High Human Exposure and Measurable Environmental Impact of Pesticides Application on Agriculture: A Review Article

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Abstract
The adverse ecological effects occur from pesticides at all levels of biological organization. The effects can be global or local, temporary or permanent, or short-lived (acute) or long-term (chronic). The most serious effects involve loss in production, changes in growth, development and/or behavior, altered diversity or community structure, changes in system processes (such as nutrient cycling), and losses of valuable species. Pesticides can directly and indirectly impact non-target organisms like plants, bees and other pollinators, beneficial insects, fish, livestock, wildlife, humans and pollute environments like water, ground water, air and soil. The majority of pesticide have the nature of adsorbing (binding of chemicals to soil particles), persistence (ability of a pesticide to remain present and active for a long time), and volatility (the tendency of a pesticide to turn into a gas or vapor). They can be degraded by microbial action-destroying pesticide in soils, by photo degradation-using sunlight, by chemical degradation using non-living processes such as hydrolysis and by a chemical reaction with water, typically with a high pH (alkaline). Soil properties and conditions also affect the rate and type of chemical reactions of pesticides. Pesticide move by three basic medium air (vapor, particle, and spray drift), water (surface runoff, movement through soil) and deposits (residues on plants and animals). People who use pesticides or regularly come in contact with them must understand the relative toxicity, potential health effects, and preventative measures to reduce exposure to the products they use and look out special environmental considerations, groundwater protection, protect sensitive areas, and protect non-target organisms. In general the aim of this paper is to create awareness on effect of high human exposure to pesticides and measurable environmental impact of its administration on agricultures.
Keywords: Pesticides, Environment, Health risk, Pest management

INTRODUCTION

Promoting sustainability in agricultural production requires critical consideration of agricultural technologies and identification of best practices. Pesticides are one of agricultural technologies that enable farmers to control, repel or mitigate any insects, rodents, nematodes, fungi, or weeds or pests and any other form of constitute declared their productivities when producing a cereal crops, fruits and vegetables (Kateregga, 2012). Pesticides are chemicals that are used in agriculture for the control of pests, weeds, or plant diseases or fungi and based on nature they classified as inorganic, organic and biological (Mohammad and Seyed, 2011). Some of pesticides are of biological origin in addition to agricultural importance, one best example is *Bacillus thuringiensis*, which is used in public health programming to control mosquitoes that transmit malaria and *Simulium sp*., the vector of onchocerciasis (river blindness), as well as in agriculture against lepidopteran pests (WHO, 1990).

The majority of the pesticides used in agriculture are organic compounds rather than inorganic pesticides serve as fumigant insecticides (HCN, SO_2, CS_2 and PH_3) that exist in the vapor phase mostly used in the treatment of empty transport containers, grain stores, warehouses, harvested products prior to or during storage and to destroy pests in the soil, most copper compounds used as fungicides ($CuSO_4$ and Cu_2O) and insecticides (HCN, SO_2, PH_3, $CuCl_2$, $Cu(OH)_2$, $Cu(NO_3)_2$, $CuCO_3$) (Sharma *et al*., 2009). Organic pesticides may be extracted from plants or may be synthesized from carbon and other elements such as hydrogen, nitrogen, or chlorine (Mohammad and Seyed, 2011). Pesticide has got a wide range of impacts on human and other living beings. The direct impacts are on soil microorganisms, which has got special role in various nutrient cycles (Jan *et al*., 2001; Cycon *et al*., 2006) and also contributing to increase crop protection. Most pesticide preparation includes large amount of carrier substances (inert ingredients usually not included in any discussion of health effects), active ingredients, solvents and compounds that improve absorption, etc. The adverse effects of inert ingredients may exceed the active ingredients such as carbon tetrachloride, CCl_4 and chloroform, $CHCl_3$ (both potent agents are toxic to liver and CNS). The adverse effects of pesticides on health may also be caused by impurities, such as dioxins in certain phenoxyacid herbicides, ethylene thiourea in ethylene bisdithiocarbamate fungicides, and isomalation in Malathion (WHO, 1990).

Besides this, majority of pesticides, especially OCPs', have got bio-accumulative capacity (Shokrzadeh and Ebadi, 2006) and breast cancer risk under specific situations and also may increase the risk of hypertensive disorders during pregnancy as a result of frequently uses of DDT and its derivative DDE. While pesticides may cause severe problems to human like sperm chromosome segregation and augment the risk for genetic syndromes due to Ops (Chen *et al*., 2004). Its negative impact on flora and fauna can also be linked to the continuous direct exposures as for example cypermethrin (Class, 1992). Almost 10% of the total cancer patients are found to be caused due to pesticide poisoning alone (Gu and Tian, 2005).

Now a day, Ethiopia (most Oromia, Amhara, South and Tigray region) one of the largest pesticides consumer in Africa to alarmingly increase crop production by protect insects. However, there is no proper record of the actual volume of pesticides used in vegetable production in Ethiopia (Mengistie *et al*., 2014). The aim of this paper is to create awareness on effect of high human exposure to pesticides and measurable environmental impact of its administration on agricultures. For several years, increased attention has been focused on IPM programs and alternative methods of pest control to reduce pesticide use in agricultural systems because of food safety issues, groundwater contamination, and increased environmental awareness in European and USA. IPM is a pest management strategy based on their efficacy or cost rather than on their potential environmental impact since there is no easy method to assess pesticide impacts, while EPA pesticide registration process is based on a wealth of toxicological and environmental impact data for most pesticides that are commonly used in agricultural systems (Kovach *et al*., 1992). A recent study shows that natural honey decrease by 75% has occurred and no more available in the market due to extensive use of pesticides for agriculture. Still the apicultural activities are ongoing and people are keeping honeybee, but pesticides are the main hurdles and adversely affecting the socio-economic activities of the people in the business (Nafees, 2008).

TYPE AND PROPERTIES OF PESTICIDE

Based on their chemical composition pesticides can be classified broadly into three categories of organochlorines, organophosphates and organocarbamates (Williams, 1967), whereas in their application they classified as insecticides kill insects (organochlorines, organophosphates, carbamates, and synthetic pyrethroids), fungicides kill fungi, herbicides kill weeds and others (rodenticides kill vertebrate, nematocides kill nematodes, fumigants kill whatever treat crop transport containers, grain stores, warehouses, harvested products prior to or during storage, biocides and chlorine or hypochlorites) (Zenilda *et al*., 2011; Mahalashmi *et al*., 2007).

Organochlorines Pesticides (OCPs)

OCPs are hydrophobic (water-hating) insecticides and show low solubility in water, but are readily soluble in fat (lipophilic). Namely they includes, dichlorodiphenyltrichloroethane, DDT (derivatives 2,4-DDE, 4,4-DDT and 2,4-DDD), methoxychlor, kepone, propiconazol, aldrin, dieldrin, lindane, endosulfan, endrin, chlordane, heptachlor, mirex, toxaphene, HCB and industrial chemicals and byproducts, including PCBs, dioxins and furans (Anju *et al*., 2010). They are major types of pesticides, notorious for their high toxicity, highly persistence in the physical environment, bioaccumulation, biomagnification and their ability to enter the food chain (Akan, 2013).

Organochlorines have been widely used as pesticides and have two important characteristics: these are, chemically stable and remain active in the environment for many years and low polarity, low aqueous solubility, high lipid or fat-soluble and readily concentrate in adipose tissue. These properties lead directly to their most undesirable characteristics like the environmental persistence, bio-concentration, and bio-magnification through the food chain. In times of food shortage, fat reserves may be metabolized, releasing the pesticide into the blood of the organism. This may be fatal (Brian, 1998). Its residues enter to aquatic environments through effluent release, discharges of domestic sewage and industrial wastewater, atmospheric deposition, runoff from agricultural fields, leaching, equipment washing, empty containers disposal and direct dumping of wastes into the water systems and accumulate in the biota (Yang *et al*., 2005).

DDT is the common name for a man-made OCPs chemical, and does not occur naturally in the environment. Chemically, it is a mixture of p, p'-DDT (63-77%), o, p'-DDT (8-21%), p, p'-DDE (0.3-4%). DDE is the major metabolite of DDT rapidly transformed in biological systems from DDT (IPCS, 1979). DDE has a very long half-life and is of toxicological importance (ATSDR, 2002). Half-lives of DDT and DDE in humans have been estimated in ranges from 6-10 years (Wolff, 1999) and have long-term exposures slowly released from fat. Today DDT is among a suite of tools that are available for reducing transmission of malaria by indoor residual spraying to decrease the incidence and spread of the disease not only by killing mosquitoes but also by repelling them from interior surfaces (Attaran and Maharaj, 2000; Roberts *et al*., 1997).

Endosulfan is an organochlorine insecticide and acaricides which acts as a contact poison in a wide variety of insects and mites. Endosulfan is effective against a wide range of insects and certain mites on cereals, coffee, cotton, fruit, oilseeds, potato, tea, vegetable, crops, and also for wood preservative. Short-term toxicity is high, and influenced by the solvents and emulsifiers used to dissolve it. Endosulfan is easily absorbed by the stomach, by the lungs and through the skin, meaning that all routes of exposure can pose a potential hazard for fish as well as other micro flora and fauna (DeLorenzo *et al*., 2002; CSE, 2001). Besides, it also produces endo-sulfate, endosulfan-diol, endosulfan ether and endosulfan lactone which is also hazardous and can stay several years (Wan *et al*., 1995; Callahan *et al*., 1979).

Organophosphate pesticides (OPPs)
OPPs are rapidly degraded in outdoor environment and do not bioaccumulate. Even if, they are easily degradable those have toxicity on humans through inhabitation of AchEmechanism in nerve tissue and have symptoms of over stimulation of parasympathetic nervous system, salivation, constricted pupils, diarrhea, sweating, muscle twitching, CNS disturbances, coma, death, delayed peripheral neuropathy, not a carcinogen or teratogen, possible long-term neurological consequences from repeated exposures and the like (Hashim, 2002; Beise, 1992; Gergis, 1983). OPPs includes, malathion, parathion, diazinon, dimethoate, fenitrothion,guthion, nerve gases-tabun, sarin, soman, dichlorvos, demeton, methyl schradan, phorate, disulfoton, trichlorophon, mevinphosand chlorpyrifos which are readily deactivated and degraded by micro-organisms (Reigart and Roberts, 2006; Raven, 2008).

Malathion is a non-systemic, wide spectrum organophosphate insecticide used to control aphids, mites, flies, leafhoppers, leafminer, spittlebugs, chinchbugs, grasshoppers, corn earworms, armyworms, bollworms, lice, ticks, ants, spiders, and mosquitoes. Malathion is a non-specific poison, is known to be highly toxic to bees and fish many aquatic non-target species, such as aquatic stages of amphibians and aquatic invertebrates, moderately toxic to birds and also toxic to many species of beneficial insects as well as nervous system (due to inhibiting the enzyme acetylcholine esterase) and cases of long-lasting polyneuropathy, sensory damage, mutagenic in humans and animals, as well as behavioral changes in humans (Petty, 1958 and Healy, 1959). Dimethoate is an organophosphorus insecticide with contact and systemic action. It is a general-use chemical for use against a broad range of insects in agriculture and also for the control of the housefly. Hydrolytic degradation is the main inactivating pathway of dimethoate in the environment. In moist air, it is degraded photochemically to hydrolytic and oxidation products. Degradation in soil is dependent on the type of soil, temperature, moisture and pH level (IPCS, 1989). Dimethoate is not expected to persist in water (Health Canada, 1991).

Carbamate
Carbamates are insecticides that were derived from carbamic acid, acts on nervous transmissions in insects also through effects on cholinesterase enzyme by blocking acetylcholine receptors similar to organophosphates. It includes Carbarylal, dicarb, methiocarb, methomyl, carbofuran, bendiocarb, and oxamyl (Amy *et al*., 2012). In general, although they are broad-spectrum insecticides, of moderate toxicity and persistence, rarely bioaccumulate or cause major environmental impacts. Like organophosphates, this compound is highly effective and induces little or no excite-repellency response from the vector. It has short residual activity (2-6 months) and is more expensive than pyrethroids and DDT. The mode of action of carbamates is similar to that of organophosphates (WHO, 2006, Brown, 2006).

Herbicides
Herbicides are low acute toxicity chemicals to humans that are applied on agricultural lands to remove unwanted plants or weeds. It includes paraquat, diquat, ammonium sulphamate, ammonium glyphosinate, borax, ferrous sulphate, sodium chlorate, 2,4-D, 2,4,5-T, dintrophenols, cyanophenols, pentachlorophenol, and triazines can persist in the soil for several years, are slightly toxic to soil organisms and moderately to aquatic organisms. However, there are exceptions; many can be dermal irritants since they are often strong acids, amines, esters, and phenols. They can also adversely affect birds by destroying their habitat. Inhalation of spray mist may cause coughing and a burning sensation in the nasal passages and chest. Prolonged inhalation sometimes causes dizziness. Ingestion will usually cause vomiting, a burning sensation in the stomach, diarrhea, and muscle twitching (WSSA, 1994). 2, 4-D is one of the oldest herbicides used in the US and still continues to be one of the most commonly used herbicides on the market. 2, 4-D is a selective herbicide that kills dicots (but not grasses) by mimicking the growth hormone auxin (indole acetic acid), which causes uncontrolled growth and eventually death in susceptible plants. Ester formulations of 2,4-D are toxic to fish, aquatic invertebrates, dogs than rats and humans (Ibrahim *et al*., 1991), certain crops (grapes) but salt formulations are registered for use against aquatic weeds. It is relatively low toxicity to animals but some formulations can cause severe eye damage (Tu *et al*., 2001). The most volatile of the 2,4-D esters, methyl and isopropyl, have been banned in the U.S. (Que Hee and Sutherland, 1981), but some volatile ester formulations of 2,4-D remain available and less volatile alkali and amine salts. Symptoms of 2,4-D workers and sprayers have an experienced of weakness, fever, headache, dizziness, muscular hypertonia (an abnormal increase in skeletal or smooth muscle tone), constipation, vomiting, stomach pains, urinary incontinence, nausea, brief loss of consciousness, and moderate leukopenia (an abnormal reduction in the number of WBC, often reducing immune system function) (Stevens and Sumner, 1991).

Fungicides
Fungicides are widely used differing chemical structures and most have relatively low mammalian toxicities, and except for carbamates such as benomyl, a relatively narrow spectrum of toxicity to soil-inhabiting and aquatic organisms. Their greatest environmental impact is toxicity to soil microorganisms, but these effects are short

term (Liebich *et al*., 2003).

Others

Pyrethroid are synthetic insecticides were introduced in the 1960s and includes tetramethrin, resmethrin, fenvalerate, permethrin, lambda-cyalothrin, and deltamethrin, all used extensively in agriculture. They have very low mammalian toxicities and potent insecticidal action, are photo-stable with low volatilities, persistence and not bioaccumulate, but are very toxic to aquatic invertebrates, fish, crustaceans, and bees. Pyrethroids affect the nervous system, liver and thyroid problems and they can also interfere with the immune and endocrine systems. For that reason, EPA has established restrictions that prohibit their direct application to open water within 100 feet of lakes, streams, rivers, or bays (Estrogenic and Antiprogestagenic, 1998). Nematicides are soil nematocides, such as dichlopropene, methyl isocyanate, chloropicrin, and methyl bromide important for broad-spectrum soil fumigants. All have very high mammalian toxicities and can kill a wide range of organisms from both the plant and animal kingdoms. Although transient in soil, they may have drastic ecological effects on soil systems (WHO, 2006; Brown, 2006).

Health Effects of Pesticides

The data on environmental alongside health risk assessment studies may be regarded as an aid towards a better understanding of the problem. In developing countries, very high risk groups exposed to pesticides include production workers, formulators, sprayers, mixers, loaders and agricultural farm workers. But, there is also other groups like mammalians, fish, bees, and humans specially children and women whose live around pesticide spray or consume different agricultural product produced by applying pesticides exposed to high, moderate and less health risk as study in various researchers in developed countries of the world (WHO, 1990; Davies, 1984). The health effects of pesticides depend upon their chemical characteristics and have two effects long term (chronic) and short term (acute toxicity) effects on farmers and sprayers due to careless in handling or wear insufficient protective clothing and equipment during sprays. Pesticides are one of the five worst threats to children's health (Environmental news Forum, 1999; Rand, 1995). The other four are lead, air pollution, environmental tobacco smoke, and drinking-water contamination (Karunakaran, 1958).

Synthetic organic pesticides of their low solubility in water and their strong tendency to chemically attach to soil particles, these compounds have rarely contaminated groundwater. There is growing evidence on cancer, neurological damage (CNS- convulsions and coma), endocrine disruption and birth defects arising from exposure of pesticides (Williams *et al*., 2013). Moreover, they show numbness, tingling sensations, headache, dizziness, tremor, nausea, abdominal cramps, sweating, in coordination, blurred vision, difficulty breathing or respiratory depression, and slow heartbeat. Pesticides in general are known to affect the protein and nucleic acid metabolism (Bergen *et al*, 1974; Suhasini, l979). Very high doses may result in unconsciousness, incontinence, and convulsions or fatality of human health effects are due to:

- ✓ Skin or dermal and eye contact (handling of pesticide products),
- ✓ Inhalation through lungs or mouth(breathing of dust or spray), and
- ✓ Ingestion (pesticides consumed as a contaminant on/in food or in water) (HCN, 2004; WHO, 1990).

Pesticides Degradation Factors and Mechanisms

Basically pesticides can be degrading by four mechanisms. These are (1) chemical reactions such as hydrolysis and photolysis, (2) photochemical reactions like photosynthesis, (3) microbiological processes in soils and water like catabolism and (4) metabolism of pesticides that are ingested by organisms as part of their food supply. Many pesticides dissipate rapidly in soils by a process of mineralization and converted into simpler compounds like H_2O, CO_2, and NH_3. Soil micro biota utilizes the pesticide as a source of carbon or other nutrients. In addition, degradation rates are affects by the microbial population, environmental pH, soil moisture, and temperature (Que Hee and Sutherland 1981; Wilson *et al*., 1997).

Pesticide Management and Control

According to (Ekstrom,1994) prediction of water quality impacts of pesticides and related land management practices is an essential element of site-specific control options and for the development of generic approaches for pesticide control. Also, the key hydrological processes that control infiltration and runoff, and erosion and sediment transport, are controlling factors in the movement of pesticides. In recognition of pesticide abuse and of environmental and public health impacts the European countries have adopted a variety of measures that include the following (FAO, 1991): reduction in use of pesticides (by up to 50% in some countries), bans on certain active ingredients, revised pesticide registration criteria, training and licensing of individuals that apply pesticides, reduction of dose and improved scheduling of pesticide application to reduce spraying, testing and approval of spraying apparatus, limitations on aerial spraying, environmental tax on pesticides and promote the use of mechanical and biological alternatives to pesticides (WHO,1990).

Pesticides in Food Chains and Environments

Currently, IPM seems the most promising strategy for widespread application by vegetable farmers, as it can change farmers' perceptions, attitudes and practices in using pesticides without requiring large investments or radical transformations in management systems (Williamson *et al*., 2008; Pan, 2007). Pesticides can contaminate sediments, soil, water bodies like lake, ground water etc., turf/grass, crops, and other vegetation. Insecticides are generally the most acutely toxic class of pesticides, but herbicides can also pose risks to non-target organisms. More than 90% of water and fish samples from all streams contained one, or more often, several pesticides (Kole *et al*; 2001). When pesticides are found in water supplies, they normally are not present in high enough concentrations to cause acute health effects such as chemical burns, nausea, or convulsions. Instead, they typically occur in trace levels, and the concern is primarily for their potential for causing chronic health problems like cancer, birth defects, genetic mutations, or other problems such as damage to the liver or central nervous system (Mwevura *et al*., 2001). The main crops of the world wheat, maize and rice require insecticides and fungicides, at least once in a year whereas vegetables and fruits such as pea, tomato, onion, brinjal (eggplant), okra (lady's finger), apple, peaches, mango etc, heavy use of pesticides is practiced (Nafees and Jan, 2009).



Maize Wheat Pesticide sprays

In Russia, residues of more than ten times the allowable level were found in eggs, milk, and meat products served by public caterers and one study reported residues in 46% of tested cattle (QueHee and Sutherland 1981).

According to (Hasanuzzaman *et al*., 2016), report shows that among 30 water samples, malathion was detected in 7 water samples ranging between 42.58 - 922.8 µg/L including a tube-well water samples and according to (European Commission, 1999) the amount of seven pesticides (in apples, tomatoes, lettuce, strawberries, oranges, peaches, carrots, spinach and grapes) and 13 pesticides (in mandarins, pears, bananas, beans, and potatoes) were detected with around 5.2% in all vegetables and range from 9-69% in crops.

Table 1: health effects/symptoms of some pesticides found in the environment and food staff

Chemical name	Chronic effects	Acute toxicity*	Acute at high concentrations
Alachlor	Growth depression in laboratory animals	Moderate	
Aldicarb	None observed	High	diarrhea, nausea, vomiting, abdominal pain, profuse sweating, salivation, and blurred vision
Atrazine	None observed	Moderate	mildly irritating to skin, eyes, and upper respiratory tract
Carbofuran	None observed	High	diarrhea, nausea, vomiting, abdominal pain, profuse sweating, salivation, and blurred vision
1,2-dichloropropane	Possible liver and kidney damage	High	acute gastro intestinal distress, with congestion and edema of lungs
2,4-dichlorophenoxyacetic acid	-	-	irritating to skin, mucous membranes vomiting, headache, diarrhea, confusion bizarre or aggressive behavior muscle weakness in occupationally exposed individuals
Metolachlor	-	-	irritating to skin, eyes
Paraquat	-	-	burning in mouth, throat, chest, upper abdomen diarrhea giddiness, headache, fever, lethargy dry, cracked hands, ulceration of skin
Carbaryl (N-methyl carbamate)	-	-	muscle weakness, dizziness, sweating, headache, salivation, nausea, vomiting, abdominal pain, diarrhea nervous system depression, pulmonary edema in serious case
Endosulfan	-	-	Itching, burning, tingling of skin, Headache, dizziness, nausea, vomiting, lack of coordination, tremor, mental confusion Seizures, respiratory depression, coma
Malathion	-	-	Headache, excessive salivation and tearing, muscle twitching, nausea, diarrhea, Respiratory depression, seizures, loss of consciousness Pinpoint pupils

Sources: SCAMP computerized data base maintained by Cornell University, and Drinking Water and Health, Vol. 5, National Research Council, Washington, D.C., 1983.

**Acute toxicity ranges are in high: < 500 mg/kg, moderate: 500 - 5000 mg/kg and low: > 5000 mg/kg*

Table 2: Standard permissible values of some selected pesticides in ppb or µg/kg.

Pesticide	WHO	US(MCL)	NZ(MAV)	CANADA(MAC)	AUSTRALIA(HV)
Carbofuran	7	40	8	90	30
2.4-D	30	70	40	100	30
Lindane	2	0.2	2	-	20
Malathion	-	100	-	190	50
Simazine	2	4	2	10	20

CONCLUSION AND RECOMMENDATION

CONCLUSION

In developing countries, many government extension programs encourage farmers to use pesticides for crop protection (mainly advertising by retailers and extension officers) including Ethiopian. This approach is needed to identify alternatives, for instance in terms of good agricultural practices, integrated pest management (IPM) or organic farming. Pesticides are often considered a quick, easy, and inexpensive solution for controlling weeds and insect in urban landscapes as a result all of age, sex, race, socio-economic status, diet, state of health, etc. affect human exposure since all pesticides are potent chemicals with potential health effects in humans, animals, other living organisms, and the environment even at very low concentrations if used incorrectly. Pesticides have both short-term (acute) and long-term (chronic) effects of low level exposure to one pesticide are greatly influenced by associated exposure to other pesticides as well as to pollutants present in air, water, food and drugs. There is a need to convey the message that prevention of adverse health effects and promotion of health are profitable investments for employers and employees as a support to a sustainable development of economics. The key to reducing health hazards when using pesticides is to always limit your exposure by using personal protective clothing and equipment (PPE) and purchase or use a low-toxicity pesticide when available at shop/home. In addition reading the label, identifying their type and practicing safer work habits minimize hazards from the use of pesticides.

Therefore, to be sustainable, they will have to change from a reliance on traditional knowledge and perception (dispositional dimensions of lifestyles) and the existing system of provision via the introduction of new and safe products and the new systems of provisions to the creation of new linkages in the performance of the practices. Moreover, people who use pesticides or regularly come in contact with them must understand the relative toxicity, potential health effects, and preventative measures to reduce exposure to the products they use and look out special environmental considerations, groundwater protection, protect sensitive areas, protect non-target organisms (bees, pollinators, beneficial, fish, livestock, and wildlife, protect endangered and threatened species).

RECOMMENDATION

The importance of education and training of workers is a major vehicle to ensure safer use of pesticides, increasingly recognized and change attitudes of pesticide importer, whole sellers and extension officers to take actions on pesticide health risk assessments rather than simple advertised. Like the most important concept of integrated pest management (IPM) introduced in 1959, Ethiopia also plan effectively applicable pest management system to documenting high health expose pesticides and to take different action on them.

There is also a move toward sustainable agriculture which aims to minimize use of pesticides and fertilizers based on a systems approach instead growing concern recently on the promotion of organic farming which emphasize on techniques such as crop rotation, green manure, compost and biological methods of pest control to maintain soil productivity. Since organic farming strictly excludes the use of manufactured fertilizers, pesticides, plant growth regulators, livestock antibiotics, food additives, and genetically modified organisms.

Pesticides manufacturers should conduct long-term studies on ecosystem-wide impacts to demonstrate that a pesticide has no adverse effects before allowing it to be registered for use in the environment and EPA, FAO, and WHO also must examine their short as well as long-term health and environmental impacts of pesticides before rising to the world market. The fact that present regulations view a pesticide as innocent until proved guilty is detrimental to the environment health. So, everybody and risk takers think more on our environment pollution by long and short-term health risk pesticides and easy way of transformation in the food chains.

REFERENCES

A Centre for Science and Environment, CSE (2001); Report on the contamination of endosulfan in the villagers. New Delhi, February 21.

Akan B. Williams (2013); Residue analysis of organochlorine pesticides in water and sediments from Agboyi Creek, Lagos. African Journal of Environmental Science and Technology; 7(5), 267-273.

Aly, O. M., and Faust, S. D. (1964); Studies on the fate of 2, 4-D and ester derivatives in natural surface waters. Agric. Food Chem. 12(6), 541-546

Anju Agrawal, Ravi S. Pandey, Bechan Sharma, (2010); Water Pollution with Special Reference to Pesticide Contamination in India. *J. Water Resource and Protection* 2, 432-448.

ATSDR (2002); Toxicological Profile for DDT, DDE and DDD. Atlanta, GA: U.S. Department of Health and Human Services. *Public Health Service. Agency for Toxic Substances and Disease Registry*.

Attaran A, Maharaj R (2000); Ethical debate: doctoring malaria, badly: the global campaign to ban DDT. *Bmj*, 321:1403-1405.

Beise, S. (1992); Pesticide residues in food as a potential health hazard in 3rd world congress, food born infections and intoyications Berlin; 11:706.

Brian Taylor, (1998); Bioaccumulation and Biomagnification of Pesticides. *Bio Fact sheets*: 14:1.

Brown A (2006); Mode of action of structural pest control chemicals. Pesticide Information Leaflet (University of Maryland), 41.

Callahan, M.A., Slimak, M.W., Gabel, N.W., May, I.P., Fowler, C.P., Freed, J.R., Jennings, P., Durfee, R.L., Whitmore, F.C., Maestri, B. Mabey, W.R., Holt, B.R., and Gould, C., (1979); Water-related environmental fate of 129 priority pollutants. National Technical Information Service, Springfield, VA, I (I (EPA-440/4): 79-029.

Class T.J. (1992); Environmental analysis of cypermethrin and its degradation products after forestry applications. *Environmental Analytical Chemistry,* 49(4): 189-205.

Cycon, M., Piotrowska-Seget, Z., Kaczynska A.J., and Kozdroj J. (2006); Microbiological characteristics of a sandy loam soil exposed to tebuconazole and kcyhalothrin under laboratory conditions. *Ecotoxicology,* 15(8): 639-646.

Damte, T., and Tabor, G. (2015); Small-scale vegetable producers' perception of pests and pesticide uses in East Shewa zone, Ethiopia. International Journal of Pest Management, 61(3), 1-8.

Davies, J.E., (1984); Epidemiologic concerns for exposure assessments, Determination and assessment of pesticides exposure, New York, In: Siewierski, M., ed. *Elsevier Environmental Science*: 67-77.

DeLorenzo, M.E., Taylor, L.A., Lund, S.A., Pennington, P.L. Strozier, E.D., Fulton, M.H., (2002); Toxicity and bioconcentration potential of the agricultural pesticide endosulfan in phytoplankton and zooplankton. *Environmental Contamination and Toxicology*, 42(1): 173-81.

Edwards, C.A., (1987); The environmental impact of Alaska. PLoS ONE. 5(8): 87-92.

Ekstrom, C., ed. (1994); World Directory of Pesticide Control Organizations. Farnham, U.K.: British Crop Protection Council.

Environmental News Forum (1999); Killer environment. *Environ Health Prospect.* 107: 62.

Estrogenic and Antiprogestagenic Activities of Pyrethroid Insecticides (1998); Biochemical and Biophysical Research Communications, 251 (3), 855-859.

European Commission (2001); Monitoring of Pesticide Residues in Products of Plant Origin in the European Union, Norway and Iceland. Report 1999: 46.

FAO (1986); Prevention of Post-harvest Food losses. Rome, food and Agriculture Organization of the United Nations, 120.

FAO/WHO (1997); Pesticide residues in food-1996 evaluations. Part II-Toxicological. Geneva, World Health Organization, Joint FAO/WHO Meeting on Pesticide Residues (WHO/PCS/97.1).

Gergis, A.F. (1983); pesticide residues in meat. M. V. Sc. Thesis Fac. Vet. Med. Cairo University, Egypt.

Grin, J. (2010); Modernization processes in Dutch agriculture, 1886 to the present. In J. Grin, J. Rotmans, and J. Schot (Eds.), Transitions to sustainable development. New directions in the study of long term transformative change. New York: Routledge, 249-264.

Guo, Y., Meng, X.Z., Tang, H.L. and Zeng, E.Y., (2008); Tissue distribution of organochlorine pesticides in fish collected from the Pearl River delta, China: Implications for fishery input source and bioaccumulation. Environ. Pollut., 155: 150-156.

Gupta SK, Jani JP, Saiyed HN, Kashyap SK. (1984); Health hazards in pesticide formulators exposed to a combination of pesticides. Indian J Med Res.; 79:666.

Hasanuzzaman M., Rahman M. A. and Salam M. A. (2016); Identification and quantification of pesticide residues in water samples of DhamraiUpazila, Bangladesh. Appl Water Sci, 5.

Hashim, M.F. (2002); Pesticide residues in local processed fish products J. Egypt. Vet. Med. Ass. 62 (6c): 7-13.

Hauser R, Chen Z, Pothier L, Ryan L, Altshul L (2003a); The relationship between human semen parameters and environmental exposure to polychlorinated biphenyls and p,p'-DDE. Environmental Health Perspectives, 111: 1505-11.

Hauser R, Singh NP., Chen Z., Pothier L., Altshul L., (2003b); Lack of an association between environmental exposure to polychlorinated biphenyls and p,p'-DDE and DNA damage in human sperm measured using the neutral comet assay. Hum Reprod, 18: 2525-2533

Health Canada (1991); Dimethoate. In: Guidelines for Canadian drinking water quality supporting documents. Available at http://www.hc-sc.gc.ca/hecs-sesc/water/dwgsup.htm.

Health Canada (2014); Guidelines for Canadian drinking water quality-summary table. Water and air quality bureau, healthy environments and consumer safety branch, Health Canada, Ottawa, Ontario.

Health Council of the Netherlands, HCN (2004); Pesticides in food: assessing the risk to children*. The Hague: Health Council of the Netherlands.*

Healy, J.K. (1959); "Ascending paralysis following malathion intoxication: A case report." *Med. J. Aust.* 1:765-767.

IARC (1991). DDT and associated compounds. In IARC Monographs on the Evaluation of CarcinogenicRisks to Humans. Occupational Exposures in Insecticide Application, and Some Pesticides, Lyon, France: *World Health Organization, International Agency for Research on Cancer*, 53: 179-234.

Ibrahim, M. A., Bond, G. G., Burke, T. A., Cole, P. F., Dost, N., Enterline, P. E., Gough, M., Greenberg, R. S., Halperin, W. E., McConnell, E., Munrun, I. C., Swendberg, J. A., Zahm, S. H., and Graham, J. D., (1991); Weight of the evidence on the human carcinogenicity of 2,4-D. *Environ. Health Perspect.* 96:213-222.

IPCS (1979); DDT and its Derivatives. Environmental Health Criteria. Vol. 9. Geneva: World Health Organization, International Programme on Chemical Safety.

IPCS (1989); Dimethoate. Geneva, World Health Organization, International Programme on Chemical Safety

(Environmental Health Criteria 90).
Jan, M.R., Zahir, S., Jasmin, S., and Shazia, I., (2001); Effect of pesticides on soil microorganism. American Laboratory, 33 (24): 24-25.
Karunakaran C.O. (1958); The Kerala food poisoning. J Indian Med Assoc. 31:204.
Kateregga, E. (2012); Economic analysis of strengthening the governance of pesticide management in Uganda's agriculture sector. International Journal of Development and Sustainability, 1(2), 527
Kole RK, Banerjee H, Bhattacharyya A. (2001); Monitoring of market fish samples for Endosulfan and Hexachlorocyclohexane residues in and around Calcutta. *Bull Envirron Contam Toxicol*., 67:554-559.
Kovach J., Petzoldt, C., Degnil, J., and Tette, J., (1992); A Method to Measure the Environmental Impact of Pesticides. New York's food and life science Bulletin, Geneva. Number 139.
Liebich, J., Schäffer, A., Burauel, P. (2003); Structural and functional approach to studying pesticide side-effects on specific soil functions. Environmental Toxicology and Chemistry 22(4), 784-790.
Mahalakshmi, M.; Arabindoo, B.; Palanichamy, A.; Murugesan, V. (2007); Photocatalytic degradation of carbofuran using semiconductor oxides. *J. Hazard. Mater.,* 143 (1-2), 240-245.
Malik A, Ojha P, Singh K (2008); Levels and distribution of persistent organochlorine pesticide residues in water and sediments of Gomti River (India) - A tributary of the Ganges River. Environ. Monit. Assess. 148 (1-4): 421-435.
Mengistie, B. T., Mol, A. P. J., and Oosterveer, P. (2015); Private environmental governance in the Ethiopian pesticide supply chain. NJAS - Wageningen Journal of Life Sciences.
Mengistie, B. T., Mol, A. P. J., Oosterveer, P., and Simane, B. (2014); Information, motivation and resources: The missing elements in agricultural pesticide policy implementation in Ethiopia. International Journal of Agricultural Sustainability, 13(3), 240–256.
Mohammad S., and Seyed S.S.S., (2011). Pesticides in Agricultural Products: Analysis, Reduction, Prevention, Pesticides-Formulations, Effects and Fates. *InTech*, 307: 532-537.
Morse, R. (1989). Bee Poisoning, In the New York State Pesticide Recommendations 1989 Ed. The Chemicals-Pesticides Program, Cornell University, Ithaca, NY. 28-30.
Mwevura, H., Othman, O.C. and Mhehe, G.L. (2001); Organochlorine pesticide residues in waters from the coastal area of Dar es Salaam and their effects on aquatic biota. In: Richmond, M.D. & Francis, J. (eds) Marine science development in Tanzania and eastern Africa. Proceedings of the 20th anniversary conference on Advances in Marine Science in Tanzania. IMS/WIOMSA, Zanzibar, Tanzania. pp. 193-205.
Nafees M. and Jan M.R. (2009); Residues of cypermethrin and endosulfan in soils of Swat valley. Soil and Environmental journal of Pakistan, 28(2): 113-118
Nafees, M. (2008); Soil conservation in River Swat watershed, NWFP, Pakistan. PhD thesis, Department of Environmental Sciences, University of Peshawar.
Pan U K. (2007). IPM Research Project: Phase I Country Background Papers. http://www.pan-uk.org/archive/Projects/Obsolete/IPM%20country%20papers.pdf
Petty, C. (1958). "Organic phosphate insecticide poisoning." American Journal of Medicine 24:467-470.
QueHee, S. S., and Sutherland. R. G. (1981); The Phenoxyalkanoic Herbicides, Volume I: Chemistry, Analysis, and Environmental Pollution. CRC Press, Inc., Boca Raton, Florida. 319 pages.
Rand, G.M., (1995). Fundamentals of Aquatic Toxicology: Effects, Environmental Fate and Risk Assessment. Washington, D.C. e.d: Taylor and Francis.
Raven, P. H.; Berg, L. R.; Hassenzahl, D. M. (2008); Environment, 6th ed.; John Wiley & Sons, Inc: Hoboken, NJ.
Reigart J. R., and Roberts J. R., (2006); Recognition and Management of Pesticide Poisoning. 5th ed. U.S. EPA Offi of Pesticide Programs. Available at www.epa.gov/pesticides/safety/healthcare/handbook/handbook.htm. Accessed September 20.
Roberts DR, Laughlin LL, Hsheih P, Legters LJ (1997); DDT, global strategies, and a malaria control crisis in South America. Emerg Infect Dis 3: 295-302.
Sharma J. J, Nell Angelo, Stella Johnson, Amare Legesse, Dawit Tafesse, Shimeles Admase, Nega Gichile, Mahtot Abera And Solomon Haileyesus (2009); FDRE Ministry of Ethiopia Chemistry Student Textbook of Grade 10. New Delhi and Aster Nega publishing enterprise.
Shokrzadeh M. and Ebadi, A.G., (2006); Investigating and measurement of residues of chlorobenzilate (Organochlorine Pesticides) in four species of the most consumed fish in Caspian Sea (Iran), Pakistan Journal of Nutrition 5(1): 68-70.
Stevens, J. T., and Sumner, D. D., (1991); Herbicides. Chapter 20 in Handbook of pesticide toxicology, Vol. 3, Classes of Pesticides. W.J. Hayes, Jr. and E. R. Laws, Jr. eds. Academic Press, Inc. San Diego, California. 1576 pages.
US Environmental Protection Agency, US EPA (2006); Guidance for assessing chemical contaminant data for

use in fish advisories. Vol. 2: Risk assessment and fish consumption limits. Available at: http://www.epa.gov/ost/fishadvice/volum2/index.httml.

Wan, M.T., Szeto, S., and Price, P., (1995); Distribution of endosulfan residues in the drainage waterways of the lower Fraser Valley of British Columbia. Environmental Sciences and Health-Part B 30(3): 401-433.

WHO (1990); Public Heath Impact of Pesticides Used in Agriculture, Geneva. *J. world health organization*; 12-40.

WHO (2006); Pesticides and their application for the control of vectors and pests of public health importance. Geneva, WHO Pesticide Evaluation Scheme.

Williams AB, Ayejuyo OO, Unyimadu JP (2013); Distribution of chlorineted pesticides in shellfishes from Lagos Lagoon, Nigeria. J. Mar. Biol. Oceanogr. 2:1. http://dx.doi.org/10.4172/2324-8661.1000106.

Williamson, S., Ball, A., and Pretty, J., (2008); Trends in pesticide use and drivers for safer pest management in four African countries. Crop Protection, 27, 1327-1334.

Wilson, R. D., Geronimo, J., and Armbruster. J. A., (1997); 2,4-D dissipation in field soils after applications of 2,4-D dimethylamine salt and 2,4-D 2-ethylhexyl ester.

Wolff M (1999); Half-lives of organochlorines (OCs) in humans. Arch Environ ContamToxicol36:504.

WSSA. (1994); Herbicide hand book. Weed Society of America. Champaign, Illinois., 352.

Xue N, Zhang D, Xu X (2006); Organochlorinated pesticide multiresidues in surface sediments from Beijing, Guanting reservoir. Water Res. 40: 183-194.

Yang R, Ji G, Zhoe Q, Yaun C, Shi J (2005); Occurrence and distribution of organochlorine pesticides (HCH and DDT) in sediments collected from East China sea. Envt Intl. 31: 799-804.

Zenilda L. Cardeal, Amauri G. Souza and Leiliane C.A. Amorim (2011); Analytical Methods for Performing Pesticide Degradation Studies in Environmental Samples, Pesticides - Formulations, Effects and Fate. *InTech*, 307: 532-537.