

## Commercial Flower Farms and the Resulting Environmental Pollution Consequences in Uganda

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### Abstract

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Commercial flower growing in Uganda started picking in 1990s when the traditional cash crops like coffee and tea declined both in value and in volumes. The government encouraged this shift from traditional to non-traditional but high value crops. Flower farming is heavily dependent on fertilisers and pesticides. The objective of this article is to find out the fertilizers and pesticides used by commercial flower farms and how they affect the surface water and the general environment. Nitrogenous fertilisers and pesticides are commonly used. These contaminate soils and pollute surface water and cause eutrophication leading to anoxia hence food insecurity. They also cause human health problems including death. Many flower farms in Uganda have not followed environmental guidelines strictly in mitigating the dangers that result from their activities. Some banned chemicals like dursban, folio gold, impulse, and meltatox are still used on farms. Information from articles, bulletins, newspapers, and reports has shown that a number of chemicals and fertilisers are used on flower farms. In conclusion, there is need for government to strictly ensure that commercial flower farms adhere to environmental regulations, policies, and laws and if they cannot comply, heavy punishments, being forced to close, then law should be invoked.

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**Keywords:** pesticides, mitigation, eutrophication, commercial flower growing

### 1. Introduction

Commercial flower growing started in Uganda as far back as 1992 by the Hudda family who owned Mairye estates Gabre-Madhin and Hans de Vette ((2004), but the Hudda family had been in greenhouse farming since 1950s. When Amin nationalized all the investment owned by foreigners, it was not spared. However, in 1988, the estate was returned to owners Gabre-Madhin (2004). This type of farming is characterised by massive use of fertilisers and other agricultural chemicals specifically pesticides. In 1992, there was a shift from dependency of traditional cash crops like coffee, tea, tobacco and cotton to other crops especially flowers in the horticulture subsector. Most of the flower farms had their proprietors coming from foreign countries to Uganda. This was because the costs of labour in those countries especially Europe was higher than the cost of labour in Uganda. Commercial flower growing has made tremendous contributions to the economy of Uganda with exports valued at US\$21 million in 2002 Ellen and Hans (2004). It is also important to understand that Africans and Ugandans in particular did not cherish flowers like Europeans and other western traditions did.

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In western culture, flowers were and are still used as gift and to commemorate important festivities like Christmas, Valentine's Day, and burials. In all these important events, Ugandans never used to celebrate with exchange of flowers. With western culture taking a centre stage, some Ugandans now are using flowers in celebrating major events. This has therefore shifted the whole status quo.

Most of the commercial flower companies are located in central Uganda in the districts of Mpigi, Entebbe, Kampala and Wakiso and they are in one way or another utilizing some of the important water resources like Lake Victoria which covers a big part of those areas. Despite the economic gains that Uganda has got out of commercial flower growing, there are serious environmental concerns that must be addressed without delay especially the contamination of the surface water of Lake Victoria and other surrounding ecosystems. Water bodies are important for the livelihood of man and should be protected.

### 1.1 Objective

The main objective is to find out the pesticides and fertilisers used by commercial flower farms in Uganda. To understand measures through which pollution from these agricultural inputs can be mitigated.

## 2. Characteristics of commercial flower farms in Uganda

### 2.1 Introduction

Most commercial flower farms in Uganda occupy a relatively big piece of land and production is majorly done inside doors (Indoor system). The system uses metallic and sometimes wooden structures, cladding material (plastic cover) which lasts 5-7 years depending on care, climate and the type. When the quality of these plastic films deteriorate, they are always removed and disposed of to the environment and sometimes, they are burnt releasing gases into the atmosphere. The average size of most of these commercial farms is about 47 hectares IFPRI survey (2003)

Fertilisers and chemical usage. All commercial flower farms use a range of agricultural chemicals ranging from inorganic fertilisers to pesticides. These fertilisers and other chemicals later find their way into surface water bodies where they cause eutrophication affecting fish due to hypoxia. This is also common in Lake Victoria and other surrounding surface waters.

**Table 1: Chemicals used on flower farms in Uganda in 2008**

Product name	Active Ingredient/WHO class	Type
Chlorine products	calcium hypochlorite	Disinfectant/fungicide
Pyrinex	chlorpyrifos/WHO II	Insecticide
Cypermethrin 5%	cypermethrin/WHO II	Insecticide
Dimethoate	dimethoate/WHO II	Insecticide
Endosulfan	endosulfan/WHO II	Insecticide
DiurexSC	diuron/WHO U	Herbicide
Mancozeb	mancozeb/WHO U	Fungicide
Divipan	dichlorvos/WHO Ib	Insecticide/Acaricide
Nimrod	bupirimate/WHO U	Fungicide
Thiovit	Sulphur/WHO U	Fungicide
Amitraz	amitraz/WHO III	Acaricide/Insecticide
Aqua Right	4-indol-3-ylbutyric acid	Plant growth regulator
Agral 90; BB5; Biofilm	various	Stickers, adjuvants
Celsure C	Acid copper chromate	Wood preservative
Florissant	aluminum sulphate	Post-harvest flower treatment
Glyphogan	Glyphosate/WHO U	Herbicide
Hortisan	quaternary salts	Fungicide
Sapro	Triforine/WHO U	Fungicide
Polytrin P446	Cypermethrin+profenofos/WHO II	Insecticide

Source: African horticulture bulletin, 2008, p.2

Some chemicals do not only contaminate water but are even dangerous to humans, insects like bees hence reduced pollination and lower yields in farmers' crops in the surrounding area (African horticulture bulletin, 2008, p.3).

**Table 2: Chemicals used on commercial flower farms in Uganda in 2012**

Common name	Active Ingredient	Hazard phrase
Verita	Fenamidone+(An imidazole) (S)-1-anilino-4-methyl-2-methylthio-4-phenylimidazolin-5-one;Fosetyl-Aluminium(Anorganophosphate) Aluminum tris (ethyl phosphate)	Slightly toxic. Unlikely to be hazardous to man (WHO) Toxic to fish, shrimp and oysters and to aquatic invertebrates Some laboratory feeding animal studies indicate that fosetyl-AI has a slight degenerative effect on the testes of dogs and shows evidence of cancer effects(urinary bladder tumors) in male rats, when these test animals are fed high doses of the pesticide
Equation pro	n-butanol 30%+(An Alkane) Bupirimate 25%+(A pyrimidine) Famaxodone3-anilino-5-methyl-5-(4-phenoxyphenyl)-1,3-oxazolidine-2,4-dione.	Slightly hazardous. WHO clarification III. Famoxadone has low acute toxicity when administered by oral, dermal and inhalation routes; no genotoxic potential; and is unlikely to pose a carcinogenic risk to humans. It is relatively non- toxic to terrestrial wildlife, but highly toxic to fresh water fish and aquatic invertebrates. Irritating to respiratory system
Aliette Flash WG 80	Ethyl hydrogen phosphate Fosetyl-al also called(Aluminum tris phosphate) An organophosphate	Slightly toxic. Unlikely to be hazardous (WHO) Does not pose risk to birds or fish and does not adversely affect aquatic plants. Avoid breathing dust. Avoid contact with skin, eyes, and clothing.
Scala	Pyrimethanil (an anilnopyrimidine) 4,6-dimethyl-N-phenyl-2-pirimidamine	If swallowed, do not induce vomiting unless to do so by a physician Possible human carcinogen.
Ammonium phosphole	Sec-butyl ammonium phosphate	Toxic to humans, including carcinogenicity, reproductive and developmental toxicity, neurotoxicity and acute toxicity
Apollo	Clofentezine (A tetrazine) 3,6-bis(2-chlorophenyl)-1,2,4,5-tetrazine	Clofentezine has low acute oral toxicity in all species tested. Possible carcinogen(US-EPA).Suspected endocrine disruptor (US-EPA)Skin and eye irritant
Dyname	m-Xylylenediamine (M-XDA) (A diamino xylene) 1,3-Bis (aminomethyl) benzene	Exposure routes: inhalation, skin absorption, ingestion, skin and/ or eye contact. Corrosive. Causes eye and skin burns. Harmful if inhaled. May be harmful if swallowed or absorbed through the skin. May cause severe respiratory tract irritation with possible burns. May cause severe digestive tract irritation with possible burns
Flint	Trifloxystrobin A Beta-methoxyacryl ester) Benzeneacetic acid, (E,E)alpha-(methoxyimino)-2-[[[1-[3-(trifluoromethyl)phenyl]ethylidene]amino]Oxy]methyl]-, methylester	Classified (US-EPA) as a "not a likely human carcinogen". Sub-chronic and chronic toxicity studies demonstrated that the primary effects of trifloxystrobin occur in the liver and kidneys, at high doses
Previcur Flex	Propamocarb hydrochloride.(A carbamate). Propyl [3-(dimethylamino)propyl] carbamate hydrochloride	Acute oral toxicity category III Acute dermal toxicity category III Acute inhalation toxicity category IV
Nissorum	Hexythiazox (A thiazolidine) (4RS,5RS) 15-(4-chlorophenyl)-N-cyclohexyl-4-methyl-2-	No harmful effects are expected if the precautions are followed Inhalation: High vapour concentrations – irritating to the eyes and respiratory tract, may cause

	oxo-1,3-thiazolidine-3-carboxamide.	headaches and dizziness, and may have other central nervous system effects, irritates the skin. Prolonged contact with the concentrate can cause defatting of the skin and may result in dermatitis
Folio Gold	Metalxyl-M Concentration(% w/w):3.0 Methyl N-(2, 6-xylyl-D-alaninate and chlorothalonil concentration(%w/w). (a polychlorinated aromatic) 2,4,5,6-tetrachloroisophthalonitrile	Harmful by inhalation. Irritating to eyes, respiratory system and skin. May cause sensitisation by skin contact. Limited effect of carcinogenic effect. Very toxic to aquatic organisms may cause long term adverse effects in the aquatic environment.
Collis	Indoxacarb (An oxadiazine) Methyl (S)-N-(7-chloro-2,3,4a,5-tetrahydro-4a-(methoxycarbonyl) indeno [1,2e][1,3,4]oxadiazin-2-ylcarbonyl]-4-(trifluoromethoxy) crbanilate	Harmful if swallowed. Causes moderate eye irritation. Harmful if absorbed through the skin. Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling Harmful if inhaled. Avoid breathing (dust, vapour or spray mist). Remove contaminated clothing and wash clothing before reuse
Impulse	Chlorpyrifos or Dursban (An organophosphate) O,O diethyl O-3,5,6-trichloripyrudin-2-yl phosphorothioate	Potential for both acute toxicity at large amounts and neurological effects in fetuses and children even at very small amounts. For acute effects, chlorpyrifos classified as being moderately toxic. Highly toxic to amphibians Very toxic for aquaculture
Biodewcon	The fungus ( <i>Ampelomycesquisqualis</i> )	A bio-pesticide, derived from micro-organism (bacteria, fungus, viruses) and natural enemies of pests (parasitoids, predators, and pathogens)
Biophos	dipotassium phosphate; dipotassiumphosphonate.(A biologically activated phosphate 210iarrhea210r system,which works with nature to efficiently deliver minerals toplants through	Hazardous to humans & domestic animals.Harmful if inhaled or absorbed through skin.Causes moderate eye irritation. Avoid contact with eyes, skin, or clothing. Avoid breathing spraymist. Wash thoroughly with soap and water after handling.
Biopotash	An eco-friendly liquid biological formulation containing bacteria, <i>Frateuriaaurentia</i> which remains around the seed or seedlings. Parasporal crystalcontaining Delta-endotoxin.	Safe to mammals, man, non-target parasites and predators, insects, hydrobionts, fish, and birds, Classified as, low hazardous pesticide.
Nimrod	Bupirimate. (A pyrimidine) 5-butyl-2-ethylamino-6-methylpyrimidin-4-yl dimethylsulfamate	Low toxicity to mammals. Eye and skin irritant. Skin – Bupirimate mild irritant, moderate skin sensitizer Not mutagenic or teratogenic (i.e. does not cause cancer or reproductive problems).If swallowed – Nausea, dizziness, diarrhoea, central nervous system depression, nose andthroat irritation. If uncoordinated, vomit may enter lungs causing complications. On skin – repeated and prolonged exposure maycause allergenic contact dermatitis. N-butanolcan be absorbed through the skin giving symptoms similar to ingestion above. Inhalation may lead to headache, dizziness, fatigue and possible nausea. High concentrations can produce central nervous system depression, loss of coordination, impaired judgment, and eventually unconsciousness.
Melton	Esfenvalerate – 3.5% (A pyrethroid). (S)-Hydroprene: (Ethyl(2E,4E,7S)-3,7,11-trimethyl-2,4-dodecadienoate or	Acute toxicity: moderate; It is a suspected Endocrine disruptor. Symptoms of poisoning: • Irritation of skin and eyes • Irritability to sound or touch, abnormal facial

	4-chlorophenyl)-3-methylbutyrate	Sensation, sensation of prickling, tingling or creeping on skin, numbness. •Headache, dizziness, nausea, vomiting, diarrhea, excessive salivation, fatigue. • In severe cases: fluid in the lungs and muscle twitching may develop. Seizures may occur and are more common with cyano-pyrethroids that are more toxic.
Chlorpyrifos 48%	Chlorpyrifos also called Dursban. (An organophosphate) O,O-diethyl O-3,5,6-trichloropyridin-2-yl	Potential for both acute toxicity at larger amounts and neurological effects in fetuses and children even at very small amounts. For acute effects, the US-EPA classifies chlorpyrifos as Class II: moderately toxic. Highly toxic to amphibians. Very toxic for aquaculture.
Ridomil	Mefenoxam. (A Xylylalanine) Methyl N-(methoxyacetyl)-N-(2,6-xylyl)-D-alaninate.	Causes moderate eye irritation. Harmful if inhaled or absorbed through the skin. Avoid contact with skin, eyes, or clothing. Avoid breathing dust. Wash thoroughly with soap and water after handling. Personal Protective Equipment (PPE):Applicators and other handlers must wear: - Long-sleeved shirt and long pants; Chemical resistant gloves made of any waterproof material; Shoes plus socks.
Silwet Gold (wetting)	Polyalkylene oxideSiloxanePolyalkylene oxidecopolymer	Harmful by inhalation. Irritating to eyes. Danger of serious damage to health by prolonged exposure though inhalation. Toxic to aquatic organisms, may cause long term adverse effects in the aquatic environment. Not biodegradable. Bioaccumulation potential
Meltatox	Dodemorph (A morpholine) 4-cyclododecyl-2,6-dimethylmorpholine	Dodemorph-acetate is of low oral toxicity to rats and low dermal toxicity to rabbits. It is of low toxicity to mammalian species. Dodemorph-acetate is extremely irritating to the skin, severely irritating to the eye and is a potential skin sensitiser. The target organ of dodemorph-acetate is the liver, with effects including increases in liver weights and various histopathological complications There was no evidence that dodemorph-acetate was genotoxic or evidence of carcinogenicity Dodemorph-acetate is of low risk to bees, is highly toxic to fish, aquatic invertebrates and algae.
Thiovit Jet	Elemental sulphur.	Oral toxicity: Tests on rats indicate this product has a low toxicity following single doses of undiluted product. (LD50= >5000 mg/kg); Dermal toxicity: Tests on rabbits indicate this product has a low toxicity following skin contact with undiluted product. Inhalation: Tests on rats indicate this product is not harmful due to inhalation of undiluted product.No evidence was obtained of mutagenic, carcinogenic, teratogenic neurotoxic or reproductive effects.

Source: "NAPE" (2012)

It should also be noted that this is not an exhaustive list of all pesticides that are used in flower farms in the country and that not all of the above chemicals used are allowed. Some of them do not meet International standards and others have been banned by standing protocols but they are still used either secretly or with the knowledge of authorities in the country ("Banned farm chemicals still on market", 2014). Some of the pesticides that are not supposed to be used include dursban which is considered toxic to fish and generally aquaculture. Furadan 5G is also banned but still in use. Pesticides classified as WHO 11 are very toxic. The aquatic environment especially the surface water in Lake Victoria has been affected by these pesticides and fertilisers. Their impact is not only on fish but also on the entire ecological environment.

**Table 3: Chemicals used on one of the flower farms in Uganda, April 2016**

Updated List Of Chemicals Under Use								
Trade Name	Origin	Active Ingredient	% aainUganda	Chemical group	Target	Stage+	Dosage per litre	Entry Interval (Hrs)
Secure	Holland	Chlorfenapyr	360g/l	Arylpyrrole	Mites	Adults	0.5ml	12
Bavistin	Available in Uganda	Carbendazim	50%	Benzimidazo	Botrytis, Powdery and downy mildew		100gms	12
Dimilin	Available in Uganda	Diflubenzuron	250g/l	Benzoylurea	Caterpillar	Larvae	0.5gm	12
Nomolt	Available in Uganda	Teflubenzuron	150g/l	Benzoylurea	Caterpillar, aphids	Larvae	1ml	12
Cascade	Available in Uganda	Flufenoxuron	10%	Benzoylurea	Mites	Nymphs & larvae	0.5ml	12
Match	Available in Uganda	Lufenuron	50g/l	Benzoylurea	Thrips, Caterpillar	Larvae	1.5mls	12
Methomex	Available in Uganda	Methomyl	90%	Carbamate	thrips, Leafminer, Caterpillar, eraphids, Aphids	All stages	0.4gm	24
Mesurool	Available in Uganda	Methiocarb	500g/l	Carbamate	White flies, Thrips,	Adults	1.5mls	24
Nissorun	Available in Uganda	Hexythiazox	250g/l	Carboxamide	Mites	Eggs & larvae	0.5ml	12
Daconil	Available in Uganda	Chlortalhalonil	720g/l	Chloronitrile	Fungal diseases		2ml	12
Rizolex	Available in Uganda	Tolcofos Methyl	500g/kg	Chlorophenyl	Rizoctonia, phytophthora		2gm	12
Spectrum	Available in Uganda	Immidacloprid	200g/l	Clorinicotinil	thrips, aphids, Aphids	Adults	0.5ml	12
Confidor	Available in Uganda	Immidacloprid	200g/l	Clorinicotinil	Thrips, white flies, aphids	Adults	0.6mls??	12
Rovral	Available in Uganda	Iprodione		Dicarboximade	Botrytis, Phytophthora,		2mls	12
Baraque	Available in Uganda	Etoxazole	100g/l	Diphenyloxazoline	Mites	Eggs & larvae	0.5ml	12
Dithane	Available in Uganda	Mancozeb	800g/l	Dithiocarbamate	Fungal diseases		2mls	24
Metham sodium	Available in Uganda	Metham sodium		Dithiocarbamate	Soil fumigant			24
Sugarbait	Available in Uganda			Fructose	Thrip bait		4mls	0
Floramit	Available in Uganda	Bifanazate	240g/l	Hydrazine carboxylate	Mites	nymphs & larvae, Adults	0.4ml	12
Ferramol	Available in Uganda	Ferrifosfaat	1%	Inorganic compound	Slugs	Adults	150gms / bed.	12
Abamectine	Available in Uganda	Abamectine	78	Lactonamacrocicilica	Leafminor, Mites, Thrips, White fly	Adults	0.7ml	12
Tracer	Available in Uganda	Spinosad	480g/l	Naturalyte (microorganism)	Thrips, Caterpillar	Larvae & Adults	0.3mls	12
Actara	Available in Uganda	Thiamethoxam	250g/l	Neonicotinoid	thrips, aphids	Larvae & Adults	0.5gm	12
Protect	Available in Uganda	Acetamiprid		Neonicotinoid	Thrips, aphids	Adults	0.5mls	
Regent	Available in Uganda	Fipronil		Phenyl pyrazole	Thrips, slugs, white flies	Adults	1.25mls	12
Round up	Available in Uganda	Glyphosate	360g/l	Phosphonoglycine	Herbicide		20mls	12
Indolebutyric acid	Available in Uganda	Indolebutyric acid	100%	Plant derived	Rooting hormone		1%	12
Neem oil	Available in Uganda	Azadirachita		Plant derived	White flies, Thrips, aphids, Fungicidal claim	Adults	2.5	12
Oscar	Available in Uganda	Tebufenpyrad	200g/l	Pyrazole	Mites	Nymph and Adults	0.7ml	12

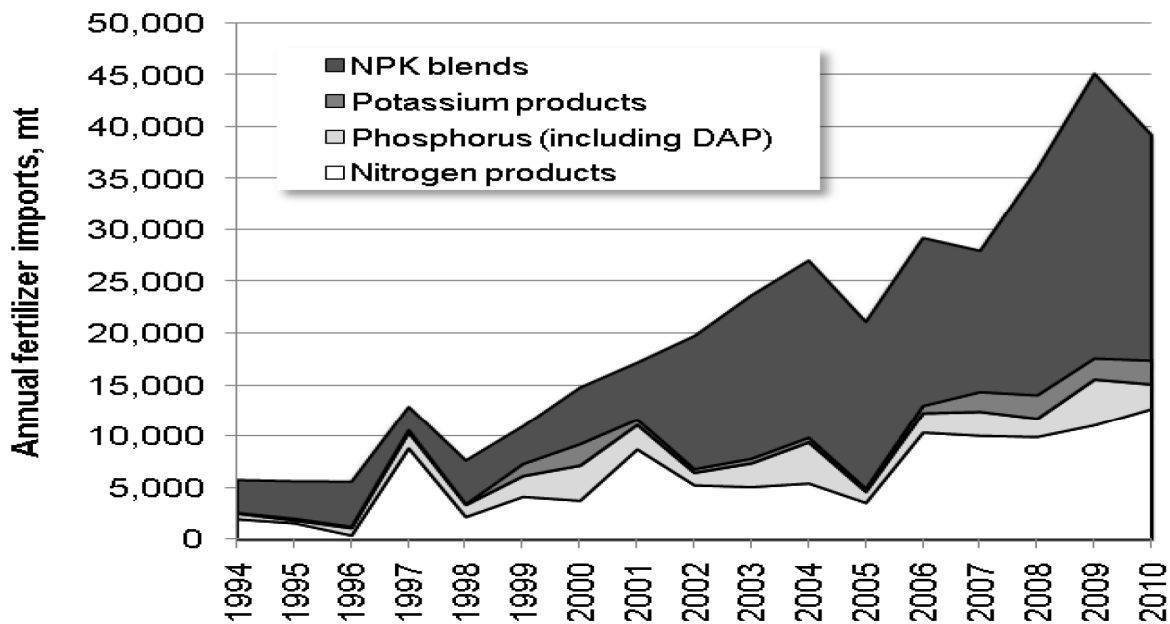
Decis	Available in Uganda	Deltamethrine	25g/l	Pyrethroid	Caterpillar, aphids , Thrips	Adults	0.5ml	12
Apollo	Available in Uganda	Clofentezine	500g/l	Tetrazine	Mites	Eggs & larvae	0.5ml	12
Envidor	Available in Uganda	Spirodiclofen	240g/l	Tetronic acid	Mites	Ad ults	0.4ml	12
Trigard	Available in Uganda	Cyromazine	100g/l	Triazine	Leafminor	Adults	0.25gm	12
Baycor	Available in Uganda	Bitertanol	300g/l	Triazol	Down and powdery mildew,Rusts		0.6ml	1
Magister	Available in Uganda	Fenazaquin	200gm/l	Un classified	Mites	Adults	0.5mls	12
B-NINE	Available in Uganda	Daminozide	850g/l	Un classified	Plant growth regulator		2gm	12
Agro-90	Available in Uganda				Chemical spreader		1 - 1.5ml	12
Othene	Available in Uganda	O S,dimethyl-acetylphosphoramidothioate	75gm/l	Organophosphate	aphids,caterpillar, Thrips	Nymphs and adults	1-1.5gms	24
Evisect	Available in Uganda	Thiocyclamoxalate	0.5g/l		aphids,caterpillar, Thrips	Nymphs and adults	0.5-0.6gm/l	16
Spectrum	Available in Uganda							
Ortiva	Available in Uganda							
Ethrel	Available in Uganda							
Belorex	Available in Uganda							
Vydate	Available in Uganda	Oxamil			Nematodes, Fungus,gnats	larvae, anymphs		
Savona	Available in Uganda	Neutral tar acid	38%				15-30Mls in 10ltrs	12

**Source: (B. Tukundane, personal communication, May 20, 2016)**

In most cases, some of these agrochemicals pesticides in particular, are used in excesses in trying to control pests and diseases. This makes even the acceptable chemicals harmful to human health and other components within the ecosystem. It is very difficult to do commercial flower farming without using fertilisers and pesticides completely but efforts to follow guidelines as in quantity can be done. Also ensuring that banned chemicals are not used can also be done. The most important is to invest in research and training of staff to come up with innovative approaches that integrate all control measures to control pests and diseases

## 2.2 Fertilizer Use in Uganda

Uganda's agriculture is characterised by a big group of small household subsistence farmers and very few farmers are practicing agriculture on a large scale. Most families/households in Uganda have farms. Family farming is characterized by a gradual but steady shift from subsistence to market-oriented farming, with most farms being small landholdings as opposed to large-scale farms. Traditional food crops that are grown for consumption, such as bananas, millet, sorghum, and potatoes, are also becoming cash crops that are sold for income (FANTA 111, 2016). Apart from commercial flower farms, there are also big farms that use fertilisers massively especially tea plantations, coffee and tobacco. Tea companies have out growers who also sometimes use not only fertilisers but also other agricultural inputs including pesticides and herbicides. The out growers who are members of tea companies get agricultural input support, directly from companies or sometimes buy for themselves from agricultural dealers in Kampala.



**Fig 1: Total annual fertilizer imports for Uganda, 1994–2010**

**Source:** Uganda Revenue Authority import database.

Note: DAP, diammonium phosphate; mt, metric ton; NPK, nitrogen phosphorus potassium.

It is now evident that there is a growing trend and demand from farms and farmers to use these inorganic fertilisers due to the need to boost production and increase productivity. The most serious environmental challenge for this farming practice is monoculture where by one crop is grown for a long period of time. In addition, there is over reliance on inorganic chemicals for a long time which destroys the physical, chemical, and biological components of soil.



**Table 4: Types of fertilisers and pesticides used by different companies.**

Farm and fertilizers applied	Quantity mixed in 1000–2000 liters of water
<b>MAIRYE flower farm</b>	
<i>Macroelements</i>	
Calcium nitrate	600 g
Potassium nitrate	350 g
Magnesium sulfate	350 g
Ammonium phosphate	150 g
Monopotassium phosphate	150 g
<i>Microelements</i>	
Iron	10 g
Zinc	5 g
Manganese	5 g
Boran	5 g
<b>PEARL flower farm</b>	
<i>Macroelements</i>	
Calcium nitrate	86 Kg
Potassium nitrate	77 Kg
Magnesium nitrate	27 Kg
Monopotassium phosphate	30 Kg
Urea	29 Kg
Microfeed	2.2 Kg
Librel	3.4 Kg
<i>Trait-elements</i>	
Nitric acid	15 Kg
Phosphoric acid	12 Kg
Zinc sulphate	0.2 Kg
Borate	0.2 Kg
<b>FIDUGA flower farm</b>	
<i>Macroelements</i>	
Lime	25 Kg
TSP (triple super phosphate)	2.5 Kg
Calcium Nitrate	3.5 Kg
N-P-K ( 12-10-18)	3.5 Kg
Magnesium sulfate	150 Kg

Source: (B. Tukundane, personal communication, May 20, 2016)

### 2.3 Commercial flower farms in Uganda

Uganda has most of the flower farms located in Central region in the Districts of Wakiso, Entebbe, and Mukono. This is because of the proximity to Entebbe International Airport of course, for easy transport of flowers. Lake Victoria is also in the same area and it supplies abundant water needed in production operations.

**Table 5: Some of the commercial flower farms in Uganda**

Name of the farm	Location	Hectares
Aurum Roses Ltd	Kawuku 16 km off Entebbe road	
African Agro Industries	NamulandaKatabi, Entebbe road	6.5
Fridge Uganda Ltd	Nsimbe estate, 20 km along masaka road	18
Jambo Roses	Buswa village SisaWakiso	12
JP Cuttings Ltd	Off Garuga Road, off Entebbe Rd, Wakiso	10
Kajjansi Roses	Kajjansi, Entebbe road, 13 km from Kampala	10
Melissa Flowers Ltd	Bwerenga, Katabi, Entebbe road Wakiso	11
Mairyte Estates Limited	Kiwenda town, NtindaVillage, Gayaza-Zirobwe Road	19
Oasis Nursery Ltd	Kyungu, Mukono, 25 kms from Kampala	11
Pearl Flowers Ltd	Two sites at Temangalo, Gayaza, Wakiso District and Ntungamo	12.9
Rosebud Ltd (now defunct)	Two locations at Rosebud I Namulanda, Rosebud II Bunono(Ab)	36
Royal Van Zanten Ltd	123 Hectares at Namaiba, off Nkokonjeru Rd Mukono district	9.5
Uganda Hortec Limited	Lugazi	10
Ugarose Flowers Ltd	NamulandaKatabi, Entebbe, 22 kms from Kampala.	12
Wagagai Ltd	Nkumba six km off Entebbe to Kampala Rd	
Xclusive Cuttings	Located 36kms from Kampala on Gayaza, Zirobwe Rd, WakisoD	50

Adapted from NAPE 2012

### 3. Exposure of agricultural chemicals to environment

#### 3.1 Workers health

In Uganda, the flower industry employs approximately 10000 people (Katula, 2014) and these are mostly women of reproductive age group. Although women do not involve themselves in spraying, they get exposed to chemical residues through cutting of flowers, poor protection from the greenhouses and delaying in greenhouses when spraying is ongoing especially during peak harvest periods and when workers are few on certain occasions.

Most commercial flower farms have spraying teams that routinely does the work in different greenhouses. Because spraying needs a lot of energy and experience, most workers cannot manage it and it is therefore left to the male youth and some other energetic old people. The most intriguing challenge is that this is always a small team that is supposed to do work almost on a daily basis depending on the size of the farm. They barely rest and sometimes, they have got to extend beyond the normal time of work in order to be able to accomplish the day's tasks. In addition, some flower farms do not strictly adhere to protection standards that are supposed to be given to this group of workers. It is something that can easily be seen on some farms where workers are using old, torn gears with chemicals splashing around their body parts and face as they spray. Also some workers do not like to use these protective equipments because of the discomfort they pose to breathing, movement and the general hot environment in most of the greenhouses. They hence decide to do work either without them or with few like gum boots and eye goggle leaving the protective gear incomplete. When the respiratory mask is left out, chances are high that the worker will inhale the chemical and this could affect his performance and health at and after the job. These poor conditions and widespread exposure to pesticides give rise to a range of adverse health effects, both acute poisoning and chronic impacts.

Symptoms of acute poisoning such as headaches, skin rashes, respiratory difficulties, eye problems, nausea, sores inside and around the mouth and even miscarriages are frequently identified by workers. Some other women experience most instances of ill-health will not reach the public eye, but occasional instances are reported (Pesticide news bulletin 2008). Therefore, the situation could be more worrying and most of the things go unreported since some of these farms have got security to stop media and other groups from accessing their farms. Sometimes, the flower farm leadership has got illegal security operatives to harass workers, chase away people, and do all sorts of illegal activities. These are some of the areas that the government should intervene and find out ways how to stop such illegal acts. At times, workers especially women have been chased from work because of complaining that they are overworked or they are sick.

This is a total violation of human rights. In some instances, sexual harassment has also been reported. This is because of poor ways women dress, drug abuse, low salaries which make women vulnerable to accept small favours, poor education, lack of training on sexual harassment and poor laws and policies.

Another factor is the cultural upbringing of Ugandan women, which muzzles them not to speak out on these issues and a culture which socialises women to do whatever a man says. Many men also consider sexual harassment as normal (Musyimi, 2016). As a result, many victims have contracted sexually transmitted infections through rape and forced sex, marriages have been broken and victims have left their jobs. Other abuses are sexual jokes, remarks or behaviour, sexual aggression with threats of reprisals, display of sexually explicit and offensive pictures, unwanted physical contact, and advances in greenhouses supervised by men. This puts the whole situation at flower farms in a mess.



(a)

(b)

**Figure 1: Workers in the greenhouse without protection from chemicals (Muziransa, 2011)**

In figure 1a, a worker handles chemicals without any protection while in b, workers bend thorny roses without gloves putting their lives at risk.

**Table 6: Summary of studies on flower workers health in different countries**

Country	Diagnosed disorders, symptoms and comments from workers	Period
Uganda	Headache, unconsciousness, dizziness, general weakness, fatigue, nausea, vomiting, skin rashes, excessive sweating, blurred vision, chest pain, watery eyes, runny stuffy itchy nose, depression, nervousness, muscle twitching, breathing difficulties, asthma, coma and death	2011
Columbia	strong headaches, nausea, swelling, rashes, diarrhea, sores inside and around the mouth, skin lesions, allergies, respiratory problems, fainting spells, headaches, eye problems and chronic asthma, as well as congenital malformations	2003
Ecuador	Inflamed throat, cough, fatigue, headaches, and personality changes. This was observed on a 16 year old sprayer operator who worked for 6 months	X
Costa Rica	Headaches, eye problems, and nausea. 50% of the respondents	X
Mexico	Allergies, skin rashes and headaches and these 8 men complained of spraying more than twice a day. 22 women participated in the study and were found to have acute poisoning, occasional cephalaea, skin and mucosa irritations, and nausea.	1999
Denmark	Respiratory disorders, sensitization to allergens, vomiting, skin reactions, loss of sensation, asthma, asthma-like syndrome, mucous membrane irritation, chronic bronchitis and dermatitis. Sperm concentration and time to pregnancy problems, fainting, musculoskeletal and neurobehavioral disorders, carcinogenicity	1992
Italy	A study of the genotoxicity of pesticide exposure on flower greenhouse workers in found that DNA adduct formation(chemical complexes between potential carcinogens) in the white blood cells was significantly higher in flower workers than in the control. A specific adduct pattern, with up to six different spots, was observed in 60% of the flower workers, which may represent an early stage of carcinogenesis	2001

**Source:** Pesticide New Bulletin, Dec 2008

### 3.2 Water bodies

As earlier said, most of these commercial flower farms are located in central Uganda near the shores of Lake Victoria. The possibility of the chemical reaching the waters in the lake is very high especially in situations where poor handling may occur. This exposes the lake to let in serious chemical contaminants after run off that are not only dangerous to fish but also other forms of aquatic life (Pesticide news bulletin, 2008). Fertilisers containing nitrogen and phosphorus also mineralise the water body creating biochemical oxygen demand (BOD) as a result of eutrophication. This generally kills fish and other organisms. Sometimes, fish may not necessarily die but may end up shifting to look for other breeding grounds within the lake ecosystem and this affects the food security and general livelihood of people in the area (New Vision, Uganda's leading daily 23rd April 2013)



**Figure 2: Algal growth at a flower farm near Lake Victoria**

c) Other beneficial organisms like bees are also affected by chemicals particularly pesticides which are sprayed on flowers (NAPE report, June 2012)

Most broad spectrum pesticides will kill even non targeted organisms both in soil and in water causing a serious impact on the ecosystem. In addition, it may end up creating pesticide resistance forcing farmers to switch to other more toxic chemicals.

**3.3 Pesticides use and protection from pesticides in areas around the flower farms and Uganda as a whole.**

Generally, Ugandans have low knowledge about the use of pesticides, its effects and handling (Anna et al., 2014). It is therefore common to find farmers spraying pesticides and other chemicals used in agriculture with no protection at all. Some people even eat while spraying in their gardens. This calls for more sensitisation on the government side to carry trainings through the ministry of Agriculture to the farmers and the general population.



**Figure 3: Farmers spraying with no protective gears**banda.R (personal communication May 20, 2016)

In addition, farmers are not aware of the consequences resulting from pesticides spilling in surface water. A country dominated by small holder farmers who cultivate during rains should be well sensitised about pollution and its effects on the environment. A big portion of these small holder farmers cultivate their crops at the banks of rivers making chemicals reach the water bodies during rainy seasons.

### 3.4 Policies and agencies in place to regulate on environment

There are a number of policies that are meant to regulate not only use of pesticides on commercial flower farms and other agricultural farms but generally on the environment as a whole. There are also a number of environmental monitoring watchdogs and agencies in the country ranging from local, regional, national, and international levels. The most challenging question therefore remains what has all these policies, agencies and organisations done?

**Table 7: Ministries and organizations regulating environmental issues**

Primary Government bodies and institutions	Other ministries	Agencies
Ministry of water and Environment(MWE)	Ministry of Agriculture Animal Industry and Fisheries	Environmental Alert
National Environment Management Authority(NEMA)	Climate Change Department	Nature Uganda
		Uganda Water and Sanitation NGO Network
		Green watch Uganda

The primary ministries are involved in drafting, implementing, monitoring, and evaluating environmental policies. There are also very many local community based organisations, regional and National Non-Governmental Organisation working along the above agencies as partners. Several policies and statutes have been developed, such as the National Environment Statute (MLWE 1995), the National Wetlands Policies (MoNR 1995), the Environmental Impact Assessment Resolutions (1998), the National Land Use Policy, and the National Land Policy. Despite the existence of these policies and implementing organs, the water and land resources have been seriously encroached on (Morrison, 2009)

#### 3.4.1 Suggested measures to reduce environmental pollution on flower farms

#### 3.4.2 Policies and laws

With poor implementation, monitoring, and evaluation of environmental laws, there is virtually no serious measure that can work. This is because, commercial flower farms are owned by people oriented in making money. They need a strong government initiative to make them abide all the regulations concerning environmental policies. There is need to strictly monitor and enforce environmental laws from grassroots to the ministry. This makes supervision easy at different levels if all stakeholders are involved.

#### 3.4.3 Corruption

It is common knowledge that this is a big problem not only hampering effecting of policies in environment but across the entire government spectrum. The implicated farms can be made to pay the damages caused basing on the environmental assessment. Also, farms that totally fail to abide can be closed temporarily or permanently so that others can learn from them. There are cases of farms that have been located in wetlands yet all the government agencies to stop such are in place but inactive ("Flower farms drive fish away from Lutembe", 2013)



**Figure 4: Flower farm situated at a wetland near shores of Lake Victoria, Uganda**

According to the people living in the area, the fish stocks have dwindled apparently following pollution from the nearby flower farms. “We used to have a lot of fish, especially Nile Perch and Tilapia, but today you can spend over five hours on the lake and return with only two or three fish,” Munyagwa said. Lutembe wetland is one of the few Ramsar sites in Uganda that are among the world's most productive environments (A. Munyagwa, personal communication, April 23, 2013). Incidentally the site today houses about five flower farms including Melissa, Aurum Roses, Ugarose, Expressions and Rosebud Ltd. He added “We used to have a lot of bees which helped in pollination.

The bees have also died because of the chemicals. We have on several occasions asked Rosebud to stop expanding, but he refused,” said Munyagwa. A report published by the National Association of Professional Environmentalists (NAPE) in June, 2012 revealed that many flower farms in Uganda still use perilous chemicals banned in most developed countries yet there are no proper waste management systems in place (NAPE, 2012). Some of the chemicals used include Folio Gold, Impulse, Meltatox and Silwet Gold among others. NAPE says these are highly toxic to fish and other aquatic organisms and may cause long-term adverse effects in the aquatic environment. The report says illegal chemicals have caused worse ecological impacts to surrounding communities including contamination of water bodies and reduced bee population, which affects fruit yields. According to the report, the problem is exacerbated by the inadequate funding to regulatory agencies like National Environmental Management Authority (NEMA).

Government should invest resources in training and monitoring implementation of policies in different sectors ministries and institutions. For example, all the above ministries and others like ministry of Health are all doing the same job but with no significant results. There is need to streamline the departments to avoid duplication of work and utilise funds to effectively deal with environmental pollution not only in commercial flower farms but also in other areas. Strict monitoring of water bodies especially surface water like Lake Victoria to assess the pollutant load from these farms should be regularly done. Abrupt checkups on farms to find out if there are people or workers that spray with no protective gears or equipments should be done. There is need to carefully assess whether there are some banned pesticides that are still being used on these farms. Inspection can begin right from pesticide distributors.

#### **3.4.4 Trainings.**

The Ministry of Agriculture Animal Industry and Fisheries (MAAIF) should prepare and conduct trainings on use of fertilisers and agricultural chemicals. This should not only target workers but also farm owners. Training can be tailored on effective use of chemicals and fertilisers, time of spraying; protective wear, cleanliness after spraying as well as integrated approaches that can be adopted to reduce on over reliance of chemical pesticides.

### **3.4.5 Protection of farm workers.**

All the flower farms should ensure that every worker accessing the greenhouse should be well protected with a complete protective gear (Eye goggles, overall, gumboots, gloves and face masks). This enables workers to remain safe and work for the farm for a long time without falling sick from diseases resulting from use of toxic chemicals. All the banned chemicals should not be used on the farm. The farm owners should ensure that managers and other farm workers are sensitised and fully aware that such chemicals pose both environmental and human risk and should not be used.

### **3.4.6 Training of staff.**

This is necessary because informed staff know how to use protective gears, mix right quantity of chemicals, and know how to handle them. This makes it easy for flower companies to have healthy teams that do a lot of work without spending a lot of money in health care. It also helps workers save instead of spending money on treatment which in a long run is not sustainable. Spraying should follow serious precautions. The greenhouses should be closed to allow the chemical not to drift to the surrounding areas. This is because it may affect other organisms like bees, insects, and human beings. This should be done by closing all the doors and curtains of the greenhouse.

### **3.4.7 Soak pits and disposal sites.**

Chemicals should not be allowed to drain in any open water body. The drainage channels from the greenhouse should be made in such a way that they pour all the draining chemicals from the greenhouse into one area well prepared for handling chemicals and fertilisers. This saves lakes and other surface water channels from mineral containing drain which pour in lakes and rivers and causing eutrophication. This leads to death of aquatic organisms. Such a place should not be near a swamp or any water channel. Underground soak pits prevent chemical water from seeping back into the environment. The soak pits are constructed from steel and concrete ("Environmental safety", 2011).

### **3.4.8 IPM strategy.**

Integrated Pest Management uses various methods to control both pests and diseases. It consists of biological, cultural, mechanical, chemical, and physical approaches to control pests and diseases below economic injury level (EIL). This is a better and a sustainable approaches that commercial flower companies can practice.

## **4. Conclusions and Recommendations**

In conclusion, commercial flower farms in Uganda use a lot of fertilisers and other agrochemicals especially pesticides and they must use them if they have to improve production to meet their market targets and client demands. However, there is a need to strictly monitor and supervise all flower farm activities to ensure that all the environmental guidelines are strictly followed. Those farms that cannot implement government policies on environment can be heavily penalised or closed if they persistently fail to adhere. In this regard, a technical team should be constituted to specifically monitor pesticide and fertilizer use not only on commercial flower farms but also in other agricultural farms including tea plantations.

The banned chemicals like dursban should totally be abolished not only on flower farms but also in agro chemical shops. If that is not done, the health of people will greatly be affected directly and indirectly since most surface water bodies, particularly Lake Victoria will be heavily polluted, and the fish stocks will continuously dwindle impacting heavily on food security and the income of the people around the lake.

In addition, government through ministries of Agriculture, Animal Industry and Fisheries, Water and Environment, Education Science Technology and Sports should promote research to come up with novel approaches of reducing pesticide. Sustainable integrated biological approaches are dependable and economically viable in a long run.

There is need to study, streamline, and harmonise government ministries and statutory bodies to avoid duplication of work so that money can be put to proper use to monitor environmental programs. Duplication of work and overlap of roles and responsibilities make execution of certain tasks hard to accomplish and promote blame game. Most of the concerned ministries and their technical departments have roles and responsibilities that overlap. This in a long run promotes ineffective implementation and wastage of meager funds that would otherwise be used to monitor the activities of commercial flower farms timely and effectively.



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