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Prevalence of Persistent Organic Pollutants in Blantyre - Malawi

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Abstract The industrial and agricultural revolutions have led to the development of a variety of chemicals ranging from insecticides, pesticides, fungicides and bactericides. However the demand for these chemicals led the manufacturers to manufacture the chemicals without considering the sustainability of using such chemicals. During the last half of the 20th century, the global environment has become contaminated with a number of persistent and fat-soluble chemical contaminants, commonly referred to as the Persistent Organic Pollutants (POPs). These compounds generally have low water solubility, do not degrade readily in the environment, bio-accumulate in food chains, and have been linked to adverse health effects in both humans and wildlife. In order to develop appropriate strategies and institutional responses, it is pertinent to assess the prevalence of the variety of organic pollutants and the people's understanding and awareness of POPs that pose a threat to the biophysical aspect of the environment, if used or disposed of in unsupervised means. Thus, this study sought to assess the inventory of POPs, level of awareness and measures used in dealing with the chemicals in Blantyre, Malawi. The researchers used a qualitative research design. The research instruments used were a questionnaire, key-informant interviews and observations. The study focused on Ndirande peri-urban area comprising Mulanje, Thyolo, Zomba, Chiradzulu and Njuli. A random sample of sixty-four respondents was selected and a total of 64 questionnaires administered. The survey covered 5 sites that included markets, agro-dealers, hardware shops, estates and chemical companies. Descriptive statistics were obtained from key- informant interviews and observations. Findings revealed that despite the banning of POPs in Malawi as a signatory to the Stockholm Convention of 2001, the illegal usage and selling of banned POPs was rampant with hardware shops, agro-dealers and vendors. The survey also revealed low level of awareness and knowledge about POPs pesticides especially among the general public in Ndirande Peri-urban. There was presence of Chlordane as the most common pesticide used to control termites and was mainly sourced by the local farmers from the market vendors, hardware shops and Agro-dealers. The pesticide DDT was identified as resurfacing with its source into the country linked to Mozambican traders. The majority of the farmers cited DDT as the main pesticide used to control termites and protect crops such as maize after harvest. In addition the survey revealed the presence of a power utility with a number of obsolete transformers suspected to be contaminated with PCBs still waiting to be disposed for incineration at Blantyre West Sub-station. The researchers observed that this placed at high risk the workers at the power utility of PCBs due to lack of adequate protective wear. It was observed that children were mainly exposed through improperly disposed obsolete pesticides, insecticides and chemical containers. The study concluded that there is need for education of people to ensure their awareness of the dangers associated with the illegal pesticides usage. Integrated Pest Management was recommended as the best alternative approach in peri-urban agriculture.

Keywords: *persistent organic pollutants, DDT, chlordane, pesticides, integrated pesticides management*

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1. Introduction

During the last half of the 20th century, the global environment has become contaminated with a number of persistent, fat-soluble chemical contaminants, commonly referred to as the Persistent Organic Pollutants (POPs) [11]. Contamination of the global environment with a complex mixture of POPs resulted from deliberate discharges, applications and inadvertent formation of by-products of incomplete combustion or industrial processes. These POPs can be classified as; the organochlorine pesticides (e.g. DDT, chlordane, toxaphene), the polyhalogenated -biphenyls (PHBs; includes PCBs and PBBs), -dibenzo-p-dioxins (PHDDs; includes PCDDs), dibenzofurans (PHDFs; includes PCDFs), and the polychlorinated naphthalenes (PCNs) [1]. Other problematic persistent chemical contaminants not included in the POPs group include the organometallic compounds (organotins and methyl mercury [16]. The vast number of compounds which can be detected in tissue samples from organisms inhabiting

even remote parts of the world presents a considerable challenge to policy makers tasked with regulating industry and protecting the environment [8] [13].

Agriculture is the backbone of national economies of the Southern African Region, with at least 65% of their citizens living in urban areas and relying on agriculture [2].

Persistent organic pollutants (POPs) are defined as highly toxic compounds, persistent in the environment, able to migrate in food chains and have high bio-accumulation potential. Most recent international agreement for POPs is the Stockholm Convention which was enacted on May 22, 2001, of which Malawi is a binding party [17]. The Stockholm convention binds its parties to the elimination of production and use of persistent organic pollutions. The objectives of the convention were for protecting human health and the environment from persistent organic pollutants. Parties to the Stockholm Convention are required to develop National Implementation Plan (NIP) to demonstrate how the obligations of the convention will be implemented.

Evidence demonstrates that certain organic chemicals are persistent, bio-accumulative and toxic and that these chemicals cause long-term harm to the health of human beings and the planet's environment. Throughout the world, people and their environments are exposed on a daily basis to Persistent Organic Pollutants. As these chemicals move up the food chain they concentrate to levels that are harmful to humans, wildlife and fish.

POPs include hundreds of different organic chemical compounds with common properties such as long-term persistence, widespread diffusion in the environment and bioaccumulation in fatty tissues of living organisms. A growing body of scientific evidence associates human exposure to POPs with various health outcomes, including neurodevelopmental impairment through the disruption of the endocrine system [12]. Both humans and other organisms in the environment are exposed to Persistent Organic Pollutants (POPs), including contaminants through the dietary intake of food items. Adverse health effects associated with exposure to POPs have been observed in both high trophic level wildlife and humans. Evaluating the patterns, levels, trends, and effects of POPs in communities in Sub-Saharan countries may therefore contribute to the understanding of both the contamination of aquatic ecosystems (freshwater and marine), and the risks posed to human health.

Table 1. Selected POPs and Their Human and Environmental Effects

POP	Selected Trade Names	Human and Environmental Effects
Aldrin (insecticide)	Aldrec, Aldrex, Aldrex 30, Aldrite, Aldrosol, Altox, Compound Drinox, and Seedrin.	Aldrin is persistent and hydrophobicity, It is known to bio-concentrate. It is toxic to humans causing headache, dizziness, nausea, general malaise, and vomiting, followed by muscle twitching and convulsions. Aldrin causes liver and biliary cancer and may affect immune responses.
Chlordane (insecticide)	Aspon, Belt, Chloriandin, Chlorkil, Corodan, Dowchlor, HCS 3260, Kypchlor, M140, Niran, Octachlor, Ortho-Klor, Synklor, Toxichlor.	Chlordane is highly insoluble in water, but fairly soluble in organic solvents. It binds readily to aquatic sediments and bio-concentrates in the fat of organisms as a result of its high partition coefficient. Chlordane can stay in the soil for over 20 years and breaks down very slowly. In both humans and animals, it can damage the nervous and digestive systems. Furthermore, it may cause prostate and breast cancers.
Dichlorodiphenyl trichloroethane (DDT)	Agritan, Anofex, Chloropenothane, Citox, Dedelo, Detox, Detoxan, Dicophane, Genitox, Gesapon, Gyron, Kopsol, Mutoxin, and Pentachlorin	DDT is highly insoluble in water and is soluble in most organic solvents. It is semi-volatile and can be expected to partition into the atmosphere. Its presence is ubiquitous in the environment and residues have even been detected in the arctic. It is lipophilic and partitions readily into the fat of all living organisms and has been demonstrated to bi-concentrate and bio-magnify.
DIELDRIN (insecticide)	Alvit, Dieldrite, Dieldrix, Illoxol, Panoram, D-31Quintox.	Dieldrin binds strongly to soil particles and hence is very resistant to leaching into groundwater. Dieldrin is known to bio-concentrate in biomass It is toxic to many animals (humans included) far greater than to the original insect targets. It is also linked to breast cancer and immune, reproductive, and nervous system damage.
Polychlorinated Dioxins and Furans	Dibenzo - Dioxins	Dioxins and Furans cause birth defects; are known to accumulate in humans and wildlife. In humans, they can affect reproductive/sexual development, and damage immune system, cause thyroid and nervous systems disorders. In animals and fish, dioxin exposure to cause cancer, birth defects, liver damage, endocrine damage, and immune system suppression.
ENDRIN (insecticide)	Compound 269, Endrex, Hexadrin, Isodrin Epoxide, Mendrin, Nendrin.	Endrin can bio-concentrate in the fatty tissues, of organisms living in water, is toxic to aquatic organisms, namely fish and aquatic invertebrates. Its half-life in soil estimated at over a decade. It is poisonous to humans and primarily affects the nervous system
Hexachlorobenzene (HCB) (fungicide)	Amaticin, anticarie, bunt-cure, bunt-no-more, Co-op hexa,Granox, No bunt, Sanocide, Smut-go, Sniecotox.	HCB is very resistant to breakdown and has a high partition coefficient (K_{ow}=3.03-6.42), and is known to bio-concentrate in the fat of living organisms as a result. In humans it can cause liver disease, skin lesions, ulceration, hair loss, thyroid damage. HCB crosses the placenta to accumulate in fetal tissues and is transferred in breast milk.
Heptachlor (insecticide)	Aehepta, Agroceres, Baskalor, Drinox, Drinox H-34, Heptamak, Heptamul, Heptasol, Heptox, Soleptax,	Hectachlor binds readily to aquatic sediments and bio-concentrates in the fat of living organisms. Heptachlor is metabolized in animals to heptachlor epoxide, whose toxicity is similar to that of heptachlor, and which may also be stored in animal fat. Has a very stable structure, thus it can remain in environment for decades. Symptoms in animals include tremors and convulsions.
Mirex (insecticide)	Dechlorane, Ferriamicide, GC 1283	Mirex is listed as a persistent, accumulative, and toxic pollutant. It is transported across the placenta and can be passed from mother to child through breast milk. Most affected organ in animals is the liver.
Polychlorinated biphenyls (PCBs).	Aroclor, Pyranol, Pyroclor,Phenochlor, Pyralene, Clophen, Elaol, Kanechlor, Santotherm, Fenchlor, Apirolio,Sovol	Adverse effects are predominantly associated with higher blood concentrations. PCBs suppress the human hormonal and immune systemic. Disturb behavior and reproductive system of animals. Contribute to population declines in wildlife through toxic contamination. Are known to cause cancer and cause birth defects
Toxaphene (insecticide)	Alltex, Attac 4-2, Camphochlor, Camphoclor, Clorchem T-590, Huilex, Melipax, Motox, Phenacide, Phenatox, Texadust, Toxon 63	Exposure can cause damage to lungs, nervous system, kidneys and can be fatal. Toxaphene is highly insoluble in water, and has a half-life in soil of up to 12 years. It has been shown to bio-concentrate in aquatic organisms and is known to undergo atmospheric transport. Other cheaper and safer alternatives such as synthetic pyrethroids for insect control for public health and agriculture are preferred

2. The Major POPs

The following are some of the POPs that need to be reduced or eliminated: Dioxins, Furans, Hexachlorobenzene, Heptachlor, PCBs, Aldrin, Dieldrin, DDT, Endrin, Chlordane, Mirex and Toxaphene. Table 1 shows the human and environmental effects of these POPs. Management of POPs is a relatively new subject in Malawi, hence there is very limited information and capacity to manage POPs. Although many POPs exist, the United Nations Environment Programme (UNEP) has targeted the POPs in Table 1 for immediate action.

2.1. Legal Instruments/ Policies for Managing Chemicals in Malawi

There is no single legislation that deals specifically with chemical management in Malawi. Instead, there are various pieces of legislation, regulations and standards which address different aspects of chemical management. The legislation, regulations and standards dealing with chemical management are fragmented and uncoordinated. Below are two of the relevant legal instruments for management of chemicals in Malawi.

2.1.1. Pesticides Act 2002

Pesticides Act No 12 of 2002 provides for the importation, exportation, manufacture, distribution, storage, disposal, sales, repackaging and use of all pesticides in Malawi [9]. The Act defines a pesticide as "any substance or mixture of substances intended to be administered on animals, plants, or humans for preventing, destroying or controlling any pest and includes any substance intended for use as a plant growth regulator, defoliant, desiccant or agent for thinning fruit or preventing the premature fall of fruit, and substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport". Section 17 of the Pesticides Act stipulates that "No person shall import, manufacture or sell a pesticide, which has not been registered under this Act". It further stipulates that unregistered pesticides may be imported under an import permit issued under Section 20 for the purpose of analysis, registration or research, or under a pest emergency permit issued under Section 52 and manufactured for export in accordance with a license to manufacture issued under Section 24. This means that only those pesticides that are registered under the Act can be imported or sold without a permit. Section 34 of the Pesticides Act which is in line with the Occupational Safety, Health and Welfare Act, places the responsibility for the safety, health and welfare of employees, including providing facilities, equipment and clothing conducive to the safe handling of pesticides on the employer. Section 37 of the Pesticides Act prohibits the disposal of any pesticide container or packaging in a manner that is unduly hazardous to human or animal health or the environment or that is contrary to any written law.

Other important regulatory frameworks containing provisions for management of pesticides include the Pharmacy, Medicines and Poisons Act of 1996 (Chapter 35:01 of the laws of Malawi) implemented by the Ministry of Health and Population; the Plant Protection Act of 1957 (Chapter 64:01) implemented by the Ministry of Agriculture and Food Security in which fumigants are regulated; the Seeds Act of 1996 (Chapter 67:02) which regulates seed treatment with pesticides [14]; The Occupational Safety, Health and Welfare Act (1997) under the Ministry of Labor which deals with the safety and welfare of employees handling hazardous substances [15]; The Ministry of Finance responsible for the clearing of imports and exports of all commodities local authorities, City, Town, District Assemblies, to appropriate infrastructure for collection, categorizing, recycling and disposal of municipal waste.

2.1.2. The Environmental Management Act No. 23 of 1996

The Environment Management Act, No 23 of 1996 (EMA) which was enacted to make provision for the protection and management of the environment and the conservation and sustainable utilization of natural resources does not have a definition of "chemicals". The Act refers to chemicals indirectly by providing for the management of hazardous substances. A hazardous substance is defined as "any chemical, waste, gas or gaseous matte, medicines, drugs, plant animal or micro-organism which is injurious to human health or the environment". Section 39 contains provisions on importation and exportation of hazardous substances and states that "no person shall import or export any hazardous waste or substance, except under a permit issued by the Minister subject to such conditions as the Minister may determine, and in the case of exportation, the exporter shall, before a permit is issued, produce to the Minister written confirmation from an appropriate authority of the receiving country that the hazardous waste or substance may be exported to that country"[4].

Section 40 provides for the classification of pesticides and hazardous substances and empowers the Minister responsible for Agriculture to make rules for classifying pesticides and hazardous substances, and for determining their toxicity. The rules may make provisions requiring the registration, labeling and packaging of pesticides and hazardous substances, for measures for controlling the manufacture, importation and exportation of pesticides and hazardous substances for the distribution, storage, handling and transportation of pesticides and hazardous substances, for monitoring the impact of pesticides and hazardous substances and their residuary effect on public health, the environment and natural resources, and for restricting or banning pesticides and hazardous substances.

2.2. Problem Statement

Malawi is an agro-based economy with an estimated 62% of its population dependent on agriculture as a means of livelihood. The government is spending on average 14% (between 2008 and 2013) of the total annual budget on agriculture [7]. As a result maize yield increased from 1.3 tons/ha in 2000 to 2.1 in 2013 [3]. In that regard, contamination of the environment in Malawi and globally with a complex mixture of POPs has resulted from deliberate discharges and applications, as well as from the inadvertent formation of by-products of incomplete combustion or industrial processes.

There is no single legislation that deals specifically with chemicals management in Malawi. Instead, there are various pieces of legislation, regulations and standards which address different aspects of chemical management. However, legislation, regulations and standards dealing with chemicals management are fragmented and uncoordinated, and as such environmental challenges are perpetual.

Therefore a better understanding of the local dimensions of the prevalence of persistent organic pollutants is essential to develop appropriate institutional and local measures that will aid in raising urban and peri-urban people's understanding and awareness on POPs that pose a threat to the biophysical aspect of the environment if used or disposed of in unsupervised means.

3. Study Area

Ndirande is one of the peri-urban areas of Blantyre that lies within the Ndirande Hill terrain. Most part of Ndirande is a low income area with informal settlements and a large part of catchment base that serves the Blantyre Water Board and has a reserve water dam. The area has no dump site for waste disposal and collection services by the Blantyre City Assembly is usually not enough hence mushrooming of illegal dump sites. This could as well be related to health risks associated with burning practices that are done to get rid of the waste. The practice results into generation of some elements of furans and dioxins.

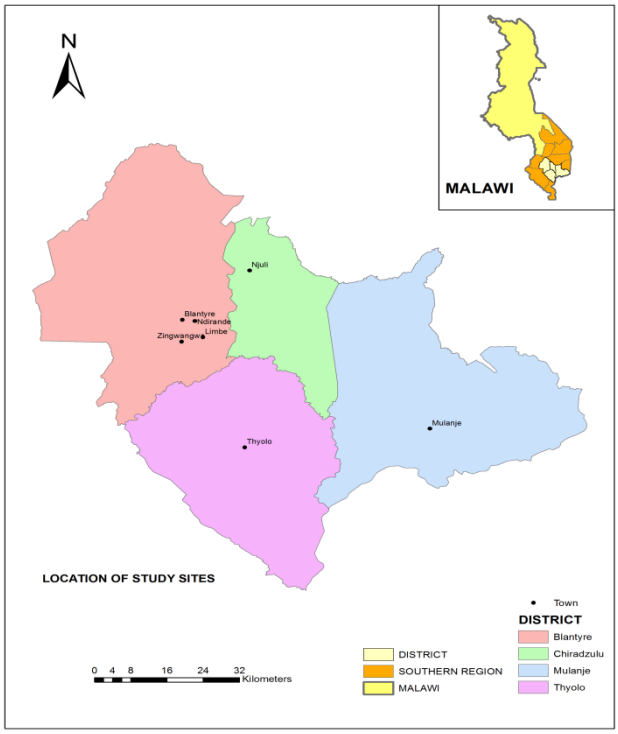

Figure 1. Map of Malawi showing study sites

The catchment base is now used illegally by most people for agriculture where people cultivate maize and other crops. This practice has seen a high increase of over use of pesticides in agricultural activities at the expense of other cleaner production options. The preceding scenarios lead to high level of POPs invading the local markets, vendors and local shops. The containers of the POPs after use are eventually thrown in rivers, dump places, or thrown anyhow, this is a case of health concern to the people including the children who collect the containers from the dump sites for secondary use.

The liberation of agricultural sector has seen many use and sale of pesticides some of which are labelled with instructions with unfamiliar languages and others are without instructions and no chemical composition as they are purported to have been repacked to suit the pocket of the consumer. Many pesticides lack instructions on application, formulations and dilutions, they lack appropriate application tools, protective wear and equipment. As a result the situation has created high chances of misuse and mismanagement of pesticides including POPs putting both the environment and people at risk.

Urban agriculture has seen a high increase in the use of POPs in crop pests, disease and weeds control. This act as natural sinks of pollutants and POPs in particular, and by virtue of their persistent nature (bioaccumulation, bio-magnifications, non-biodegradable) POPs in peri-urbans are found in their highest concentrations thereby increasing the vulnerability of people from different healthy risks. Poverty and illiteracy also contribute great chances of marginalized people being at risk from use and mismanagement of such chemicals and in particular POPs [18].

4. Materials and Methods

The survey study was carried out between April 2010 and June 2010. The sites that were visited are: Blantyre Flea Market, Bvumbwe Market, Ndirande Market, Limbe Market, selected agro-dealers in Blantyre and Limbe, hardware shops in Blantyre and Limbe, Limbe Admarc, Chemicals and Marketing Limited, ESCOM, Auction Floors, Farmers Organization Limited. Antipest, ATC, Blantyre ADD, Sable Farming, Lauderdale and Makandi Tea Estates. The site visits were scheduled for physical inspections using the designed questionnaire. A total of 64 questionnaires were administered to key informants and all questions were fully answered. Data collected was analysed using descriptive statistics.

5. Results and Discussion

The survey covered 5 sites that surround Ndirande peri-urban and some areas in Mulanje, Njuli and Thyolo.

The results have revealed the presence of Chlordane as the common pesticide used to control termites and is mainly used by the construction industry. Chlordane is mostly being sold by the market vendors, hardware shops and Agro-dealers. The survey also revealed the resurface of the DDT coming through Mozambique Border. DDT is used by individuals and farmers to control termites and protection of crops such as maize after harvest. The source from the power utility revealed that between 2003 and 2005 there were about 395,000 litres of PCB containing oil that was received in Malawi. This means that there are still more traces of PCBs in many sites in Blantyre. The power utility has a number of obsolete transformers that

are suspected to be contaminated with PCBs. These are disposed of at Blantyre West Substation (Near Green Corner) and are waiting financing in order to be shipped off to the fore-mentioned countries for incineration.

5.1. Organizations and Individuals Dealing and Handling POPs

Out of the 5 sites visited 9 vendors in Limbe Market, 3 vendors in Bvumbwe Market, 2 vendors in Blantyre Market and 6 vendors in Ndirande Market were found with a total of 212kgs of DDT and a total of 45 litres of chlordane. A total of 50 litres of Chlordane was found at Hardware Store 1. Hardware Store 2 had 1,000 litres of chlordane, At Hardware Store 3 were 65litres, Agro-dealer 1 had 120 litres while Agro-dealer 2 had 290 litres. The survey showed that hardware shops sell chlordane but they do not sell DDT. Almost all packets of DDT that were being sold in Ndirande Market had expiry date of 1977 and some packets of DDT had their packets without labels. Some packets of unknown chemicals had foreign languages. The survey showed that limited quantities of DDT and chlordane are displayed on shelves for fear of being confiscated by the Pesticides Control Board.

5.2. Users of POPs

The survey showed that most people who buy DDT are households and small-scale farmers comprised of women, men and children who cultivate near the catchment areas of Blantyre Water Board and on the edge of the Ndirande Hill. DDT is used to protect crops such as maize from termites and ants. Users of chlordane are mostly construction industries and some individuals for termite protection. PCBs are mostly used by the power utility where there are PCBs containing equipment (transformers) [5,6]. The other users of PCBs are vendors who vandalize transformers in search of oils for sell.

5.3. People at Risk

The survey showed that the Ndirande community and the surrounding community are exposed to POPs through occupational and non-occupational exposure. Exposure to POPs is due to negligence at work that results from non-compliance to occupational safety guidelines. Most residents of Ndirande use the products from improperly disposed pesticide containers that are reused for packing foods such as chips, water and thobwa (sweet beer) that are sold in markets and by road sides. Vulnerable groups include hardware shops, market vendors, industries, agro-dealers, estate workers, men, women and children.

The survey showed that women are at high risk of DDT - 40%, followed by farmers 25%, men 20% and children at 16%. Women are at the highest risk because they are the ones who cultivate in the gardens than men and they are the largest group that apply the chemicals on crops. The highest percentage of users of Chlordane was farmers and construction industries – 40%, followed by men 25%, women 20% and children 15%. Chlordane is mostly used by construction industry and farmers for protection of crops to termites. Personnel working at the power utility where there are PCBs containing equipment are at lower risk of PCBs exposure because they have at least protective wear than men, women and children. The other people at risk are men vendors who vandalize ESCOM transformers in search of oils for sell.

5.4. Wastes Containing POPs

The Blantyre City Assembly has designated sites and facilities for the management of wastes. There are no specific dump sites for wastes in Ndirande, as a result most of the wastes are dumped in rivers, forests and along the sides of roads. Many respondents said they do not have waste chemicals that are thrown away as most of these chemicals are sold.

5.5. Safety Wear

The protection offered by many organizations, businesses and individuals is in the form of gloves and work suites. Some individuals do not use safety wear because of either negligence or lack of information on the dangers of POPs another pesticides. Most estates and competent organizations afford to have all the needed protection wear. The survey showed that most of the Agro-dealers and the power utility use work suits (100%), masks and head gear (75%), goggles (10%) and aspirator (8%). All vendors interviewed do not use safety wear when selling the POPs and other chemicals. A small percentage (3%) of workers from hardware shops use safety wear when selling chemicals.

5.6. Awareness Gap

The Ndirande community comprises women and children implying that they are vulnerable to the dangers of POPs. The survey showed that the risk of POPs or pesticides contamination is mainly due to lack of awareness among the users and handling personnel. Used pesticides containers are thrown away unnecessarily and taken by labourers and the surrounding community for packing water, chips or thobwa (sweet beer) for sale; thus, putting men, women and children at risk of POPs. The survey revealed that there is very little public information, awareness and education on POPs. Most of the information about environmental integrity emphasises afforestation and climate change but POPs. Most of the handlers of pesticides said that they had never attended a formal training in chemical handling and management. Some respondents claimed they have very little information from the Pesticides Control Board as a result they are not updated with a list of banned pesticides.

5.7. Alternatives of POPS

The Malawi Government recommended the replacement of some POPs as follows:

(i) The use of aldrin, heptachlor, dieldrin and endrin has been replaced bycarbofuran, chloropyrifos and carbo-sulfan for soil pest.

(ii) Toxaphane has been replaced by amitraz for the control of ticks in livestock.

(iii) Chlordane for the control of termites and other soil pests in the tea, coffee and Tobacco Industry is being replaced by carbofuran and carbosulfan.

(iv) The use hexachlorobenzene was replaced by carbofuran and carbosulfanin the agriculture sector, while in the health sector amitraz is being used.

(v) DDT has been replaced as follows: For cotton insect pest the alternative pesticides are deltamethrin, cypermethrin, lambda-cyhalothrin, thiodicard and carbaryl. Tobacco soil pests the alternatives are carbosufuran and carbosulfan. Maize stembores and armyworms the alternatives are deltamethrin carbaryl, fenitrothion and sumicidin. Household use against mosquitoes the recommended chemicals are deltamethrin, permethrin and lambda-cyhalothrin.

6. Conclusions and Recommendations

A lot needs to be done by the Government of Malawi to ensure that all the unauthorised POPs are eradicated as a matter of urgency. The Government of Malawi and all its partners should be committed and adhere to the National Implementation Plan for 2005-2020, whose objective is to improve the optimal and most effective POPs management system while securing human health and environmental protection. The Government of Malawi to be more committed to stop the importation of the POPs. There is need for capacity building to relevant stakeholders in the process of eliminating the POPs in Malawi. The government should continue looking for other alternatives to POPs pesticides. For instance, though the Malawi Government found carbofuran and carbosulfan as alternative for Chlordane for termite protection; there is still a gap in the construction industry.

There is need to conduct comprehensive awareness workshops and consultations with stakeholders. The awareness should be through possible channels such as radio, TV, print media literature developed in Local language (Chichewa) and participatory methodologies (seminars, workshops, exchange visits, field days, and documentaries). The awareness should aim at:

(i) Raising awareness about mechanism through which obsolete pesticide stock accumulates.
(ii) Sensitizing the end-users the dangers and health risks of POPs and effect to the environment.
(iii) Orienting the end-user on the policies that govern management of chemicals.
(iv) Involvement and training of communities, local markets, pesticide merchandisers, vendors, local shopkeepers that sell pesticide, and agro-dealers dealing in pesticides.
(v) Handlers of POPs in the country should be updated on any changes to the policies on POPs and should be provided with a list of banned pesticides.
(vi) Handlers of POPs should be provided with policy documents such as, Environmental Management Act, The Pesticides Act, Control of Animal Disease Act, Water Resource Act, The Pharmacy, Medicines and Poisons Act and the Public Health Act.
(vii) The promotion of alternative pest management strategies, such as the integrated pest management (IPM) through training and awareness.
(viii) Promoting the development and involvement of communities and local NGOs in pesticide safety, health risks and other environmental issues.

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