

# THE REPUBLIC OF UGANDA



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## The effect of industrial chemicals on biodiversity and human health: A case study of DDT in Kanungu district, Uganda.

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## **1.0 Uganda's Background Information**

### **1.1 Physical, Demographic and Climatic Description**

Uganda is a land locked country with an area of 241,500 km<sup>2</sup> lying astride the equator. It is located in the Eastern Region of Africa, situated between latitudes 1° 30' South and 4° North and longitudes 29° 30' East and 35° West. The country is bordered by the Republic of Kenya to the East, Tanzania and Rwanda to the South, the Democratic Republic of Congo (former Zaire) to the West and Sudan to the North. Of the total area coverage of 241,500 sq. km, about 15.3% is open water, 3.0% permanent wetlands and 9.4% seasonal wetlands.

Though situated on the Equator, altitude, relief and many large water bodies moderate the tropical climate. The country experiences only two dry seasons (December-February and June-August) with a semiarid climate in the Northeast. Temperatures average 21°C ranging between 16°C to 27°C. Annual rainfall varies from 500mm in the East to 2000mm around Lake Victoria and the mountains. Rainfall is moderately reliable, is bimodal in the South and unimodal moving towards the Northern border. Generally, the country's climate is classified as humid with a steady sunshine regime all year round, only modified by cloud cover during rainy seasons.

The main topographical features of the country include the high plateau modified by eroded volcanic mountains in the North Eastern and Western borderlands. The Rwenzori and Mufumbira volcanic mountains are part of the Western Rift Valley, which continues up to Tanzania.

The drainage system is dominated by the Lake Victoria basin whose only outlet at Owen falls dam marks the beginning of the River Nile journey to Egypt, through Lakes Kyoga and Albert. Other smaller lakes include Lake George, and Edward. Notable rivers are Kagera, Katonga, Kafu, Mpanga and Mubuku, which form part of the intricate drainage systems in the country. Open water covers 15 per cent of the total area of the country while wetlands cover another 13 per cent.

### **1.2 Form of Government**

Uganda is a Republic that got her independence on 9<sup>th</sup> October 1962. It is governed under the Multi Party System with the National Resistance Movement (NRM) headed by His Excellency, Yoweri Kaguta Museveni as the ruling party. The executive power is vested in the president while legislative power rests with a legislature of more than 300 Members of Parliament serving a five-year term at national level. In addition, the country operates a local government system comprising of local government councils and Kampala is the capital city.

### **1.3 Language**

English is the official language. While English the official national language taught in grade schools, used in courts of law, used by most newspapers and some radio broadcasts, there are other local languages. These include Luganda which is most widely used by Bantu speakers and is preferred for native language publications in the urban

areas and it is taught in schools as well. Other languages include Lusoga 8%; Luo 12%; Runyankore/Rutoro/Rukiga 9% and Swahili 10%.

#### **1.4 Ethnic Groups**

Uganda's population is made up of a number of ethnic groups. The largest being the Baganda at 17%, Karamojong at 12%, Basoga at 8%, Iteso at 8%, Langi at 6%, Banyankore at 6%, Bagisu at 5%, Acholi at 4%, Lugbara at 4%, Banyoro at 3%, Batoro at 3%, non-African (Europeans, Asians, Arabs) at 1%, and others at 23%.

#### **1.5 Religion**

Uganda is predominantly a Christian country, comprising of the following major groupings: Roman Catholic 33%; Protestant 33%; Muslim 16%; indigenous beliefs 18%.

#### **1.6 Economy**

Uganda's GDP growth rate has been estimated at 5.7% per annum for the last five years. On the sectoral basis, industrial production saw the highest rate of growth averaging between 10.4% per annum between 1990/91 and 2002.03 as a whole. According to labour force by occupation, agriculture constitutes 82%, industry at 5% and other services at 15%. The population below poverty line is estimated at 13.58 Million.

#### **1.7 Population**

Uganda's population is currently estimated at 27 million with a growth rate of 3.4%. Of the total population, about 85% live in the rural areas. The urbanization rate is at 14.4% and life expectancy is estimated at 50-78 years for men and 52-73 years for women. The fertility rate has stagnated at 6.9%. Adult literacy rates are at 45% for women and 70% for men. It is estimated that in 2018, Uganda will have a population of 36.4 million people.

The population is typically young, showing larger proportions in the younger age groups. Uganda has a typical broad-base population pyramid characteristic of least developed countries (LDCs), which signifies high fertility and mortality rates. The population dynamics have been constant over the years, and the shape has not altered. About 47% of the country's population is still under 15 years of age and there are more females than males. With total fertility rate (TFR), Uganda has remained high and steady, averaging 7.1 (Population Reference Bureau, 1991) children per woman as compared to Kenya (6.7), Democratic Republic of Congo (6.1) and Sudan (6.4).

#### **1.8 Urban and Rural Population**

Settlement patterns and distribution in both rural and urban areas have been influenced by history, infrastructure, landforms, productivity of land, climate, vegetation, water supply, and presence of disease agents, land tenure systems and economic activities among others.

The majority of the population of Uganda estimated at 85% live in the rural areas; however the percentage distribution of rural areas varies by district. The urban population presently is estimated at 15% of which the majority live in Kampala district. The least

urbanized districts are Pallisa, Ntungamo and the newly created districts. Kampala is the most urbanized district (100%) because of its status as the capital city.

## **2.0 An overview chemical production, use and management in Uganda**

Chemicals refer to substances obtained by chemistry with the help of a chemist. Chemicals in Uganda have been seen in the form of petrochemicals, fertilisers, pesticides, industrial chemicals, synthetic organic cosmetics, pharmaceuticals, solvents, and natural-synthetic (rubber etc) among others. Overtime in Uganda, an extensive array of chemical substances, which never existed in the environment, and for which the environment can not provide natural conditions to cause their degradation or break down, now predominates in the name of development. Chemicals in Uganda are mostly used in the agriculture sector, health sector, energy and mining sector, water supply and sanitation sector, academic and research sectors and most importantly, the industry sector. Data and information on chemical production, import, export and use in Uganda is not comprehensive and is lacking in a number of aspects.

### **2.1 Industrial chemicals**

Industrial chemicals have become common in many economical activities and are increasingly used in almost all the sectors of Ugandan societies. The production of chemicals in Uganda is still minimal, and account for less than 2% of the total amount available within the country. Most chemicals used in Uganda are imported. The major suppliers of chemicals to Uganda include Israel, Kenya, China, South Africa, India and Arab-Gulf Countries among others. Distribution of industries in all parts of the country is being encouraged by the government. Uganda does not export chemicals but it is only used as a transit country to transport large quantities of chemicals through to neighbouring countries such as Sudan, Congo and Rwanda. However, there is also a likelihood that re-exporting some chemicals illegally.

### **2.2 Pesticides**

Pesticides are chemicals used for destruction of an organism that is detrimental to man or any of his interest. Most of the pesticides used in Uganda have been classified as; - insecticides that kill insects, acaricides that kill mites, molluscides that kill snails (molluscs), nematicides that kill nematodes (round worms), fungicides that kill fungi, rodenticides that kill rats (rodents), herbicides that kill herbaceous plants (weeds, and arboricides that kill shrubs and trees.

The common pesticides that have been used in Uganda include;- organophosphates (Bromophos, DDVP (*Dichloro dimethyl vinyl phosphate*), Diazinon, Dursban, Dimethoate, Malathion, Parathion), organochlorines (Aldrin, BHC, DDT, Dieldrin, Lindane, Thiodan, Toxaphene), Carbamates (Dithane M45, Dithane M22, Furadan), Pyrethrins/pyrethroids (Ambush CY (*Permethrin*), Ripcord (*Cypermethrin*), Decamethrin), Phenoxy Acetic Acid (2-4-D, (*Dichlorophenoxy acetic acid*), 2-4-5-T, (*Trichlorophenoxy acetic acid*), MCPA (*Monochlorophenoxy acetic acid*), Inorganic Metals (Shell copper (*copper oxide*), Lead arsenate Arsenic trioxide, Phenylmercuric Acetate) and Bipyrityls ( Grammoxone (*Paraquat*), Weedol, Diquat).

## **2.3 Institutions and Agencies managing chemicals in Uganda**

This section attempts to describe and analyze the mandates and programs of different ministries, agencies and other governmental institutions responsible for and concerned with various aspects of chemical management.

### **2.3.1 Ministry of Agriculture, Animal and Fisheries**

The Ministry of Agriculture, Animal, Industry and Fisheries mainly controls the use of pesticides in Uganda. In the management of agricultural chemicals, the Ministry's Central roles include development of relevant policies, guidelines, standards and provision of technical support supervision and resource mobilization for the districts. The local authorities are to implement activities at the local and community levels.

### **2.3.2 Agrochemicals Control Board**

This is a government agency responsible for controlling the use of agricultural chemicals in Uganda mainly for phyto-sanitary plant/ crop protection purposes. This body regulates the following categories of chemicals: Herbicides; Pesticides (e.g. Rodenticides, Insecticides, Fumigants); Fungicides; Fertilizers; Insecticides; Plant Growth regulators; Seed Treatment chemicals; Biopesticides; Chemicals for wood industry (petroleum and wood treatment); Vector control - the Board also handles chemicals for the control of epidemic pests and diseases.

### **2.3.3 National Agricultural Research Organization (NARO)**

NARO is responsible for all agricultural research in the country. The research mandate of the various institutes established is expressly spelt out and research on chemical management in Uganda can only be implied from the general provisions of the respective Statute.

### **2.3.4 Ministry of Health (MOH)**

This is responsible for health care management and policy at the national and local levels.

### **2.3.5 Ministry of Tourism, Trade and Industry**

This is the ministry that is concerned with the development of the industry sector.

### **2.3.6 The National Drug Authority (NDA)**

This is a government agency whose role is to ensure that the entire population of Uganda has access to safe, good quality and cost - effective pharmaceutical products. The National Drug Policy and Statute, 1993, mandates it to carry out this function. These functions include: Control of the importation/exportation of pharmaceutical products; Licensing of all pharmaceutical outlets in the country; Regulation of veterinary drugs and chemicals e.g. Acaricides; Regulation of chemicals for public health use such as, insecticides; rodenticides; fumigants and disinfectants.

### **2.3.7 The National Medical Stores (NMS)**

The National Medical Stores (NMS) was established by Act of Statute. NMS imports about 90% of all the drugs it handles. 10% is procured within the country. NMS handles over 350 human pharmaceutical products including chemicals for public health use and

over 100 laboratory chemicals. Its responsibility starts at the ports of entry in case of imported drugs. Drugs are then distributed to the districts and that is where the responsibility of NMS stops.

However NMS has a computerized tracking system on expiry of drugs that might occur in its stores to ensure that expired drugs or those with short shelf lives are not supplied to districts or consumers. In case of expired drugs occurring in the districts, their management is the responsibility of the district authorities.

### **2.3.8 Uganda Virus Research Institute (UVRI)**

UVRI was established as an analytical research institute. The Institute uses chemicals and reagents for purposes of diagnosis and research. Categories of chemicals include reagents, disinfectants, culture media, drugs and radioactive materials. Most chemicals are imported from well-established companies as finished products, however some are reconstituted at source. These companies provide UVRI with detailed descriptions and updates as a way of ensuring quality of chemicals delivered. All chemical consignments are accompanied by licenses from the countries of origin.

### **2.3.9 Ministry of Water and Environment**

The mandate of the Ministry is to promote and ensure the rational and sustainable utilization and development and safeguard of water resources and the environment for social and economic welfare and development as well as for regional and international peace. In Addition, the Ministry promotes the utilization of weather and climatic information for sustainable development.

### **2.3.10 The National Environment Management Authority (NEMA)**

This is a body that is concerned with the management of all issues related to environmental management and conservation.

### **2.3.11 Ministry of Internal Affairs**

Under the Ministry of Internal affairs are the Government Chemist Laboratories that provide support services for forensic analysis. Other departments under this ministry that utilize chemicals are the fire department and the explosives department.

### **2.3.12 Ministry of Energy and Mineral Resources**

This Ministry and its departments of energy development, geological survey and mines, petroleum exploration and petroleum supplies are responsible for setting and regulating the energy sector as well as the mining sectors. In particular, the geological survey and mines department is responsible for the enforcement of the provisions of the Mining Act.

### **2.3.13 Non governmental environmental organization**

The non environmental organizations play a big role of lobbying for fair chemical and waste management policies, holding the government accountable on programs regarding chemical management and the environment. Non governmental organizations carry out a lot of work ranging from advocacy, capacity building, sensitization and awareness. In Uganda the lead chemical management Non governmental organizations include;- Pro-biodiversity Conservationists in Uganda (PROBICO), the National Association of

Professional Environmentalists (NAPE), the National Union of Plantation Workers of Uganda (NUPWU), Climate and Development Initiative (CDI) and Uganda Environmental Education Forum (UEEF) among others.

#### **2.4 Some of the laws governing the management of chemicals in Uganda**

There are no inclusive laws for chemicals management in Uganda. The laws which are in place are scattered in different legislations. There are some legal instruments in place to help in the management of chemicals in Uganda but these laws/legislations do not adequately address all the chemical concerns. **These include;-** the 1995 Ugandan Constitution, the National Environment Act Cap 153, the Public Health Act 269, the Control of Agricultural Chemicals, Statute 8/1989, the National Drug Statute 1993, the National Environment Statute 1995, the Uganda National Bureau of Standards Act, the Plant Protection Act. Cap. 244 of 1964, the Protection of Animals (anaesthetics) Acts 1954/64, the National Medical Stores Act 2000, the Factories Act 2000, the Employment Decree of 1975 and the East African Community Customs Management Act 2004 among others.

There are also other regulations **such as;-** the Chemicals Regulations (Registration and Control) 1998, the Guidelines for Inspection issued by; Agrochemicals Board, Uganda National Bureau of Standards (UNBS) and the National Drug Authority ( NDA), the Modalities for safe disposal of chemicals Regulations, the National Environment (Waste Management) Regulations 1999, the Environment Impact Assessment Regulations 1998, the National Environment Standards for the discharge of Effluents onto Land or Water Regulations 1999, the Regulations on Ozone Depleting Substances, the National Environment (Minimum Standards for the Management of Soil Quality) 2001, the National Environment (Waste Management) Regulations 2001, the National Environment (Conduct and Certification of Environmental Practitioners) Regulations 2003, the Guidelines for solid waste management in Uganda 2004 and the Environmental Audit Guidelines for Uganda 2006 among others.

Due to the fragmented nature of the chemicals' laws/legislations/regulations in Uganda, it has been and is very difficult to implement and enforce them. The other factors that have been recognized have been pecuniary constraints, lack of appropriate monitoring tools and equipment, ill-motivated law enforcement personnel, inadequate penalty provisions, lack of institutional co-operation in some aspects and adequate technical personnel to handle chemical related problems. Currently, the regulation on pesticides is considered adequate and incorporates all the international techniques for the management of pesticides. Management of industrial and other chemicals is still deficient and needs to be addressed. There is therefore a need for a comprehensive legislation covering all chemicals.

#### **2.5 Uganda and International Chemical Conventions/ Agreements**

Uganda is a signatory to several international Conventions and Agreements related to the management of chemicals. These include; - the Stockholm Convention on Persistent Organic Pollutants (POPs), the Vienna Convention on the Protection of the Ozone Layer, the Montreal Protocol on substances that deplete the Ozone Layer, the Basel Convention

on the Control of Transboundary Movement of Hazardous Wastes and Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction among others. However, the National implementation of the Principles of the Agreements can not be said to be excellent.

### **3.0 DDT as a Pesticide**

Dichlorodiphenyltrichloroethane (DDT) is an organochlorine insecticide. It is a highly hydrophobic colourless crystalline solid substance (in its pure form) with a weak chemical odour and tasteless. It has good solubility in most organic solvents and animal fats, such as Benzene, chloroform, petroleum solvents, ethanol but it is practically insoluble in water.

DDT was first synthesized, for no purpose, in 1874 by a German chemist Othmar Zeidler. It remained in the shelves of the laboratory until over 60 years later (in 1939) when Dr. Paul Herman Muller discovered its chemical insecticidal potential. Muller found that DDT quickly killed flies, aphids, mosquitoes, walking sticks and Colorado potato beetles. Muller and the Geigy Corporation patented DDT in Switzerland (1940), England (1942) and U.S. (1943). Peak usage of DDT in the world occurred in 1962, when 80 million kilograms of DDT were used and 82 million kilograms produced.

The first large-scale use of DDT occurred in 1943 when 500 gallons of DDT were produced by Merck & Company and delivered to Italy to help squelch a rapidly spreading epidemic of louse-borne typhus. Later in 1943, the U.S. Army issued small tin boxes of 10 percent DDT dust to its soldiers around the world who used it to kill body lice, head lice and crab lice. Muller won the Nobel Prize in 1948 for his work on DDT.

#### **3.1 When and where was DDT used in Uganda?**

In 1959-1960, DDT indoor residual spraying (IRS) was applied at 2g/m<sup>2</sup> in homesteads and kraals in Kihhi sub county of Kanungu District just adjacent to Queen Elizabeth National Park as recommended by the World Health Organization (WHO). It is reported that within one year, the formerly hyper endemic area, Rwangaminyeto, was rendered habitable and the name was changed to Kihhi. Because of the success of this project, other areas in Kigezi were sprayed to prevent or at least reduce new infections being brought into the protected area. This option was repeated elsewhere in Uganda before independence.

#### **3.2 Why was DDT used in Uganda?**

In May 1955, the Eighth World Health Assembly adopted a Global Malaria Eradication Campaign based on the widespread use of DDT against mosquitoes and anti-malarial drugs to treat malaria and to eliminate the parasite in humans. As a result of the Campaign, malaria was eradicated by 1967 from all developed countries where the disease was endemic and large areas of tropical Asia and Latin America were freed from the risk of infection. The Malaria Eradication Campaign was only launched in three countries of tropical Africa since it was not considered feasible in the others. DDT was

thus used in Uganda to kill mosquitoes. However, it is alleged that DDT was also used in the agricultural sector.

### **3.3 Why was there a study on DDT?**

Although DDT played a vital role in eradicating malaria, it is important to note that in 1972, DDT use was banned in many countries with the first being USA. People especially the environmentalists raised eyebrows on the likely negative impact of the chemical to human health and the environment generally. Rachel Carson sounded the initial alarm against DDT when she observed its harm on birds in her book the “**Silent Spring.**”

The Swiss Scientists also discovered that DDT leads to the birth of impaired Calves whose mothers have been grazed on DDT sprayed pastures. They also found out sufficient evidence of hazards to human health and wildlife. According to them, the chemical/ pesticide could harm human health by damaging the developing brain, causing hypersensitivity, behavioural abnormalities and a suppressed immune system. It was further reported that DDT is a global pollutant, bio- magnifies in the fish species, persists in the environment and can travel long distances on air and water currents and in the bodies of migratory species. It can then cause injury to human health and the environment at locations far from where it was originally released.

It was and is alleged that DDT enters the ecosystem, it bio-accumulates in micro-organisms. In humans for example, it passes through the placenta, and appears in breast milk. It then disrupts a developing child’s brain functions and creates deficits in language skills, memory, attention, motor skills, and visual abilities. When DDT exposure is combined with malnutrition, the risk greatly increases. The US Environmental Protection Agency lists DDT as one of the carcinogens.

The background of the study on DDT dates from the resurgence of the malaria epidemic in Uganda. Malaria in Uganda has had a negative impact on human social welfare and economic development. Currently, malaria is the biggest threat to health, with most of the victims being children and pregnant mothers. At least one child in every 20-30 seconds falls a victim of malaria. The World Health Organization (WHO) estimates that between 70,000 and 110,000 children die as a direct result of malaria in Uganda each year with endemism at 95%. It has been reported to be the leading cause of morbidity and mortality rates.

Although there are measures to control malaria in Uganda such as using ITNs, IRS and improving case management among others, malaria cases are on a rise due to the fact that the health sector is under stress, there is a breakdown in malaria control efforts, presence of environmental changes favouring malaria transmission such as the increase of temperature on the earth’s surface (global warming), growing drug and insecticide resistance, and increased population movements and limited research on malaria for over 20 years. In Northern Uganda for example, the problem of Malaria is welcomed by intra-rural as well as rural-urban population movements, and population displacements as a result of Lords Resistance Army (LRA) conflict and natural disasters.

In 2006, the World Health Organization (WHO) gave a clean bill for indoor residual spraying of DDT in the fight against malaria. On hearing that, Uganda was one of the first countries to relax their bans on DDT use for indoor residual spraying (IRS) in malaria control. However, the permission triggered a hot debate the country over whereby two groups emerged with one supporting the move by WHO whereas the other group vehemently opposing the idea on the grounds that DDT is dangerous to human health and the environment.

It is from this scenario that specialized physicians from the Pathology Department, Faculty of Medicine Makerere University and Mulago Hospital Department of Medicine under the department of Medicine pioneered and conducted a study to resolve the controversy by probing the persistence of DDT in Kihhi sub county and looking for markers of diseases allegedly associated with DDT by using Nyarusiza sub county as a control area.

### **3.4 What were the objectives of this study?**

The major aim of the study was to find out whether DDT negatively affects human health and environment. This was however guided by the following specific objectives;-

- (i) To prove whether DDT persists in the environment
- (ii) To examine and establish the bio-chemical markers of diseases associated with DDT.
- (iii) To quantify the residues of DDT in human body fluids and environmental specimens.

### **3.5 When was the study conducted?**

The debate to re-introduce DDT for Malaria control in Uganda intensified in 2004. However, this study was conducted between 2005- 2006.

### **3.6 Where was the study conducted?**

The study was conducted in Kihhi Sub County (Kanungu district) and Nyarusiza sub county (Kisoro district) in the extreme end of South Western Uganda approximately 510 km from Kampala city. The study was conducted in an area (Kihhi) where DDT was sprayed and in another area (Nyarusiza) where DDT was not sprayed.

### **3.7 How was the study designed?**

The study team consisted of 9 people. The study was designed by five lead researchers with one among them acting as a core researcher. These were specialized physicians and chemists from the Pathology Department, Faculty of Medicine Makerere University (3 people) and Mulago Hospital Department of Medicine (2 people). There were also 4 assistant researchers who purposively collected the samples from the two study areas. These consisted of two researchers from the Faculty of Medicine Makerere University (MUK) and two researchers from Pro-biodiversity Conservationists in Uganda (PROBICOU).

Two Assistant researchers (one from MUK and one from PROBICOU) collected samples (plasma, urine, beans, bananas and soil) from Kihhi sub county while the other two also collected samples (plasma, urine, beans, bananas and soil) from Nyarusiza sub county. Besides collecting these types of samples, fish samples were also collected. Five fish

species were collected and these were only collected from Kihihi sub county. It is vital to note that the assistant researchers were constantly supervised by the lead researchers. The study involved reviewing the literature of the related studies and this was done by all researchers. After collecting the samples, they were handed over to the lead researchers for verification, testing, analysis, comparison and interpretation.

### 3.8 How many people were involved in the study?

The number of people differed depending on the sample to be tested. For example, on plasma samples, 150 people were randomly selected from Kihihi while 169 were selected from Nyarusiza. On urine samples, 45 people were selected from Kihihi while 44 people were selected from Nyarusiza. The study also established and probed the fecundity of men from the two study areas. On this, 42 men were used by purposively selecting 21 men from each of the two study areas. This considered the mean number of wives, the mean number of children and the mean number of grand children. This part of the study was however handled by the lead researchers and or core researcher.

### 3.9 What were the results of the study?

#### 3.9.1 Interpretation of Results by tables

**Table 1: DDT/DDE levels in Samples from Kihihi and Nyarusiza**

Area	Kihihi		Nyarusiza	
	n	DDT ppb	n	DDT ppb
Plasma	150	52.4	169	9.7
Urine	45	11.7	44	6.9
Beans	22	11.1	15	7.3
Soil	34	7.3	35	1.1
<i>Bananas</i>	<i>15</i>	<i>0</i>	<i>13</i>	<i>0</i>

**Table 2: Fecundity of sampled men from (A) Kihihi (21) and (B) Nyarusiza (21).**

Sample	A	B
Mean number of wives	1.3	1.2
Mean number of children	9	8

<i>Mean number of grand children</i>	<i>14</i>	<i>9</i>
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**Table 3: DDT/DDE in Kihihi Fish Samples**

<b>Type of Fish</b>	<b>DDT/DDE ppb</b>
<i>Clarius (Male)</i>	<i>0.00</i>
<i>Tilapia (Ngege)</i>	<i>0.12</i>
<i>Harprochomis (Njunguli)</i>	<i>3.94</i>
<i>Protopterus (Mamba)</i>	<i>4.92</i>
<i>Bagrus (Semutundu)</i>	<i>22.98</i>

**Table 4: DDT/DDE in food stuffs in Toronto, Canada (1996)**

<b>Food Code</b>	<b>Name of Food</b>	<b>DDT/DDE ppb</b>
<i>G16</i>	<i>Raw Potatoes</i>	<i>0.49</i>
<i>G18</i>	<i>Boiled unpeeled potatoes</i>	<i>0.54</i>
<i>G08</i>	<i>Celery</i>	<i>0.64</i>
<i>G04</i>	<i>Broccoli</i>	<i>2.30</i>

**Table 5: Maximum DDT found in Meat fat around the World**

<b>Country</b>	<b>Year</b>	<b>DDT ppb</b>
<i>Egypt</i>	<i>1989</i>	<i>4100</i>
<i>China</i>	<i>1990</i>	<i>4100</i>
<i>Former Soviet Union</i>	<i>1991</i>	<i>2000</i>

India	1993	7000
Spain	1994	9100

### 3.9.2 Discussion of Results

According to the lead and core researchers, the study results revealed that;-

- Clinical and laboratory examinations yielded no cancer, no neurological defects, no hormonal imbalances or abnormal levels of disease biochemical-markers (table 1)
- Harmless traces of DDT in ppb were found: 50 in blood, 12 in urine and 7 in soil (table1).
- Their results confirm persistence of DDT in man and his environment in Kihhi Nyarusiza in small harmless quantities (table 1, 3, 4, and 5).
- DDT resulting from IRS does not cause cancer, teratogenicity, mutagenicity, neurological defects or infertility in man (table 2).
- DDT persists in the different fish species but that, it does not harm them (table 3)
- Despite DDT residues in environment, its associated bad effects on food, flora and fauna were not reported or detected (table 4).
- Queen Elizabeth National Park which drains Kihhi boasts of 100 mammal species, a remarkable 606 bird species and claims the highest biodiversity rating of any game reserve in the world.
- In comparison to their findings, DDT in blood drawn from European Ministers of Health and Environment were reported to the tune of 3300 ppb which is 66 fold of that found in Kihhi and Nyarusiza people.
- DDT is found in trace levels almost all over the world (table 5)

### 3.9.3 Conclusion by lead and core researchers

From the study, all the lead and core researchers concluded that DDT as used in IRS protocol is safe, inexpensive and effective against mosquitoes/malaria and should be used for malaria control in Uganda

### 4.0 Emerging issues from the study results

It is important to note that after the interpretation of the study results, the core researcher went ahead to publicize the results. The results were even taken to the President to confirm that DDT is not harmful to both human health and the environment. At a public hearing organized by the National Environment Management Authority (NEMA) before approving the DDT Environmental Impact Assessment, the same results were also presented. This was welcomed by the pro-DDT agitators. However, the pronouncements of the study results culminated into some serious questions with some people questioning their authenticity and accuracy. The issues queried about the study results include;-

- That the researchers tested for the DDT/DDE using the same method and yet these are different.
- That the samples were collected from people who were not sick. It did not cover people who were in the hospitals and sick beds to see whether they had the alleged DDT diseases.
- The study showed that some DDT traces were found in the plasma blood samples but that they were harmless. People criticizing the results argue that the study did not determine how harmless those traces were and to which degree.
- People are inquisitive to know how DDT which was sprayed in Kihikihi went into Nyarusiza where it was not sprayed.
- The study did not investigate to know how many have died ever since the spray of DDT in Kihikihi and to determine whether they died of DDT related sicknesses.
- The study did not explain why the DDT residues in some fish species were much higher than in other fish species. They also argue that the study did not establish whether the presence of DDT in the Kihikihi fish has any effect on their population.
- The study population is queried to be small compared to the number of people in Kihikihi and Nyarusiza. This therefore does not guarantee the researchers to conclude that DDT is harmless.
- That there are alternatives to DDT in the control of malaria and that therefore DDT should not be looked at as a safe blanket.
- That, mosquitoes too have a right to co-exist with people.
- That, different studies have been carried out and the negative effects of DDT and both human health, biodiversity and the environment generally have been cited and observed. (References also appended).

### **Conclusion**

- In my personal opinion, the study incorporates all the three aspects of population, health and environment. However, there are a lot of gaps in the study. It is therefore not right for one to conclude that DDT has no harm to human health and the environment. Some studies have also noted that DDT as a single tool can not eradicate malaria. An integrated approach therefore needs to be applied. Also, all the aspects of the study indicate that DDT has a negative effect on biodiversity and human health. However, this should be established by a comprehensive study.
- Science is rapidly proving beyond any doubt that, if we are to preserve our own personal health, we must protect the natural systems that make all life on this planet possible... and that means, protecting the health of ecosystems and individual species around the globe.

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