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## Environmental Impact of Pesticides Usage on Farmlands in Nigeria

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### **Abstract:**

*The paper has appraised the use of pesticides on farmlands and stored food crops in Nigeria by reviewing relevant related works. The paper has discovered that the ease, availability, affordability and effectiveness of pesticides have led to increased usage by farmers to control pests that ravage their farm produce. Unfortunately, in an attempt to solve the pest's problem, the indiscriminate use of these chemicals are gradually destroying the environment, posing serious threats to human health, animal life, plant forms, soil and water; leading to emergence of resilient species of life forms that are becoming resistant to fungicides, insecticides and herbicides. The paper has recommended legislative measures and mass public enlightenment on the necessity of reducing the pesticides usage in sensitive areas, reversion to traditional methods of hand hoeing and hand weeding as well as other relevant measures aimed at forestalling further degradation of the environment that feeds, cloths and accommodates the present generation and the generation yet to be born.*

### **1. Introduction**

Nigeria is a country in West Africa sub-region, found between latitudes 4<sup>0</sup>N and 14<sup>0</sup>N of the equator; and between longitudes 3<sup>0</sup>E and 15<sup>0</sup>E of Greenwich Meridian (Atlas of Nigeria, 2011:18). The country has a land mass of about 98.3 million hectares (Avan and Uza, 2002:92); with a population of about 140 million people, comprising 50.78% male and 49.22% female (population census 2006). Between 70- 80% of the entire workforce is basically agrarian. The country has a cultivable land of about 72 million hectares which has been under rain-fed agriculture while 1 million hectares are said to be under irrigation, mainly in northern parts of the country where rainfall is seasonal (Avav and Uza, 2002:92).

Agriculture, which is the most fundamental form of economic activity in the country, is facing serious challenge. Farmer's efforts are often undermined by the activities of other biotic components of the environment, particularly parasites, pathogens, fungi and weeds. These are not only in competition with the farmers for space and food materials but are also agents of diseases to root crops, cereal crops, fibres, fruits, vegetables, stored grains and livestock. The effect of these pests on crops and livestock is that they reduce the yields to the level that agricultural endeavours become uneconomical to the farmers. Farmers are therefore compelled to explore ways of controlling these unwelcome fungi, insects, birds and weeds to curtail the losses. One means of controlling pests is the purchase and application of pesticides to farmlands, crops and stored grains to protect and remedy the farm produce from ravage of these unfriendly organisms.

The invention of many chemicals which came after World War II to combat pests of human and animal diseases in tropical areas including Nigeria has encouraged their rapid use in agriculture as chemical industry has provided an arsenal of over half a million chemical substances into the market (Smith and Smith 1998:236). The production of these agricultural poisons has been one of the largest growth areas in chemical industry today such that few farms are without their store of these poisonous substances.

The ease of application, affordability, availability and effectiveness in small doses of these agrochemicals is no doubt, boosting their usage in Nigeria. However, instead of solving the pest's problem, the pesticides are compounding the problem by killing natural predators, thus, posing serious threats to human health and degrading the environment that feeds, cloths and accommodates this generation and generation yet unborn. The questions that readily come to one's mind are: what are the common pesticides in circulation? What are their characteristics? Why do farmers insist in using them for pests control? How do the pesticides work? What adverse effects do these pesticides have on the environment? Are there restrictions on the use of some of these harmful pesticides in this country? What is the way forward?

In answer to these questions, the paper undertakes a review of relevant, related works done on the impact of pesticides on the environment with the aim of recommending appropriate measures to take in order to safeguard the environment that sustains this generation and the incoming generations. For this purpose, the paper is divided into eight parts. Part one is the introduction; part two clarifies some concepts; part three sets the theoretical framework, part four identifies classes of pesticides and their characteristics; part five highlights reasons why Nigerian farmers insist on using some pesticides, part six discusses impact of pesticides on the environment; part seven examines legislation on the use of pesticides with appropriate recommendations made while the last part concludes.

## **2. Clarification of Concepts**

The concepts that need to be clarified in this paper are environment, pest and pesticide.

### *2.1. Environment*

The word 'environment' was derived from an old French word 'environ' meaning 'encircle'. The etymological meaning of environment is surroundings of an organism comprising animal's plants and physical objects like land, air and water. Kemp (1998:127) sees environment as 'a combination of the various physical and biological elements that affect the life of an organism which is capable of changing in time and place. By this it means once a serene and friendly environment is infused with substances like pesticides, it can degrade and pose threats not just to land, soil, water and air but biotic components including human health and their means of livelihood.

### *2.2. Pest*

The word 'pest' was derived from the Latin word 'pestes' which means 'plague'. The etymological meaning of pest therefore is any element of the environment that causes trouble to human beings or their useful property. The Webster 3<sup>rd</sup> New International Dictionary as cited by Olufemi (2009:1) defines pest as 'a destructive or noxious thing, plant or animal detrimental to man or his interests. Similarly, the Organization for Economic Cooperation and Development has defined pest based on damage to crops and injuries on livestock and man as "any form of plant or animal life or any pathogenic agent injurious or potential injurious to plants, plant products, livestock and man; these include insects and other arthropods, vertebrates, nematodes, weeds, micro-organisms, fungi, bacteria, viruses, rickettsiae, mycoplasma, among others (Olufemi, 2009:1).

From the various definitions, of pest given above, we can consider the term to mean those biotic components of the environment like fungi, insects, birds, other mammals, microorganisms and weeds that are injurious to agricultural crops and livestock that human beings invest in and depend on them for food material to sustain life. These organisms are not only in competition with man for food material but are also agents of diseases to his root crops, fibres, cereals, fruits, vegetables stored grains and his livestock. The effect of pests on crops and livestock is that they reduce their yields to the level that may become uneconomical for the farmer to continue in the business.

### *2.3. Pesticide*

A pesticide is any natural or synthetic chemical that causes directly the death, impulsion, attraction, deterrence or in other ways influence pests for control purposes (Olufemi, 2009:160). Similarly, Smith and Smith (1998:236) identified two broad types of pesticides, namely synthetic which are humanly manufactured like chlorinated hydrocarbons, organophosphates and carbamates while the second type is botanically derived from plants like Pyrethrum, nicotine and rotenone. Pesticides could simply be regarded as products of human technological breakthrough commonly used to kill, suppress or render pests invalid, ineffective and unproductive to the advantage of man and his interests. In other words, pesticides are effective weapons made and use by human beings in the fight against the biotic components of the environment that are injurious to his root crops, cereal crops, fibres, fruits, vegetable and stored grains at home and in the field.

## **3. Theoretical Framework**

Understanding the continued usage of pesticides by Nigerian farmers in their farmlands can best be achieved within the concepts of ecology (man-environment relationships) environmental determinism and environment possibilism.

One way of viewing the environment according to May and Soger (cited in Obasan, 1998:132) is to regard it as an ecosystem which is a relatively stable community of organisms that have established interlocking relationships and exchange with one another in their natural habitat, materials and substances for their continued survival. Every ecosystem is composed of two large parts, made up of abiotic and biotic community as recognized by Obasan (1998:133). According to him, the abiotic environment consists of inorganic substances such as gases, water, soil, rocks and all other inorganic mineral compounds that provide the necessary resources for the use of the living organisms while biotic community is composed of three levels of living organisms. The primary producers which are green plants, capable of producing their own food; the consumers or heterotroph which are the animals that feed on organic matter and carnivores that feed on flesh, and reducers which are microorganisms that promote decay of dead organic matter (Obasan, 1998:133).

The doctrine of ecology or man-environment relationship is based on the idea that natural and human phenomena in a given area are closely interrelated and interact beneficially with each other in order to survive. Human beings always relate with other living things in order to meet their dietary requirements and other felt needs to survive in the environment. To this extent, they exercise some influence over their environment and they are at the same time subject to controls and limitations set by the environment. The

components of the environment exist and interrelate in a manner similar to the components of a functioning system. So, in order to continue to exist in the environment, human population must cope with the problems posed and in the process help to modify it to a greater or lesser degree by exploiting the natural resources (Ogunjuyigbe, 1998:136).

The description and explanation of human behavior in terms of the man-environment relationship is however being replaced with environmental determinism and environmental possibilism. Determinism whose exponents include Hippocrates, Strabo, Bodin and Buckle, among others looks for the mechanistic chain of direct cause from particular physical conditions of human environment which “rests on the various connections and interdependence of things and events” as typified by biotic-abiotic relationships (Obasi, 1999:202). A good example is that when farmers constantly disturb the soil to grow food crops, the action can populate pests in the field capable of choking and killing the crop plants because, according to Smith and Smith (1998:235) “pests possess certain genetic characteristics that give them advantage over food crops namely as; they have high rates of increase and dispersal, seek new and open habitats, adapt well to conditions provided by humans and spread rapidly in homogenous habitats where both shelter and food are abundant, colonize highly disturbed sites and respond quickly to disturbed sites and are tough and resilient”. The increased disturbance of soil by Nigerian farmers in trying to produce sufficient food to meet the needs of the teeming population is leading to high rise in pest population which compel farmers to seek for how to checkmate them to curtail losses that might follow.

As a result of technological development, determinism which sees man as a product, a child and a slave of the earth that mothers, feeds and restricts his food production, can no longer adequately hold, hence environmental possibilism will certainly give us more insight into why farmers in Nigeria and elsewhere have persistently embarked on the use of pesticides. The exponents of environmental possibilism like Paul Vidal, de Blanche, Jean Brunhes, Albert Demangeon, among others “suggest that man can alter the environment in any manner as a consequence of his technological and scientific skills, as the environment is passive” (Barry and Imo, 2003:87). Although man has to a great extent freed himself from the exigencies of his unmodified environment, however, he has to face the challenges offered by certain biological components of the environment like fungi, insects, birds and weeds that are undermining his efforts to attain food sufficiency. With improvement in skills, man has succeeded in manufacturing poisonous substances to kill the pests that ravage his crops in order to produce healthier largest food materials. Although the main objective of the chemists has been to make pesticides which destroy just some target forms of life without completely destroying others, unfortunately these poisonous substances are systemic such that as they enter through the food chains, they affect virtually every member of the biotic community, showing up immediately or after many years. So the position of this paper is that it is possible for Nigerian farmers to achieve food security if appropriate measures are taken to control pests without necessarily using harmful pesticides that are non-degradable which readily degrade the environment.

#### 4. Classes of Pesticides

Pesticides are chemical substances produced and are used for preventing, destroying, repelling or mitigating unwanted harmful organisms, viruses and air pollutants in order to ensure healthy returns from farms. The chemicals are many in the market for agricultural work. Many scholars like Seymour and Girardet (1987), Okeke (1993), Smith and Smith (1998), Dhameja (2006), Olufemi (2009) and Don-Pedro (2009) have variously grouped pesticides into classes using different criteria, however, for convenience sake we can categorize pesticides on the basis of target organism as fungicides, insecticides and herbicides; and on the basis of chemical identity as organochlorines, organophosphates and carbamates.

##### 4.1. Fungicides

These are chemical compounds produced and intended for use to kill fungal organisms that attack plants and animals including man. Most fungicides are based on compounds containing metals such as copper and sometimes mercury or on hydrocarbons containing sulphur which are readily very toxic to both plants and consumers of plant products with long residual effect (Seymour and Girardet 1987:45; Okeke 1993:51). The common groups of fungicides available in the market are:

- Carbamates: Used for preservation of fibre food and seed e.g. thiom, ziram
- Quinones: Used as seed and fruit protectants e.g. chloranil and dichlone
- Benzene Compounds: Used in the control of powdery mildews, fruit rot and for post-harvest treatments against deterioration e.g. thiabendazole.
- Benzimidazole (Benomyl): Used for control of ascomycete and basidiomycete fungi because they are important systemic fungicide.

Fungicides are often sprayed directly onto the part of a crop that is destined to be eaten and traces are frequently found on fruits and vegetables where they can build up within the body with adverse effect. Worldwide use of the fungicides has been estimated to be growing high, from 0.66 million tons in 1972 to 2.52 million tons in 1980 and to 12.0 million tons in 1990 (Seymour and Girardet, 1987:45).

##### 4.2. Insecticides

In the past, insecticides were classified on the basis of mode of entry into the host as stomach, fumigant or contact poison, however in recent times the chemicals nature are considered much more important (Okeke, 1993:52). Insecticides that kill aphids, weevils, other insect pests and for growing crops as well as stored grains are very common in the market and are carbamates, organochlorines and organophosphates.

- **Organochlorines:** These are the earliest group of synthetic, man-made insecticides used against pests of plants and animals, composed of chlorine, hydrogen, carbon and occasionally oxygen and sulphur (Olufemi 2009:164). They belong to the major synthetic man-made pesticides. They are fat-soluble which readily accumulate in fat tissues of animals because the compounds are typically denser than water due to the higher atomic weight of chlorine compared to hydrogen chlorinated organic compounds. DDT, aldrin, eldrin and lindane have long time persistence, highly toxic to wide range of animals as the toxins can be transferred through food chain. They are the most prevalent pesticides in the environment, potentially dangerous as pollutants hence, most pest species have become resistant to these insecticides (Don-Pedro, 1009:313). Many of these organ chlorines especially lindane are still in use in most parts of the world including Nigeria, although banned in USA, European countries, Australia and some Asia countries. There is need for Nigerian government to legislate against the indiscriminate use of these harmful substances in order to safeguard the environment from degradation and destruction.
- **Organophosphates:** These are organic molecules containing phosphorus which are esters of organic salts of phosphoric acid and its derivative developed in Germany to replace nicotine during world war II (Olufemi 2009:164). They belong to the major groups of synthetic man-made pesticides. They are water-soluble and are sprayed agriculturally on fruits and vegetables. They are less stable and persistent than chlorinated hydrocarbons because they easily leach to ground water and degrade rapidly by hydrolysis on exposure to sunlight, air and soil; hence, they are less toxic and serve as alternative to the persistent organ chlorine pesticides. Some of these pesticides are systemic in plants and animals. When taken up by plants they are transferred to leaves and stems, then they become available to leaf-eating and sap-sucking insects where they render the plants sap and insect's blood toxic (Olufemi 2009:165). They kill by damaging an enzyme in the body called acetyl cholinesterase enzymes which is crucial for controlling nerve signals in the body (Don – Pedro, 2009:312). The most obvious danger from uncontrolled use of organophosphates is that of poisoning the wrong organisms as spray drift can carry over into stream and uncultivated land, wildlife, bees and human beings.
- **Carbamates:** These are esters of unstable carbonic acid, first developed by the Geigy Corporation in 1951 (Olufemi, 2009:166). They belong to major group of synthetic, man-made organic chemicals. Many of these compounds are systemic and their insecticidal activity resembles acetylcholine and therefore, they have a high affinity for enzymes cholinesterase. They kill insects in a similar way as organophosphate insecticides by inhibition of sterase enzymes which affect nerve impulse transmission. They kill a narrow spectrum of insect but highly toxic to vertebrates (Smith and Smith, 1998:236). Though they are relatively low persistence, Don- Pedro (2009:313) warns that because they are neurotoxicants to man, they must be handled and used with care. Sevin and Carbaryl are good examples of carbamate insecticides. According to Seymour and Girardet (1987:45), worldwide use of insecticides is estimated to have increased from 1.08 million tons in 1972 to 4.8million tones in 1980 and to 18.0million tones in 1990.

#### HERBICIDES

These are a group of highly varied chemicals which mimic natural poisonous substances within plants (Seymour and Girardet 1987:45). Weeds are killed either through foliage sprays as post-emergence or application of the chemicals to the soil as pre-emergence sprays. The major sites of action of herbicides as identified by Okeke (1993:55) are three, namely,

- **Soil:** act on germinating weed seeds.
- **Contact:** burns off foliage of emerged weed and
- **Systemic:** translocates throughout the plant after foliage application.

Herbicides kill plants and may either be non-specific, killing all plants when land is cleared or specific, when for example, only broad-leaved weeds growing in cereal crops are killed. Some herbicides are deadly if accidentally consumed while others may cause non-fatal illness when eaten in food. Worldwide use of herbicides has been increasing rapidly, from 1.08 million tons in 1972 to 408 million tons in 1980 and to 16.0 million tons in 1990 (Seymour and Girardet, 1987:45).

#### 5. Reasons for the Persistent Usage of Pesticides

The usage of fungicides, insecticides and herbicides are increasing generally in the world, and in Nigeria particularly. The reasons for the rapid increase can be attributed to the following:

- **Manpower Shortage at Peak Periods:** According to Kola and Lawal (1999:80), pesticides save labour, time and cost especially where labour costs are high or there is a peak demand for labour or where mechanical hoeing will cause damage to the young crops. The man power shortage during peak period is not unconnected with the rural-urban drift of the able-bodied youth who prefer to migrate to urban centre for white-collar job, thus running away from farm work.
- **To Reduce Wastages:** Olufemi (2009:21) posited that pests attack stored food and other property of human beings and leave them damaged; expectedly such damaged items would have been replaced at an unbudgeted cost but the use of pesticides can easily checkmate the ravage. In a similar vein, Kemp (1998:311) argued that “pesticides are used to treat granaries, storage bins, greenhouses, grain elevators and other structures” which of course would have resulted in wastages suffered by the beneficiaries. Hence, the continued usage of these pesticides are on the increase in Nigeria.
- **To Improve the Quality and Quantity of Food and Raw Materials:** As human population increases, food and materials become less sufficient and unfortunately pests do compete for the limited food and other valuable materials resulting in the loss of food crops between the range of 20 – 50% (Olufemi, 2009:20); hence the use of pesticides would increase crop yield to the benefit of human population.



- To Save Human Life: The use of pesticides, as argued by Kem (1998:311), can save by protecting food supplies, an advantage that far, outweighs the economic, environmental and health costs giving the fact that the chemicals easily kill pests that eat and destroy food supply.
- Avoidable Health Risk: Health risks of pesticides usage are becoming better understand and can be offset by responsible handling and development of safer products hence farmers in Nigeria see nothing wrong for the continued usage.
- Ubiquity of Pesticides: Pesticides are available, cheap, affordable and are more effective in small doses than many other alternative means of controlling pests, hence farmers maintain patronage.
- Protection of Social Status: Many people in the community sometime link the presence of unmanaged pests in some farmer's field and stored food as an indication of low quality of life so in order to maintain the status quo-ante, such farmers have to 'belong' by procuring the chemicals at all cost to also apply on their farms.

## 6. Impact of Pesticides on Environment

Pesticides application is increasing worldwide as farmers have now become more sophisticated in knowing how to modify the environment to increase the yields of their investments in farms. The continued usage of these harmful substances on pests is no doubt, degrading the environment and affecting the biotic community negatively in ways discussed below.

- Human Hazards: Pesticides are biologically active and present potential hazard to human health. People susceptible to pesticide hazards are factory workers in pesticide manufacturing and packaging plants sprayers, spray plane pilots, machine operators, field workers, storage workers in general and children playing with carefully packed pesticides. The risks are usually very high in developing countries like Nigeria than in developed nations because most farmers hardly protect themselves with safety gadgets. In Britain, it was discovered that male workers in organ chlorine insecticide factory had temporary lost their potency for months after exposure to the chemicals while Oxfam estimates that over 10,000 people die annually in the third world countries including Nigeria from pesticides accidents (Don-Pedro 2009:328). Similarly, in Pakistan, there was a disaster in 1970s when over 2000 rice field workers were killed by oxidized malathion. The risk is getting higher in Nigeria where Malathion being used for storing grains are hardly allowed to decay before marketing them to consumers. High concentration of DDT in human beings is suspected to cause cerebral hemorrhage, hypertension, cancer, liver damage, among others (Dhameja 2006:80). Indeed, many herbicides are extremely toxic to human's birth defects and cancers including leukemia (Smith and Smith 1998:237).
- Food Poisoning: Most of the pesticides used in post- harvest storage are hardly allowed to decay before marketing such farm produce and some of which, due to insufficient water for domestic use hardly wash them before cooking. Many doses of pesticides have residual effect which can slowly accumulate in human system when they eat fresh fruits, vegetables and grains to disrupt metabolic activities within the body. Gamalin 20 and malathion used in crop lands and post-harvest storage have been reported in many states of Nigeria where the consumption of such 'poisoned food' resulted in the death of many family members (kola and Lawal 1999:82). Most toxic incidence that result in damage to environment posing health hazards can be minimized if farmers and consumers are aware of the toxicity and necessary safeguards are available and enforced. Asthana and Asthana (2006:64), posit that the fat-soluble nature of some pesticides usually prevent victims excreting from the normal biological system and as the residues are deposited in the fatty tissues when the fats get dissolved, they may be released into circulation to cause a number of health problems. Annually in US, some 4500 humans being are 'poisoned' to some degree by pesticides that mimic the effects of estrogen to increase human infertility and birth defects (Smith and Smith, 1998:9).

### 6.1. Destruction of Biomass

The insecticidal use of chlorinated hydrocarbons, through biogeochemical cycles can contaminate global ecosystems (Smith and Smith 1998:10). Such chlorinated hydrocarbons easily become concentrated at higher trophic levels, affecting predaceous non-target animals and interferes with their reproduction hence, reduce species diversity. Adeniji (cited in Kola and Lawal 1999:82) carried out an investigation on the levels of some pesticides and heavy metals in some inland waters and the result indicated high concentrations of DDT and other insecticides in fish muscles caught from Kainji and Jebba lake areas of Nigeria in readiness to be caught and eaten by Nigerians. Pesticides contribute to ecological imbalance by upsetting the predator-prey population. Dhameja (2006:80) posited that pesticides concentrations in water may be low but its concentration increases as it moves along the food chain comprising aquatic plants, fish predatory birds and finally man.

An attempt to take a detailed work on the fate of non-target arthropods under recommended spraying regimes in tropical environment has been reported by Don-Pedro (2009:322); out of a total of 367 species of insects and spiders associated with cowpea cropland, about 209 (57%) were non-targets and after the spray between 39 – 78% of the non-target suffered reduction when compared with controlled group. The implication of the finding is that the pesticides persistent and non-persistent types did not discriminate between target and non-target arthropods like entomophagous insect predators, parasites, flower visitors and scavengers and harmless shelter seekers.

### 6.2. Degradation of Environment

Pesticides applications contribute significantly to pollution of the environment. Deliberately introduced into the environment, to manage pests in agricultural fields, run-off water, irrigation water, leaching, wind and soil erosion often contribute further to the significant spread of pesticides to sites for remote from pesticide use areas to kill wildlife while some suffer damage to vital functions such as reproductive failure. The discovery of DDT residues in seals and penguins far away in un-inhabitable Antarctic region shows that no place is safe from contamination of pesticides. The use of dieldrin to control insect pests when bio amplified in predatory birds can affect the calcium metabolism and as a result the eggs laid by these birds have such thin shells that they are unable to bear the weight of the incubating birds, leading to reproductive failure (Dhameja, 2006:80). This happens because the accumulation of organochlorine pesticides in birds make them lay eggs with thin shells.

### 6.3. Impoverishment of Soil

Kola and Lawal (1999:82) averred that the natural nutrient regeneration capacity of soil can be damaged by the use of pesticides. Soil water retention capacity and porosity may be adversely affected leading to less water infiltration and more run-off to cause flooding down streams. Although, pesticides alone cannot be the bane of soil impoverishment, the combined effect of farming system can exacerbate the problem and cause flooding too.

### 6.4. Pollution of Water Bodies

Pesticides used in crop fields are often washed down by rain and irrigation water into the ground water and they eventually get into rivers, lakes and seas. Many pesticides are synthetic organic compounds that are non-biodegradable which easily accumulate in the bodies of plants and animals: as they pass along food chains, they become concentrated in the process. Pesticides released in oil solutions for example, penetrate to the bottom and kill fish and aquatic invertebrates. Trapped in the bottom rubble and mud, the pesticides may continue to circulate and kill aquatic animals for some days while DDT in oil solutions can flood on the surface slicks, attracting planktons and carried about across the seas by ocean currents to cause havoc to aquatic life forms (Smith and Smith 1998:358).

### 6.5. Development of Resistant Pests

Prolonged use of stable and persistent pesticides like DDT produces pesticide-resistant pests which will produce progenies requiring higher doses of pesticides for their eradication. This means that pathogens, insects and other pests readily develop multiple and cross-resistance such that any attempt to get rid of them will involve the application of larger doses of chemicals in order to obtain the same effect which may not be economically profitable for the farmers. Through natural selection, insects evolve a resistance to pesticides. As one replaces another, the pests acquire a resistance to them all. According to Smith and Smith (1998:237), there were over 1600 insect pests worldwide in 1988 that had developed resistance to one or more pesticides having overcome the toxic effects of every pesticide to which they have been exposed. Most insecticides need only about five years to evolve pesticides resistance but their predators do so much more slowly (ibid).

## 7. Recommendations

The ecological problem of pesticides usage has not lessened, instead the challenges persist, affecting fauna, flora, migratory birds and man. The use of pesticides has continued unabated in the US where herbicides make up 66% of this usage, insecticides, 24% and fungicides 16% (Smith and Smith, 198:359). Several countries in the world that have the knowledge about the hazards associated with indiscriminate use of pesticides in farmlands and farm produce have made laws either prohibiting their use or restricting their usage. In the UK, the use of pesticides is generally by the Food and Environment Protection Act, FEPA 1985 and more specifically by the Control of Pesticides Regulations (COPR) 1986 where pesticides are approved for specific uses and if an approval is revoked, the pesticides are effectively banned.

In Africa, legislation regarding the use of pesticides is deficient, although Tanzania, Sudan and Malawi have made remarkable efforts towards registration of agro-chemicals through screening them (Kola and Lawal, 1999: 83). Despite these efforts issuance of advice on their safe use in handbooks and warning given as to their levels of toxicity to the environment and organisms are not adequately emphasized (ibid).

Back home in Nigeria, some efforts have been made in some states by developing a checklist of assorted agrochemicals in use, having been screened however, their toxicity effects on higher animals and aquatic organisms has not been properly assessed (Ita, 1991:95). Many developing countries, including Nigeria are often used as dumping grounds for dangerous chemicals that are already banned in developed countries of the world (Kola and Lawal, 1999:84). This assertion is not out of place, giving the fact that there are no proper instructions by Nigerian government on some of these dangerous chemicals hence, it is possible to still find such banned DDT available in the market. Although Nigerian government has set a uniform standard for all category of pesticides allowed for discharge into inland waters at 0.01mg/l however, this amount as argued by Kola and Lawal (1999:84) is no doubt inadequate, giving the fact that each chemical type has different half-life level of toxicity, persistence and accumulation in the environment. Against this background, it becomes pertinent to make the following recommendations in order to save the nations' environment from further degradation by indiscriminate application of harmful pesticides in the fields and stored food materials.

Firstly, there is need for specific legislation to regulate the importation of extremely hazardous pesticides into the country as it is being done in many countries of the world including some African countries. Government should put in place registration of all agro-

chemicals used in Nigeria and information regarding their properties and safe usage should be provided and strictly adhered to by the end users.

Secondly, government should set up pre-market regulation requirements, mandating chemical firms to test and screen a whole series of chemicals for their ability to kill pests so that only those showing considerable pesticides that are environmentally sound should be developed further. In this way, pesticides that are environmentally hazardous can be rejected out rightly.

Thirdly, post-market regulations should be employed to reduce the hazards associated with pesticides currently in use. Various codes of practices and regulations can be used to reduce the pollution hazards by modifying the form, time and location of pesticides application as the case is obtainable in USA and UK.

Fourthly, government should adequately fund tertiary, institutions of learning to enable them intensity research into the toxicological effects of some of the chemicals on the nation's environment and come up with possible solutions of controlling pests without harming the environment. In this wise, the research institutions should look for the possibility of developing cheap but effective substitutes for pesticides that target pests more accurately, breakdown rapidly in the environment and the types that ensure minimum leaching from soil.

Finally, since the attitude of indiscriminate application of pesticides by farmers is as a result of lack of adequate awareness of the side-effects, there is need for mass publicity so that farmers would revert to the traditional hand hoeing, hand weeding, use of pest-resistant seeds and organic farming systems that reject the use of agro-chemicals in order to forestall further degradation of the nation's environment by indiscriminate pesticides usage.

## 8. Conclusion

In Nigeria, farmers are facing serious challenges of controlling the upsurge of different species of pests that damage and ravage their farm produce both in the fields and stored. In an attempt to manage these pests most farmers have resorted to the usage of pesticides. Because of the ease, availability, affordability and effectiveness in small doses, farmers have found the necessity to use fungicide, insecticides and herbicides to eradicate and control those pests. Unfortunately, many of the users of these pesticides hardly cover themselves with safety equipment nor follow the instruction on how to apply them safely. The result is that human lives are often threatened and their means of livelihood like water, soil, plants and other useful non-target life forms poisoned and destroyed. The paper has therefore recommended the need to legislate on the proper use of pesticides and encourage farmers through mass publicity to urgently revert to the traditional practices that are environment friendly.

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