyzed on different crops used around the farmers. The study indicated from this site the weighted of potential hazard found in maize, potatoes, citrus, grapes and sugarcane were 0.29, 0.23, 0.11, 0.06 and 0.06, respectively, which are more than allowable than maximum recommendation for residual of the pesticides. Even if, the usefulness of pesticides cannot be denied, the negative environmental and human health effects cannot be ignored in South Africa [1]. The Survey study was conducted on 269 (n = 269) who used pesticides in South Africa. As study reported farmers were exposed to different health problems. To study these problems, the proximity of farm was considered to determine effect of pesticide. Accordingly, the individual who were resided in closer proximity to agricultural pesticide spraying faced to asthma, birth defect, mutagenicity, teratogenicity and neurotoxicity than far from farm sites [25]. This suggests that 'farm residence' are located closer to the farmer (usual farmers) are exposed to higher intensities of, spraying than far from farm sites. High height and weight of workers were highly exposed as compared to short farmers, which was other associated factors for pesticide exposure. Thus, the study concluded that lack of training, low awareness, proximity of the farm, poor utilization of pesticide and anthropometric of the farmers were associated factors for exposure of pesticide among farmers [25].

Nigeria is the second importer from all African countries and the first importer of pesticides among West Africa countries. Fungicide, herbicide and insecticides are the major imported pesticides. And also they used The other study also reported from the same place states the majority of farmers (74%) used inorganic fertilizers and 26% used organic fertilizers (compost manure) [28]. To determine the effect on human being, food test carried out on 217 different food items such as e were observed in vegetable, tuber, cereals, cow, pig and goat were detected. Thus, the study reported that the residual of pesticides like DDT, Aldrin and Dieldrin were above maximum allowable concentration level which ranged from 1.2 - 2160 μg kg^{-1} [27]. In case of survey, 300 farmers (n = 300) who used pesticides were considered in this review. Majority of them exposed to health problems such as dermatitis, allergy sensitization reaction, birth defects, morbidity, impaired immune function, causes of cancer, cardiovascular disease and neurobehavioral disorder. Most of the farmers (65%) reported that they could not read agrochemical application instructions, 92% of farmers were exposed to agrochemicals during application, and most farmers (73%) reported falling sick after exposure to agrochemicals. In addition, farmers lacked the information and poor legislation [28].

Ghana is the third from all African and the second highest importer of pesticides Western African countries. Insecticide, herbicide and fungicides are the major pesticides. To determine the effect of these pesticides an active ingredients of stored cocoa pesticides was detected from 5m and 10m away from storage structures where the various treatment regimen was imposed. Accordingly, Allethrin (0.083), Deltamethrin (0.277), Cypermethrin (0.167) and Cyhalothrin (0.011) were Identified pesticide from wall paint 10m, which are maximum recommended levels of Cacao, they have potential to cause health effect on human and other organisms [29]. Regarding to farmers (n = 254) who used pesticides were reviewed. Among these, the highest exposed to bad odor was the commonest complaint (38%) followed by sneezing (28%) and headache (16%) [29]. Similar study conducted in this country also shows that health problem symptom such as headache (37%), sneezing (34%), sweating (13%), and numbness in the fingers (11%), tiredness (3%) and runny nose (3%), were observed among farmers of Ghanaians. The study concluded that gender, age, educational level, occupation of the participants, frequency of

pesticide application, use of protective clothing, knowledge and adherence to basic rules on pesticide application, effectiveness of pesticide use as pest control strategy and ailments experienced that can be attributed to exposure to pesticides [29]. Literature review shows that 35.6% the respondents had low awareness. Also, the socioeconomic variables are labor, age, marital status, household size and years of education, extension contacts, farm size, and quantity of pesticides were significantly influencing agrochemical use that is pesticides within their farms [30].

Moreover, Morocco, is the fourth and first highest importer of pesticide from Northern Africa countries. The major pesticides were insecticides (19%), fungicides (31%), herbicides (35%) insecticides-acaricide (4%) and nematicide insecticide and (1%). Some of these substances are classified as to its carcinogenicity risk in group 1, 2A and 2B according to International Center for Research on Cancer. Thus, the farmers use carcinogens products: 47.3% are already exposed and very few of these producers are confronted with the health rules for the phytosanitary treatment. For the sake of residual analysis potato vine crops and orchards, were performed for the most record and the important use of pesticides and the residual was maximum allowable permits, which is risk on human health [33]. Regarding to farmer perceptions, 542 farmers (n = 542), who used pesticides were considered in this review. From 140 farmers, more than 2/3 do not use effective/any measure of security, and 50% not respect the dose prescript when they spread the phytosanitary product on their crop; only 20% affirmed they respect both the manufacturer notification of use and the dose [31]. In same place, the study was dealt with 402 farming households [33]. Most of them reported that they have skin irritation after application of pesticides, and other health problems such as respiratory problems including "allergies". Among the farmers who reported these problems, 3.73% reported having headaches, and eleven having respiratory problems. The consumption of alcohol and tobacco to a certain degree had a strong correlation with the return of these health problems ($p = 0.0057$ and $p = 0.052$) [33].

Furthermore, the study conducted in Egypt, the second importer of pesticides from Northern African countries. The most frequently used pesticides by the subjects were inorganic compound, organophosphates, carbamates and pyrethroids. The major pesticides used insecticide i.e. Zinc phosphide (97.14%) followed by chlorpyrifos and Malathion (94.3%). To detect the health problems of pesticides, experimental study conducted near Cairo, Alexandria, Damietta, and Manzala Lake shows that the mean concentrations of pesticides at all sampling locations was higher than national recommendation levels Alachlor (199.6 µg/L > 0.4 **µg**/L), Metolachlor (10.4 **µg**/L > 3.2 **µg**/L), Pendimethalin (2.2 > 1.8), Atrazine (4.1 **µg**/L > 3 **µg**/L) and Malathion (4.2 **µg**/L > 3.7 **µg**/L). This finding shows that such amount of concentration has the potential to affect the ecological, environmental and also if anybody consumed through the water or food, they could cause cancer, endocrine disrupting and neurotoxic effect on farmers [34]. Also to determine the effect of pesticides among market workers and sprayers the farmers the blood sampling was performed. Accordingly, about 76.7, 92.5 and 100% of farmers, market workers and spray workers had varied levels of insecticide residues was found in their blood, respectively (Table 1). This shows that the proximity of pesticide and the occupation among pesticides users are the most associated factors for risk of pesticides. As study indicated spray workers had high amount of residues detected in their blood had chlorpyrifos (84.0%), profenofos (72.0%), lambda-cyhalothrin (64.0%), pirimicarb (52.0%), carbofuran (28.0%) and triaziphos (24.0%) residues above the recommended "Allowable Dietary intake" /ADI/ levels because of their extensive and frequently use [34]. Concerning perception of farmers, about 170 (n = 170) of farmers, who used pesticides were considered. Of these, majority of study subjects were not taking the necessary precautions to prevent hazards associated with their use. The results of survey revealed that 60.0, 6.7 and 12.0% of farmers, market workers and spray workers did not wear protective apparels (such as overall, boots, gloves, etc.). The farmers did not use mask while 26.7 and 24.0 % of market and spray workers used masks. About 20 and 52 % of farmers and spray workers use hats, but pesticides marketing did not use them. Also 83.3 and 86.7% of farmers and market workers were smoke or drink and eat food during mixing and during applying pesticides, while about 40.0% of pesticide sprayers practice these habits. About 16.7% farmers and only 20.0% pesticide spray workers do have knowledge on re-entry periods. Majority of farmers do not bother to read the pesticide labels and contrarily 80% pesticide market workers read labels. Interestingly 20.0, 13.3 and 40.0% of farmers, market workers and spray workers, respectively, reported that they re-used the pesticide containers, while the majority of farmers and spray workers (80.0 and 60.0%, respectively) leave it in the field after use [35].

Algeria is the third importer of the Northern Africa. The main pesticides were insecticide, herbicides, fungicides and nematodes. The residual pesticides was performed to determine the concentration of levels in vegetables and crops. The study confirmed that chlorpyrifos-ethyl (0.028 ± 0.001 mg/kg), fenitrothion (0.68 ± 0.004 mg/kg), metalaxyl (0.048 ± 0.015 mg/kg), procymidone (0.046 ± 0.02 mg/kg) and triadimenol (0.035 ± 0.003 mg/kg), which were higher than maximum permissible limits of pesticides residuals, which highlight the need to monitor and control residual pesticide levels to protect consumer health [32]. On the other hands, blood analysis was done to determine disrupt reproductive biomarkers. All subjects and blood serum was stored and assayed for luteinizing hormone (LH), follicular stimulating hormone (FSH), testosterone (T), estradiol (E2), free thyroxin (FT4), total triiodothyronine (TT3) and thyrotropin (TSH). The obtained results showed a significant decrease in the LH concentration of the greenhouse workers compared to the control. As study revealed there was also a significant depletion in the FSH and testosterone levels of all workers exposed to pesticides. Serum concentrations of TT3 have not been affected during pesticides' exposure. However, a significant decrease in the concentration of TT4 was also noted. On the other hand, levels of TSH and estradiol were significantly higher only in the greenhouses workmen compared to the control. Thus, the study concluded that exposure to pesticides could disrupt some reproductive biomarkers, particularly in those working in closed area of greenhouses [48].

Cameroon is one of the highest importer from Central Africa. Insecticides, fungicides and herbicides were the major pesticides used by farmers. The most common of residual of these pesticides was found in tomato, pepper, onion, cabbage, amaranth, okra, nightshade, Eggplant, mallow and hot sweet, and their residuals were more than daily allowable intake [37]. Concerning farmer and sprayers, about 241 of farmers (n = 241, from two studies), who used pesticides were considered. Of these, 137 (n = 137) the farmers reported nausea (29.9%), headache (12.4%), fatigue (12.4%), eye problem (16.8%), dizziness (8.7%), catarrh (1.4%), itches (4.4%), nervousness (12.4%), cough (4.4%), sweating (3.6%), vomiting (2.9%), diarrhea (7.3), restlessness (3.6%) and anxiety (2.9%) of them had health problems [37]. About 96.4% of the farmers were mainly used manual with 54% of users experiencing health problems post-application. Because of the lack of funding and training, 19.7% sprayed pesticides without protection. For the Restricted Entry Interval (REI), 43.1% entered the field in less than 12h after pesticide application. Some respondents (54.7%) said they hadn't received any training on pesticide application while 20.4% of respondents failed to follow recommended doses. Surface water around farms was used by 62.1% of pesticides users for domestic purposes. Some farmers (46.7%) have once heard about pesticide related accident while 14.6% suffered from pesticide intoxication, the prevalence being significantly higher in males ($p < 0.05$). Therefore, the study concluded that there is a need to regulate the pesticides sector, assess ecological risk and the bioaccumulation potential of these pesticides as well as their ability to hindrance water quality and biota [37]. The other study also indicated that from 104 (n = 104), 75% them received the information about agricultural production from other farmers and have never received any training on pesticide use practices and health effects. The symptom of health problems identified from farmers were skin irritation, impairment of the central nervous system, visual problems, and respiratory difficulties, while from other study. This is due to absence of farmer training further increases the danger of pesticide misuse [49].

Moreover, Ethiopia is the highest importer of pesticide among Eastern African countries. From this study, Insecticide (66%) and Fungicide (33%) were mainly used amongst the farmers of Ethiopia [39]. The country is now struggle to eradicate the poverty through agriculture-Industry linkage. However, majority of the farmers in this country are illiterate [50]. A survey was conducted in 827 farmers (n = 827), who used pesticides were considered in this review. Of these, 516 farmers (n = 516), who used pesticides had health problems stated in table 1 (I-VI); (I) such as nervous system, headache, dizziness, excessive sweeting, salivation, confusion, weakness, anxiety and loss of consciousness (79%); (II) such as cardiovascular and Bradycardia (40%); (III) such as gastrointestinal, vomiting, diarrhea and abdominal cramp (58%); (IV) such as respiratory system, Chest tightness, dyspnea, morning cough, day/night time cough, shortness of breath and wheezing (58%); (V) such as ocular and eye tear (54%); (VI) such as dermatologic, rash on hand and skin rash (51%) [38]. On the other hands, from all participants (n = 516), 26 % was the prevalence of Acute Pesticide Intoxications/API/ in the past year among the residents in the study area, which was higher in the population living close to the flower farm (42%) compared to those living far away (11%), Adjusted odd ratio /AOR/ [AOR = 3.2; 95% CI (2.2 - 4.8)] for age, gender and education. A group living close to the farm and work-

ing there had significantly more API (56 %) than those living close and didn't work there (16%) [AOR: 3.0, 95 % CI (1.8 - 4.9)]. Flower farm workers reported more API (56 %) than those not working in the flower farm (13%), [AOR: 4.0, 95% CI (2.9 - 5.6)]. This simply indicated that the proximity of pesticide exposure matter for high severe health effect [38]. Therefore, usually farmers are working with close farm areas could affect by health problems. Moreover, the other study conducted in this country shows that from 311 farmers (n = 311), about (44%), (23%) and (43%) of them had the knowledge, attitude and practice of the farmers, respectively, which is less than half percent (50%)., which need to improve in order to prevent the risk of the pesticide [39].

Tanzania is the second importer of pesticides next to Ethiopia. The study reported that farmers were used 81 formulation produced with 54 active ingredients, which consists Carbamates and Organophosphorus (29%), Pyrethroids and pyrethrins (14%), organochlorines (17%) and other such as fungicides, fumigants, herbicides and rodenticides (40%). Regarding to farmers, 360 of farmers and sprayers (n = 360) who used pesticides were considered in this review. The study conducted by Ngowi [40] revealed that, of 133 sprayers (n = 133), they faced to health problems such as Cough (33.8%), headache (30.1%), feeling weak (22.6), Difficult in seeing (22.6%), Dizziness (15%), Abdominal pain (12.8%), Sweating (12.8%), Nausea (11.3%), Excessive salivation (10.5%), Diarrhea (8.3%) and Vomiting (6.8%) [40]. In other way, the study conducted in this country also shows that from the total of 106 rice farmers (n = 106), more than half (62%) did not see any risks with pesticide use for human health and environment. Majority (65%) did not believe that pesticides could have any negative effects on other organisms than the targeted pests. Of studied, safety instructions were seldom (50%) included when pesticides were purchased. When provided, verbal recommendations from labels on the package were most common. Written safety instructions were often only in English, which could not be understood by the farmers, who often were illiterate. More than half of the farmers did not use any PPE during mixing or application of pesticides. The pesticides and rice husks were often mixed together with their bare hands, and just half of them specifically mentioned that they washed their hands afterward. Kitchen utensils were often used for preparing the mixtures. Only two respondents mentioned that they had specific for pesticides [41]. The other study conducted on 121 farmers (n = 121) reported that 93% of farmers was reported past lifetime pesticide poisoning. The agents reported as responsible for poisoning were Organophosphates (42%) and WHO Class II agents (77.6%). Storage of pesticides in the home was reported by 79% of farmers [42]. The study reported that education levels were significantly less likely to store pesticides in their home (PRR High/Low = 0.3; 95% CI = 0.1 - 0.7) and more likely to practice calibration of spray equipment (PRR High/Low = 1.2; 95% CI = 1.03 - 1.4). However, knowledge of routes of exposure was not associated with safety practices particularly for disposal, equipment wash area, storage and use of PPE. Thus, this study concluded that a high potential for pesticide exposure, which needs comprehensive interventions to reduce both exposure and health risks, including training, improvements in labeling, measures to reduce cost barriers to the adoption of safe behaviors [42].

The last and third importer of pesticides among Eastern African country is Kenya. The major type of pesticides used by farmers were insecticides (53%), fungicides (28%), herbicides (16%) and others (3%). From these pesticides, Carcinogens (43%), bad for health (60%), and very harm full (47%) As this study indicated about 35% of the volumes belong to the organophosphates, 25% carbamates, 22% pyrethroids, 7% tetranortriterpenoids, and 7% inorganics. Of the pesticides, 8% were classified as highly hazardous compounds by WHO, 25% as carcinogens, while 43% are said to be possible carcinogens. Approximately 60% of the pesticides quantities were indicated to be bad actor chemicals, 64% to be ground water contaminants, and 47% very harmful to beneficial insects. Calculated mean EIQ-values were 22, 6 and 82 for farm workers, consumers and the environment, respectively, with an overall average of 37 [43]. The literature found that symptoms of health problems due to pesticide exposure were showed table 1 (coded as I-X) were observed among farmers of Kenya: Table 1 shows I stands for general malaise, headache (47.4%); II: such as nervous system anxiety, depression, fits and loss of consciousness (4.9%); III: such as cardiovascular palpitations, chest pain and leg swelling (30.8%); IV: such as respiratory cough, sneezing, dyspnea and wheezing (34.5%); V: such as gastric heat burn and water brush (24.1%); VI: such as gastrointestinal abdominal pain, vomiting, diarrhea, bloody, vomitus or jaundice (29.6.3%); VII: such as nose and throat itchy painful ear, nose and throat (7.7%); VIII: skin, skin rash, itching or other skin conditions (29.6%); IX: such as eyes itchy painful or tearing eyes (22.2%); X: such as joints painful swelling of bones, joints or spine (23.7%) (76.3%); XI: such as head or neck abnormality swelling on head or neck (4.2%) [9].

Conclusion

The study concluded that more than one billion United States dollars of pesticides sales was carried out into ten African countries. The review found that there were many health problems encountered by these countries' farmers and the associated factor were lack of attention to safety precautions, poor spraying techniques, carelessness of safekeeping of the chemicals and disposal of empty pesticides containers, consumption of food and beverages while working, lack of personal hygiene, weakness of legislation, and inadequate personnel protective equipment. Thus, the authors advice to the farmers to start the decontamination process by placing the patient under a shower and using soap and water to remove the pesticides. If contact occurs by the ocular route, it is essential to rinse the eyes with plenty of clean water. All the materials and clothes used by the patient at the time of intoxication, like clothes and shoes, should be removed. In cases of large contamination, it is crucial to consider the need to decontaminate all the people who work in the emergency system. Strengthen integration of pest management approach, legislation and policy development within the African countries will be encouraged.

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Both Authors contributed.

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I consent the data deposit in a public repository that meets appropriate standards of archiving, citation and curation.

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