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Review on Environmental Effects of Ethiopian Floriculture Industry

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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Review Article

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ABSTRACT

The floriculture sector is growing in Ethiopia; currently, Ethiopia is the second largest rose exporter in Africa and the sixth in the world. The aim of this study is to review the Ethiopian floriculture industry and their impact on the environment. Flowers are produced in modern farms around Addis Ababa and in the Rift valley. Ethiopian floriculture industries currently produce a number of flowers; including rose, gypsophila, Hypericum, limonium, carnations, and chrysanthemum. Rose is the most widely produced flower spices. Despite the industry's significant contribution to the national economy, many issues are raised by environmentalists' that are related to the expansion of floriculture sector and the adverse effect of pesticides and chemical fertilizers, disposal of waste materials, and pollution of water bodies. Ethiopia has developed policies and legislation to protect the environment issues. However, there are some gaps in the implementation and governing of the regulatory framework of the floriculture sector. Moreover, the competition of current international market system can force farms to comply with environmental standards. With the expansion of the floriculture industry, there is a growing concern as to its adverse effect on the national environment; to achieve the above advantage, Fertilizer and pesticide management, organic cultivation, wastewater treatment and recycling and environmental audit have to be taken into consideration.

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1. INTRODUCTION

The history of the Ethiopian floriculture industry dates back to 1980 when that state farms started to export flowers to Europe. Within the span of fewer than three decades, Ethiopia emerged as a global player in the cut flowers business ranking only second to Kenya. With a good mix of incentives and active facilitation, Ethiopia Government took a non-existing flower sector and developed it into a USD $200 million export sector with more than 85,000 jobs created. This was possible because Ethiopia has geographical advantages for a floriculture industry; the high altitude (flowers grow well above 1100m ASL) [1]. The vast unexploited arable land and the conducive climate for flowers. Since the large low-cost labor market is labor-intensive, it is very attractive for the industry. Comparing with Kenya, the Ethiopian Government's strong initiative for encouraging the safe environment is also an important advantage for Ethiopia. These advantages, especially the geographical ones, are the reason why Ethiopia has been attracting many flower farms even from Kenya where the industry has already been developed [2].

Ethiopian Floriculture industries currently produce several flower species, including roses, gypsophila, Hypericum, limonium, carnations, and chrysanthemum. The first private farm that started trading flowers was the Ethio-flora. It cultivated summer flowers except for roses and exported only to the Netherlands. Recently it has been producing mainly roses and exporting them to several countries. Another company which entered the industry in the early phase is Golden Rose Agro-farms L.T.D (hereinafter referred to as "the Golden Rose"), which started growing roses in the year 2000. Although a few companies started their businesses about 10 years ago, the floriculture industry in Ethiopia has started to advance in the past 4 years [3].

The acreage of a flower farm in Ethiopia is assumed to reach 900ha. Given that the pace of growth of the industry continues as it is now, the acreage is projected to reach to 1,250 -1,500 ha at the end of 2007 and up to 3,000 ha in 2011. The floriculture sector had started growing fast from time to time. The annual foreign incomes in the current fiscal year from floriculture alone is expected around 200 million USD. In essence, the sector is one of the top five foreign exchange earners to the nation. Flowers are produced in modern farms around Addis Ababa and in the Rift [2]. Rose is the most widely produced species. Gypsophilia, hypericum, eryngium, carnations, cala, agapanthus, freesia, and lilies are also produced. The sector's contribution to export revenue and employment generation has been progressively increasing over the last few years [4,1].

Despite the industry's significant contribution to the national economy, many issues are raised by environmentalists' that are related to the expansion of floriculture sector and the adverse effect of pesticides and chemical fertilizers, disposal of waste materials, and pollution of water bodies. Ministry and agriculture development [1]. Stated that more than 300 chemicals as pesticides and growth regulators are used in flower farms. They believe that excessive pesticide is getting into water bodies damaging the biodiversity and chemicals are killing useful organisms in the soil [5]. Environmentalists are also worried; that waste materials can damage the environment will get into the soil, into water bodies or be used by people and cause serious damage [3]. It is also known for using a large volume of water resulted in shrinking of surface and underground water. Companies such as Rose Ethiopia and Garad Flowers are some examples causing shrinkage of water [6,1].

Therefore, the general objective of this paper is to review the Ethiopian floriculture industry and its impact on the environment.

1.1 Specific Objective

- ✓ To review the Ethiopian floriculture industry significant contribution to the national economy
- ✓ To review the Ethiopian floriculture industry's adverse effect on environment

2. FLORICULTURE INDUSTRIES IN ETHIOPIA

In recent decades, the global demand for cut flowers has grown substantially. This growth in market demands and its expansion value has attracted increasing numbers of developing countries to the global fresh flower trade. These reasons seem to make Ethiopia join this business. However, some people say that

Ethiopia gives attention to this sector because the European production cost rises steeply. European cut flower growers (especially Netherlands) have been looking for other continuities for more reasonable conditions as experienced by East African countries like Kenya, Tanzania and Uganda [7,5].

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The floriculture sector had started growing fast from about 300,000 USD foreign incomes in 2001 to 104 million in 2006. The annual foreign incomes in the current fiscal year from floriculture alone is expected around 200 million USD. Land size is also expanding every year where new floriculture enterprises are opening. In May 2010, land used for floriculture is over 1,500 hectares. Ethiopia is the producer of large budded and long stemmed roses with vibrant colors. Many varieties are available and the main production season is from October to May. Flowers are produced in modern farms around Addis Ababa and in the Rift valley. The sector's contribution to export revenue and employment generation has been progressively increasing over the last few years. '27-30,000 workers, of which 60 percent are women, are employed by the sector. As far as export revenue is concerned, in the first half of 2007, about 50 million US dollars generated. Ethiopia exports up to 700-800 tons of flowers and fruits and vegetables in one week of which flower constitutes the most part [4,1]. Foreign investors account 52 percent of flower growers in the country while they are engaged in joint ventures around 4-5 percent, and the rest are Ethiopians [4,1,8]. The industry covered 1,442 hectares of land in the year of in 2011/2012 [9]. Flowers exported mainly to Holland, Germany, and the UK but Scandinavia countries, Russia, Japan, and the Middle East countries as well.

2.1 Environmental Impact of the Floriculture Activities

Like many other developing countries, Ethiopia is trying to diversify its export base with a view of acquisition new sources of income and foreign exchange; and thus reducing its exposure to price volatility that typifies international markets. In addition, the sector also plays a great role in creating employment opportunity for unemployed citizens [7].

Suitable agro-climatic conditions and natural resources, governmental incentives and support, favorable investment laws, proximity to the global market, the efficiency of the transport system and availability of abundant and cheap labor are some of the leading factors for the rapid growth of the sector in Ethiopia [6,10]. The floriculture industry has also organized itself into an association called the Ethiopian Horticulture Producers and Exporters Association (hereafter EHPEA), which is helping the sector [11].

As reported by environmentalists, the floriculture industry uses too many pesticides and chemical fertilizers, which cause adverse effete on the environment. The excessive pesticides that are getting into water bodies are damaging the biodiversity and chemicals are killing useful organisms in the soil. Although, waste materials will damage the environment will get into the soil, into water bodies or be used by people and cause serious damage [6].

2.1.1 Intensive water use

One of the major environmental issues in which floriculture industry accused is the intensive uses of water. Even if government distributes water,

Table 1. Major statistics of floriculture development in Ethiopia

Year	Number of farms	Cultivated area (ha)	Number of exported stems	Export value (US$)
2001/02	_	_	_	305000
2002/03	_	_	16000000	2900000
2003/04	_	_	32000000	5500000
2004/05	30	150	83000000	12700000
2005/06	69	345	186000000	26900000
2006	80	645	1114000000	113000000

Source: Ministry of Trade & Industry [1]

there are water shortages in the towns and villages in most floriculture areas; because flower production requires its use in large quantities [12]. The consumption of water for the production of cut flowers reached 60,000 liters/ ha/ day. After intensive water use by floriculture, the water table has dropped under the savanna surrounding Bogota [13]. According to the findings of the study, one of the cases, which rise conflict between the floriculture farms of Ecuador and the neighboring community, is depletion of water in the surrounding [14]. The flower industry is using water from the lake for irrigation purposes; Lake Naivasha is the only freshwater ecosystem in the Eastern Rift Valley with the area between 114 and 991 square kilometers; depending on the rainfall [15]. Fishermen and local residents living on the shores of Lake Naivasha in Kenya have recently made alarming announcements that the water levels of the Lake have been dropping for the past several years, fish stocks are declining and the lake is being polluted by chemicals. The blame for this situation has been put on the flower industry around the lake. Approximately 30 large flower farms, mainly producing cut flowers for the European markets, are situated around the lake.

2.1.2 Fertilizers

Malefya [16] stated as almost all Ethiopian floricul ture industries use chemical fertilizers. Nitrates that are produced from Nitrogen fertilizer can be wash away from the fields by rain or irrigation ultimately finding their way to water bodies and soil. The undesired impact of the sector includes; water pollution, soil and water quality degradation, human, and cattle health effects, air pollution, the risk of aquatic life, as well as water logging and sanitization.

2.1.2.1 Effects of fertilizer on health

Chemical fertilizers in floriculture industries can also cause different diseases for the workers. *Methemoglobinemia*, Japanese encephalitis (JE), cancer etc. are some of the major diseases that have been noted to the use of chemical fertilizers. When the excess nitrates remain in the soil, it can cause *Methemoglobinemia*. If the nitrates are, mix with drinking water it can affect human beings by interferes with oxygen-carrying capacity of the blood. Nitrates are also can cause cancer, especially stomach cancer, non-Hodgkin's lymphoma, while the proof is inconclusive, and the intensity of these risks is unknown. Excess use of urea also causes a called *Japanese encephalitis (JE)* human disease*,* which mainly affects children between the ages of four to fourteen years. The high content of chemical fertilizers also can affect castles when they graze on exposed fields [17].

As stated by Sisay [17] the amount of nitrate is increased in the impaired sites where floriculture industries were established three years ago because floriculture industries use a high amount of nitrate fertilizers in drip irrigation. In addition to this Downes *et al.*, [18] stated that Nitrates react directly with hemoglobin in human blood and other warm-blooded animals to produce methemoglobin. Under certain conditions high levels of nitrates (>10 mg/l) are toxic to human beings especially for infants water with more than 1.0 mg/l of nitrate levels should not be used for feed babies [19].

2.1.2.2 Effects of fertilizer on soil

One of the most visible impacts of floriculture industries is depletion of the soil through the exhaustive usage of fertilizers and chemical as well as during the waste disposal of cut flowers. Chemicals and fertilizers have a different character and react differently when they apply to the soil and affect its texture, acidic value, and fertility. According to Tilahun [19] flower farmers in Colombia do not realize that the exhaustive use of the soil, the water and the intensive and excessive use of chemicals is going to convert the Savannah of Bogota into a sterile land [19].

According to Mesfin et al. [20] healthy soil contains enough nitrogen-fixing bacteria, which fixes sufficient atmospheric nitrogen to supply the needs of the growing plants. However, continued use of chemical fertilizers in floriculture industries may destroy these nitrogen-fixing bacteria and many other micro- and macro- the organism of the soil. In addition, a sulfuric and hydrochloric acid which is found in chemical fertilizers can tend to increase the acidity of the soil, reduces the soil's beneficial organism population and interferes with plant growth.

As reported by Mesfin et al. [20] floriculture effluent application can significantly affect the soil chemical properties of Vertisols at DebreZeit. It can also change the soil pH, organic carbon (OC) and total nitrogen (TN) contents, exchangeable bases and micronutrients concentrations. As a result, the neutral soil of DebreZeit was been changed to saline soil. This soil degradation in DebreZeit also affects the

crops that are grown in that area like wheat. Therefore, wastewater management and treatment are necessary to reduce the impact of effluents on soil quality.

2.1.2.3 Effects of fertilizer on atmosphere and aquatic life

Fertilizers, like Urea, can cause air pollution by spread during fields spraying and the ammonia therein reacts with the water present in the air causing the formation of ammonia oxide [8,10]. Fertilizers can also pollute water bodies by a leak through the soil to the groundwater or channels and streams. In a process known as *eutrophication*, fertilizer washed from fields into surface waters stimulates algae growth, which blocks sunlight needed by aquatic vegetation putting their survival at stake. This loss in vegetation disturbs the food chain, causes the death of economically important aquatic life. Moreover, oxygen found in the water can be depleted and thus degrade the quality and usability of the water [10,21].

The levels of dissolved oxygen at the impaired sites of Lake Ziway were < 2 ppm (Fig. 1); this might indicate that the lake water around the farm is becoming unfavorable for supporting aquatic organisms [16].

2.1.2.4 Waterlogging and salinization

Naturally, some water leaks into the ground from irrigation ditches and canals, which called water logging, this outflow, can cause the subsoil water table to rise to the root zone of crops, killing them. Some plants e.g tomatoes are very low tolerance for salt and they cannot be grown in saline soil. Salinization occurs because salt is left behind as irrigation water evaporates, or from leaking of salt and minerals from the soil due to water use for agriculture or when waterlogging brings harmful salts to the surface [10,21].

The soil nutrient concentrations (nitrogen, phosphorous and potassium) in the bed need regular monitoring and fertilizers have to add only when necessary; the soil also must test before planting and managing the soil pH, essential humus (containing carbon to sustain useful soil microorganisms), salinity and variable nutrient; and Tracing element requirements of plants. Moreover, it suggested that the controlled application of soluble fertilizer in irrigation water *(fustigation*), and computer-based programs, such as *Fertijet* and *Fertigal,* or plant leaf tests be used to determine the appropriate amount of fertilizer required. If there is the disagreement that this is not practical, application of small, amounts of fertilizer suitable for growth stage of the plants should be done in spite of all the drawbacks highlighted above [10,22].

2.1.3 Pesticides

Pesticides that include herbicides, fungicides, insecticides and more can contaminate organisms, soil, water, turf, and other vegetation. 99.9 percent of pesticides are mostly leaving as

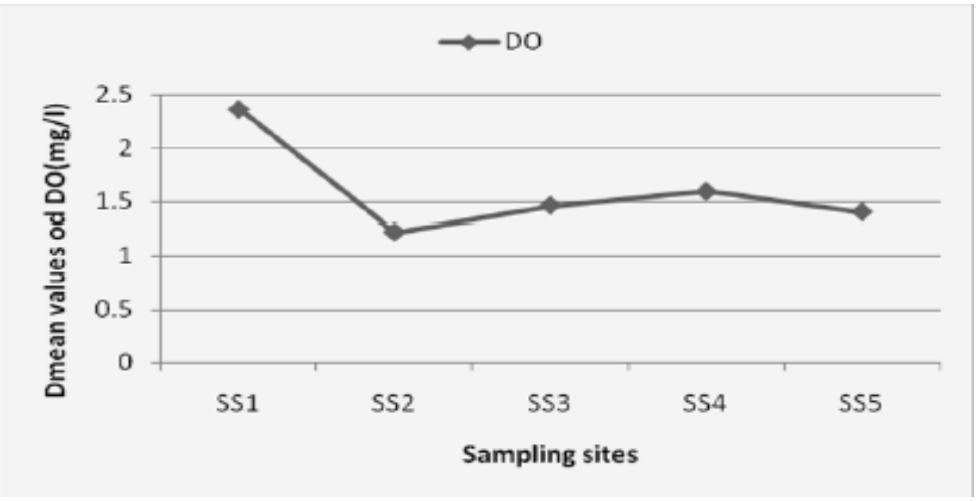

Fig. 1. Mean values of dissolved oxygen at 5 study sites in Lake Ziway
Source: Malefeya [16]
DO= 5-6 ppm is required for growth and activity of most aquatic organisms
SS= sample site

a pollutant in the environment, including the soil, air, and water, or on nearby vegetation. Only less than 0.1 percent of the 0.1 percent of the applied pesticide reaches the target pest. The adverse effect of pesticide use includes degrading soil and water quality, the effect on non-targeted lives like human beings, cattle, insects, soil organisms, aquatic life etc. air pollution, and an increase of pesticide resistance by targeted pests [23].

Recently, a large-scale horticulture and floriculture greenhouse complex have been establishing around Addis Ababa and in the Rift valleys' providing new and badly needed employment opportunities to the local population, which mainly depends on smallholder agriculture while a part receives food aid. The type and amount of pesticides and agrochemical products have been used, the manner of their usage and their very disposal are creating concerns. According to PANNA [24] In the future, these problems could have a large impact on the country's environmental health as well as develop into long-term health concerns for workers. On the other hand, this development will further increase the pressure on local water resources as the greenhouses depend on surface water for irrigation, while other inputs (nutrients and biocides) may increase the risk of environmental pollution [25].

According to Ministry of Agriculture in Ethiopia, Crop Protection Department Quarantine Office, Ethiopian floriculture industries use more than 300 chemicals as pesticides (insecticides, Fungicides, and nematodes) and growth regulators. These pesticides applied, some include: There are around 120 chemicals that enter the country for the floriculture industry which is found on the world health organization negative pesticide list, while environmentalists have characterized some of these chemicals as having carcinogenic potential, Such hazardous chemicals are used in the flower farming sector in Ethiopia [26].

2.1.3.1 Degrading water quality

Pesticides can move from the place of the application via leaking, drift, volatilization, and runoff. Pesticides, including herbicides, can and do leak to contaminate ground water. Once ground water is polluted with toxic chemicals, it may take many years, a complex process and a huge expense for the contamination to be cleaned up. As a result, the contamination (by pesticides) of ground and surface water that supplies the greatest part of drinking water is a serious problem worldwide [10,22].

2.1.3.2. Soil organisms and non – target organisms

The soil is a dynamic living system with a variety of micro- and macro- floral and faunal species including bacteria, actinomycetes, fungi, nematodes, arthropods, crustaceans, and earthworms. These flora and fauna play a primary role in the degradation of plant and animal residues and other organic matter in the environment as well as in nitrogen fixation, nitrification and the release of nutrients from soil minerals. Anything that affects their activities, in turn, affects the function of soils in crop production, and in the global carbon and nitrogen cycles [22].

Pesticides can also affect pesticide on non-target organisms. It has been reported about ten million non-target organisms including thousands of domestic animals putrefying each year throughout the world [17]. Moreover, it destroys the population of natural enemies, whose destruction and lack of biological control in agriculture, result in food loss due to pests that can increase by as much as fifty-eight percent. Pesticide use also has an adverse effect on the pollination process as honey and wild bees are vital for fertilization of about one-third of fruits, vegetables, and other crops worldwide. The principled issue that arises now is the extent to which it is justifiable to destroy thousands of species for killing the "harmful" few [17].

According to Sisay [26] In Wedecha River, there is a decrease of macro in-vertebrate biodiversity and disappearance of sensitive taxa at the downstream stretches. This seems to be due to the above chemical pesticide loads, low dissolved oxygen, and unavailability of food in the downstream of floriculture industries. In addition physicochemical parameters like EC, COD, BOD, SO_4^{-2}, $PO4^{3-}$, NO3-, N have strong negative relationship with macroinvertebrate metrics expected to decrease with perturbation and have high in amount with increasing pollution load (Table 2) whereas temperature and pH were almost the same and supplied and ammonia were very low in amount with increasing pollution load.

2.1.3.3 Pesticide resistance

Many insect pests, plant pathogens, weeds, and rats can be developed of pesticide resistance if

Table 2. Physicochemical parameters that have strong negative relationship with macroinvertebrate metrics expected to decrease with perturbation

	No. taxa	No. Odon	No. Hemi	No. Dipt	No. Chiro	No. Coleo	No. Planor	% Odon	% Hemi	% Dipt	% Chiro	% Coleo
EC	-.59	-.51	-.545	-.51	-.50		-.54	-.52	-.56	**-.61**	**-.63**	-.53
COD	**-.70**	**-.65**	**-.68**	**-.66**	**-.66**	**-.63**	**-.66**	**-.65**	**-.67**	**-.69**	**-.69**	
BOD5	**-.65**	**-.62**	**-.64**	**-.62**	**-.63**	**-.65**	**-.62**	**-.62**	**-.63**	**-.64**	**-.64**	
SO4 2-	**-.65**	-.56	-.60	-.567	-.55		-.59	-.56	-.60	**-.64**	**-.65**	
PO4 3-										-.55	-.58	**-.64**
NO3-N	-.56		-.51				-.51		-.53	-.59	**-.61**	-.55

Source: Sisay [26]

there is excessive use of pesticides. More than 500 insect and mite species, more than 150 plant pathogen species, and more than 275 species of weeds have become resistant to herbicides in Worldwide [22].

2.1.3.4 Air pollution

Air pollution caused by flower industry has given rise to various conflicts with the neighboring communities. The pesticides applied in the greenhouses travels an average distance of 1,500 miles, adding significantly to global warming and air pollution [16].

As reported by Atkure [17] many pesticides can volatilize (that is, they can evaporate from the soil and foliage, move away from the area of application, and contaminate the environment). As much as 80-90 percent of applied pesticides can be, volatilized within a few days of application. Research conducted in the US shows the availability of pesticide residues in air. Accounting for all of these effects, a conservative estimate of the total damage to the environment and public health caused by pesticides is about $9billion each year. Research is not available to show how much of this impact is contributed by the floriculture sector, but it is obvious that the sector usually uses more fertilizer than conventional farming [17].

2.1.3.5 Worker health

Pesticides can cause cancer, birth defects, reproductive and nervous system damage, and floriculture workers are expose at numerous stages of plant growth. As stated by Atkure, [17] in West Shewa, Oromia Worker exposure is of particular concern in greenhouses, where up to 127 different chemicals are used in enclosed spaces--increasing risk of exposure through the skin and by inhalation. From 612 greenhouse worker in West Shewa, Oromia about three hounded ninety-two (67.70%) had at least one skin problems. Four hundred and sixty-nine (81.10%) had at least one respiratory health symptom during the past 12 months prior to the study period, of these (78%) developed the symptoms following working at the farms. The major proportion of subjects with different health symptoms in the survey population 560 (95.85%) had at least one sign and symptom in the last 12 months prior to the study period, of those, 539 (93.25%) develop after joining the work and 407 (75.51%) were female (Table 3). The most prevalent respiratory problem is sneezing followed by shortness of breath [17].

Table 3. Prevalence of different symptoms of disease among floriculture workers in West Shewa, Oromia, Ethiopia, Dec. 2010 – Feb 2011 (n=578)

Health problems	No. of subjects	%
Skin problems		
Yes	392	67.7
No	186	32.3
Respiratory problems		
Yes	469	81.1
No	109	18.9
Respiratory problems developed after joining work		
Yes	452	78.2
No	136	21.8
Overall health symptoms		
Yes	560	95.85
No	28	4.15
Developed after joining the work		
Yes	539	93.25
No	39	6.75

Source: Atkure [17]

2.1.4 Waste disposal

According to Atkure [17] floriculture activities produce different types of waste ranging from liquid to solid, hazardous to non-hazardous, and in effect require safe waste disposal and differentiated treatment. Empty chemical containers (fertilizers, pesticides) and their washing waters and obsolete chemicals are the major spheres of concern in addition to which other agricultural wastes such as cutoff crop parts, unused soil, and wastewater are generated in the sector. In the UK, waste has been understood as any substance which constitutes a scrap material or an effluent or other unwanted surplus substance arising from the application of a process; or, any substance or article which requires being disposed of as being broken, worn out, contaminated or otherwise spoiled (not explosive). Hazardous wastes are those, which contain hazardous substance(s) in a quantity liable to cause death, injury or impairment to living beings, pollution of waters, or an unacceptable impact on the environment if not properly treated, handled or disposed of. It is believed that toxic/hazardous wastes have an adverse effect on the environment and human health. These include increased exposure to cancer, and children born near toxic waste sites can be physically deformed or have developmental disabilities.

It is not hard to know that empty chemical containers contain residual amounts of chemicals and require safe disposal. In an effort to ensure that this residue is handled, recycled or disposed of properly, procedures have been being found) or the full supply level of surface water storage reservoirs and their feeder streams. It is to be noted that fully contained plant growing, on the contrary, does not have on-site discharge. Adequate separation distances should be maintained between floriculture and natural waterways to minimize the risk of degradation of water quality; a minimum vertical separation distance of two meters to the maximum ground water table (end of wet season for free draining soils), should be maintained to avoid water logging and allow for soil contaminant filtration and aerobic microbial action. Besides, the sites of flower farms should be gently sloping ground where gradients are between one in 10 and one in 200 [23].

2.1.4.1 Water pollution

According to Malefeya [16] conducted a research on Environmental Impacts of Floriculture Industries On Lake Ziway: with particular reference to water quality, the results of Physicochemical, Oxygen demanding, nutrients and micronutrient parameters analyzed at the impaired sites were compared with samples taken at the upstream area (control). The result showed that significant difference in physicochemical, nutrients, micronutrients and oxygen demanding parameters [16].

The levels of these parameters were high at the impaired sites especially in sampling sites where wastewater management was not put in topractice. Besides, the results were compared with water quality guidelines to check if the water quality of the lake is within the acceptable range. Most of the parameters analyzed at the impaired sites were beyond the permissible limits. Based on the guideline values, the potential irrigation problem of the lake water near the farm was slight to moderate and it is becoming less suitable for the maintenance of fisheries and aquatic life. Although the water quality of Lake Ziway is still acceptable for irrigation under the current condition, the high levels of fertilizer residues in the farm effluent is promoting the growth of algae and aquatic vegetation beyond what is naturally sustainable. In addition, the Lake water around the farm is becoming less suitable for sanitation purposes. In general, because of the activities of the flower farm on the Lake, the water quality may seriously deteriorate and fish catches will decline near the shore of the lake. Unless immediate measures have taken, the lake water will be heavily polluted and become unfit for the variety of purpose being used before.

Sisay [23] stated that floriculture industries have a negative impact on the aquatic environment: macro in -vertebrate's depletion or degradation of biodiversity (species abundance and diversity), the disappearance of sensitive taxa in the downstream stretches, food chain of aquatic organisms' and consumption of water in the surrounding communities. This is due to the disposal of wastewater to the nearby rivers [23].

3. REGULATORY FRAMEWORK AND COMPLIANCE: NATIONAL POLICIES AND LAWS

The problems stated above about different environmental effects of floriculture will be very severe if the controlling framework, within the sector or from the government, is loose. Policy plays a vital role in the formulation, governing

Table 4. Mean values of physicochemical parameters (Mean ± SE, n=4) at 5 study sites

Parameter	Sampling sites				
	SS1(control)	SS2	SS3	SS4	SS5
Turbidity (NTU)	28.8±5.5	26.8±16.47	36.2±28	36.6±20.84	29.7±19.9
TSS(mg/l)	0.0196±0.01	0.0623±0.12	0.0866±0.11	0.0957±0.14	0.0316±0.0
TDS(mg/l)	272±9.4	457±82.3	519±173.8	574±176.5	530±13
PH	9.1±0.18	8.9±0.26	8.5±0.2	7.9±0.34	8.8±0.3
EC (ds/m)	0.4164±0.04	0.6705±0.83	0.795±0.147	1.358±0.38	0.9109±0.2
TH (mg/l)	45.6±4.08	33.7±6.47	61.6±8.1	74.8±9.26	72.8±1.92

TH= Total Hardness TSS= Total suspended solids TDS= Total dissolved solids SS= sample site
Source: Malefeya [16]

and implementation of any regulatory framework. Based on the national policy, laws have passed. The Environmental Policy of Ethiopia and Ethiopian Water Resource Management/ Sector Policy are a few which are authenticated by-laws [27,10].

3.1 Environmental Policy

The Environmental Policy of Ethiopia (EPE) included various policy directions for sustainable use of the environment and national resources that also address the need for protection. As a key guideline principle, the policy takes the position that when a compromise between short-term economic growth and long-term environmental protection is necessary, it is better to carry on the side of caution as far as possible because naturalizing a degraded environment is very expensive. Other than the EPE, the Ethiopian Water Sector Policy and the Ethiopian Water Sector Strategy make it very clear that environmental conservation will be an integral part of all water related projects. To this end, Environmental Impact Assessment (EIA) is obligatory in all water resource projects [10,28].

Furthermore, standards and classification systems will be established in relation to the various water uses by laying down quality standards and quantity including limits and ranges of desirable and permissible levels of chemicals and fertilizers, waste discharges, source development, catchments, management, etc. However, there seems to be a gap regarding when and by whom these standards are to be formulated.

EPE underlines recycling wastewater when it is found as a safe method for health and environment since it can reprocess the polluted water in different areas. EPE promotes the use of organic matters than conventional fertilizers, EPE also regulates waste management by specifying that waste disposal guidelines and strategies and regulations to enforce them will be formulated, and an effective monitoring system will be established. Standards to control the release of pollutants from the agricultural sector have not yet been formulated. However, the awareness about environmental damages caused by pesticides and chemicals in the agriculture sector are limited. Control of imported chemical and pesticides, control of hazardous chemicals and recycling of wastes need consideration as well [10,28].

3.2 Legislation

Laws have been enact about floriculture sector but maybe they are insufficient and there are gaps in the sphere of application. Public Health Proclamation only allows disposal solid, liquid or any waste in a way that does not contaminate the environment or affect public health through specially designated place and manner. There is a weak linkage between farms and EPA that leads to the environmental impact of the floriculture wastes is not get enough attention [28]. With regard to hazardous waste and chemicals, Article 4 of the Environmental Pollution Control Proclamation stipulates that generation, carriage and use of a chemical considered as hazardous or of restricted use requires a permit from the EPA or the relevant regional environmental agency (hereafter REA). Moreover, as per Article 6 of the same, the EPA, specifying levels allowed and methods to be used in the generation, handling, storage, treatment, transport and disposal of the various types of waste [10,4].

According to Mulugeta [3] Proclamation authorize s EPA to issue directions that are important to select projects not likely to have negative impacts and that would not require environmental impact assessment, and projects likely to have

negative impacts and requiring environmental impact assessment.

3.3 Self-Regulation: Code of Practice Adopted by Flower Farms

Ethiopian Horticulture Producers and Exporters Association (EHPEA) developed its own Code of Practice (here in after the Code) in 2007 which can help for the sustainable development of the sector and for competitive position in the market including a mechanism that enables to achieve the highest performance standards. The Code sets the minimum requirements for all EHPEA members to flower farm owners has to fulfill to get the certification for the Bronze Level, which is compulsory. Internationally accredited verification body will be select by tender and then a flower farm will receive EHPEA Code Accreditation after its compliance will be proved through independent verification. The Silver Level and the Gold Level are the higher standards and compliance criteria are not yet finalized although the Code states that they "are in preparation" and will entitle to MPS-GAP/ EUREP GAP Certification and MPS-SQ/ FFP Certification, which are international market labels. Compliance at this Bronze level ensures that the farm does or refrains from the following [29].

- The measure, performance of the farm in water consumption, pesticide use, fertilizer use, waste management and energy consumption will be evaluated every month by documents. Assess the risk related to the environment and occupational health and safety and put in place suitable mitigating actions in agreement with the Environmental Impact Assessment procedures;
- Banned and un-registered (excluding temporary permission to use products) pesticide products as per WHO list of internationally banned pesticide products are not allowed to purchase by the farms.
- Implement safe pesticide use and storage;
- Farms have to ensure that personnel trained on pest control activities.

The Code, however, does not say anything about the circumstances that entitle a farmer to the permission.

According to Tadesse and Asferachew [30] more standards that are strict are set for the pesticides than for fertilizers. The reason includes storing pesticides in 'suitably constructed stores.' The Code of Practice also specifically indicated the material to be used for its construction, the facilities to be provided, safety equipment's to be installed, its location on the farm and contact with employees, the need for labeling and keeping it in the original container, and safe disposal of 'outdated' pesticides. In addition, during transportation of pesticides and the use of agrochemical products national and international regulations have to be observed. During spraying of toxic products, only protected persons are allowed to be in the greenhouse and re-entry is prohibit for some hours after spray. Spraying of chemicals must be done by a well-trained sprayer; date and site of pray must be recorded. The record must include the type of pesticide that is used, the amount and volume of spray and the reason for its application. After spraying equipment and clothes, have to wash [30].

The Dutch company, Control Union Certification, on February 26, 2009, give a certificate of the code of practice for sustainable flower production after a one-year auditing process for the first ten flower farms and the Ethio-Netherlands Horticulture Partnership and EHPEA covered the cost. Even if, only 10 out of more than 86 floriculture farms have so far met the terms of the Code it is very clear that the Code's standards can be a regulating framework for the sector in minimizing adverse environmental impact. It is to be noted that only 10 of the farms are regulated by the Code leaving more than 85% of the farms unregulated. Moreover, EHPEA has a plan for all its members to get the certificate [29].

4. SUMMARY AND CONCLUSION

However, environmental concerns are growing because, floriculture requires intensive use of chemical fertilizers and pesticides, disposal of waste materials, and pollution of water bodies and needs huge amounts of water than conventional farming in addition to the thoroughly monitored waste management system.

The adverse effect of pesticides on the environment includes the effect on non-targeted lives, air pollution, and increased pesticide resistance by targeted pests, water, and soil quality degradation. On the other hand, fertilizers are unlike pesticides, are not inherently toxic. But, fertilizer runoff from farms has dire consequences on water pollution, soil and water quality degradation, human and cattle health hazards, air pollution, the risk of aquatic life, as well as waterlogging and salinization, are some

of the adverse effects of fertilizers. Disposal of waste produced by the sector is another issue that can affect the environment. The disposal includes empty chemical containers (fertilizers, pesticides), washing waters and other agriculture waste like cutoff crop parts, unused soil, unused chemicals, and wastewater. These are threats to the environment unless active prevention measures are put in place.

Ethiopia has developed policies and legislation to protect and preserve the environment. However, there are some gaps in the implementation and governing of the regulatory framework of the floriculture sector. Moreover, the competition of current international market system can force farms to comply with environmental standards. The Code of Practice formulated by EHPEA is also another self-regulatory framework, and its members are expected to observe environmental compliance standards in the course of their activities. However, only 10 of the farms are regulated by the Code leaving more than 85% of the farms unregulated. The relevant government agencies are thus expected to promptly empower themselves and minimize the threat through appropriate institutional and regulatory frameworks that can benefit from the environment-friendly market pressure and the code of conduct process of being put into practice.

Floriculture sector might, to a substantial degree and become a threat to the national environment unless the activities of the sector are well managed, supervised and subjected to an effective regulatory system. The government is thus expected to strengthen its regulatory offices; EPA, Ethiopian Investment Agency, Ministry of Water Resources, Ministry of Agriculture and Rural Development, Ministry of Capacity Building, and its respective regional bureaus, and the newly established Ethiopian Horticulture Development Agency. The government also have to give due attention to the antagonistic environmental impact which is already noticeable rather than offering priority to short-term income generation at the expense of the environment.

Governmental incentive and supports, favorable investment laws, suitable climatic and natural resources proximity to the global market, the efficiency of the transport system and availability of abundant and cheap labor make a great contribution to the rapid growth of floriculture industry in Ethiopia. With the expansion of the floriculture industry, there is a growing concern as to its adverse effect on the national environment; therefore, to achieve the above advantage, Fertilizer and pesticide management, organic cultivation, wastewater treatment and recycling and environmental audit have to be taken into consideration.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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