

Investigation of Physicochemical Properties of flower farms wastewater, and its impacts on nearby river and Soil in Oromia.

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Abstract: Ethiopia's flower farm industry today brings in a generous sum of money/income. Although it has made a substantial contribution to economic advancements, communities and environmentalists have expressed concerns about its effects on the environment. In light of these concerns, the study evaluates the Wolmera district's cut flower industry from cradle to gate using a case study methodology. The primary aim of the research was to examine the physicochemical characteristics of the raw water close to the flower farms, the effluent released from the farms, and the soil around the flower farms in the Wolmera district over the course of the cut flower manufacturing life cycle. The study's primary methodology was examining the physicochemical characteristics of soil samples taken from each of the chosen water shades of flower fields, river raw water, and effluent wastewater. The elements that were sampled were assessed and examined through comparison with the national effluent and river water standards (EPA 2003). Nevertheless, the outcomes of the soil sample testing were contrasted with the typical agricultural soil sample evaluation outcomes. The findings of the analysis of the sampled soil (EC, CEC, pH, T-N & P) were much higher than the results of the analysis of ordinary agricultural soil, while the results from the effluent and river water (EC, pH, TDS, SO_4^{2-} , NO_3^- , PO_4^{3-} , COD, BOD₅, T-N) were currently below national standards. These very non-degradable pollutants (0.1-0.3) are in addition, degradable and non-degradable elements in wastewater from flower farms were assessed using biological oxygen demand (BOD₅) to chemical oxygen demand (COD) ratios. Conversely, both sites have significant effects on environment and its' elements.

Keywords: Resources used, physicochemical parameters, degradable and non-degradable, wastewater.

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INTRODUCTION

Background.

Ethiopia is a country found at the horn of Africa within 15 degrees of north equator and covers about 1.1 million Km² total land areas. It bounded in North, East, South and West by Eritrea, Djibouti and Somalia, Kenya and Sudan respectively. Ethiopia is rich with sufficient natural resources & has about twelve river basins with yearly or an annual runoff volume of 122 billion m³, 2.6 - 6.5 billion m³ of ground water and 110 billion m³ surface water potential (Gezmu 2013). Ethiopia is the second most populous country in Sub-Saharan Africa and current population growth rate with 2.6 percent is made it one of the highest populous country in the world (Ethiopia 2008, Mengistie 2016). As population grow continues, the pressure on existing natural resources and ecosystem increases within time proportionally. Most of Ethiopian people depend on consumable and non-renewable resources to obtain the basic necessities of life. Ethiopia with this rate of population growth can lose the abilities of sustainable life for the societies (Debele 2014). Even today, evidence of deforestation and desertification, loss of biodiversity, land degradation are the most problem in the country (Ariti, van Vliet et al. 2018). Depletion of

potable water and aquatic resources are continuous for the purpose of agriculture without any recognition for the environmental issues (Minale and Rao 2011). In Ethiopia/Oromia most of the time production is based on subsistence food crops production and coffee harvesting for the exporting purposes dominantly, but recently agriculture sectors in the country moving from subsistence farming to commercial production which included flower farming for exporting purpose (Mbow, van Noordwijk et al. 2014).

Flower farms are one part of the agricultural sectors in Africa just like other continents for the purpose of economic developments at this moment. Africa countries cultivate the flowers or roses most of the time for the seeking of exporting to the developed countries (Riis Gard 2009). In Africa some countries that participate in the cultivation of flowers are Uganda, Ethiopia, Kenya, Tanzania, Zimbabwe, Gambia, Ghana and others are included in cut-flower production agricultural sectors. Among these Ethiopia/Oromia leads else Africa countries by flower exporting next to Kenya (Mengistie 2016) and the sixth largest country that supply cut flowers for the world markets (Getu 2009, Bedada and Eshetu 2011, Tilahun 2013, Kassa 2017). In Ethiopia for the first time this agricultural system started at Batu state farm next to Batu farm,

Bishoftu and Tibila state farms were involved in producing fresh cut flowers (Belwal and Chala 2008, Tilahun 2013). Now a days more than 84 companies cultivate cut flowers on >2000 hectares in Ethiopia (Gebreyesus 2015, Mengistie 2016). Flower farms have become make the country's the second great source of foreign exchange by agriculture products next to coffee (Mengistie 2016, Mengistie, Mol et al. 2017). In Ethiopia between 2004 and 2012, the floriculture sector generated more than \$1 billion export earnings and also more than 60 firms operated in the sector, creating direct and indirect employment for 50,000 and 130,000 people respectively in country horticulture sector. In 2012, the annual direct export volume reached 50,000 tons with \$200 million from export earnings (Oqubay 2015). The most concentrated areas of flower farms in Ethiopia's are Holeta, Sebeta, Bishoftu, Awash, Batu, Koka, Hawassa, Sandafa, Sululta, Debra Berhan (Dirre Ebba) and Bahir dar (Mengistie 2016).

Among these, Wolmera district is one of the areas found in the central parts of the country which densely occupied by flower farms. This district specially located in west shoa zone, Oromia regional state, Ethiopia with minimum altitude 2060 m and maximum altitude 3380m a.s.l (Attah and Regasa 2013, Sahle and Potting 2013). Wolmera district almost covered by high lands (>1100m a.s.l) that are most preferable for cut flowers or roses cultivation (Gudeta 2012, Sahle and Potting 2013, Kassa 2017). In addition to this concept, Wolmera district found near the capital city of the country and Bole international air ports. Therefore, this situation makes odd the areas to attracts the investors than elsewhere, especially flower farm investors are attracted by this area because, it may minimize the extra cost expends for the transportation of raw materials (inputs) to the farming areas and harvested (packed) cut flowers to the air ports for exporting purpose. This condition makes Wolmera district the highest flower farm distribution in the country and since 1980 about twenty seven (27) flower farms had established in the district (Mengistie 2016, Mengistie, Mol et al. 2017). Unfortunately, at this moment only about twenty one flower farms are on the function and the rests are already faze out.

Floriculture can be defined as "a discipline of horticulture concerned with the cultivation of flowering and ornamental plants for gardens and for floristry, comprising the floral industry." It can also be defined as "The segment of horticulture concerned with commercial production, marketing, and sale of bedding plants, cut flowers, potted flowering plants, foliage plants, flower arrangements, and noncommercial home gardening." (Getu 2009, Kassa 2017). Ethiopian floriculture industry started around 1980 when state farms begun to export cut flowers to Europe and within a short period of time recognized as an international cut flowers business player next to Kenya in Africa. Because, Ethiopia has geographical advantageous for a floriculture industry developments; i.e. cut flowers grow well at high altitude or above 1100m a.s.l (Gudeta 2012, Sahle and Potting 2013, Kassa 2017). As stated by (Belwal and Chala 2008) Ethiopia agro-ecology facilitate an opportunities to produce different varieties of flowers in different ecological zones that used to increase flower industries through time in the country. Cut flower includes all commercially cultivated rose and ornamental plants in greenhouse or in field, especially in a controlled environment. (Tilahun 2013, Mengistie, Mol et al. 2017). But, various cut flowers sometimes grow out of green house in many climatic conditions (Peppe, D., et al.

2011). Meskel and Ethio-flora, are the first private flower farms in Ethiopia and it begun its activities around 1997 on a few hectares of lands (Gudeta 2012, Kassa 2017, Teshome 2018). The rapid growth of flower farms in Ethiopia in general, due to comfortable climatic condition and natural resources, excellent governmental supports, good transportation system and availability of abundant and cheap labor forces (Getu 2009, Sahle and Potting 2013, Mengistie 2016). Floricultures are used for luxurious with high social value and rarely used for food. The demand for luxurious are increased in the international market from time to times at recent (Gudeta 2012)

Due to incremental of flower farm industries, environmentalists are raising many questions concerning on the expansion of floriculture and performance they have to environmental managements in Ethiopia even if it has great economical values. Such questions that are raised from different disciplines are excessive use of pesticides and chemical fertilizers in the farms, disposal of waste materials, protection and hardly use of natural resources. They believe that too much chemical discharges/ disposed to the environments damage the biodiversity and are killing useful organisms in the ecosystem (Getu 2009, Gudeta 2012, Mengistie 2016, Kassa 2017). In addition to this, environmentalists are also concerned on waste materials damage the environment (get into the soil, into water bodies and into the air) can cause serious health problems in the societies (Getu 2009, Kassa 2017). The floriculture chemical effects are very severe when the controlling framework and industrial performances within the sector or from government is loose. Depending on these conditions the study mainly focused on evaluating operational performance of flower farms within environments in Wolmera district, Oromia regional state, Ethiopia by understanding the necessity of compliances in the farms concerning on their own code of conduct and Ethiopia environmental protection authority laws. This paper, deals on the observed challenges have emanated from flower farms like polluted waste discharged/disposed in to environments (emission to water bodies and atmosphere).

Flower production processes.

Cut flowers are propagating in open / closed cultivation condition. In the open propagation system, cut flower seedlings are planted using a raised bed system and for closed cultivation system, it used both raised and hydroponic bed methods to propagate cut flowers in the farms (Sahle and Potting 2013, Mengistie 2016). Fertilizer (chemical fertilizer or else) and water are continuously applied during cultivation time in order to full fill any requirement materials for plants. In cut flower production, the companies use pesticides for the protection of pathogens and insects through direct application to plants or apply systemically by using an irrigation system (Sahle and Potting 2013). However, all pesticides used in the farms are harm full to environment and human health (FAO 1999).

Flower farms water consumption.

Large amount of water consumption is one of the basic natures of flower farms (Wainwright, Jordan et al. 2014). A hectare of a flower farm consumes above 900m³/month and about 90% of flower bodies (parts) made from water. This means that exporting flower is recognized just like exporting water (Teshome 2018). Despite of high amount of water use by flower farms it leads the cases much worst, which cause water, bodies to lose their natural

capacity because of high amount of water consumption. Minimizing the water level of any water bodies made frustrate, instable and finally put the environment endanger for the future (Sahle and Potting 2013). According to (Kassa 2017) the consumption of water for flower production farms reached 60,000 liters/day per greenhouse which impacts ground and surface water. Use of water in flower production farms for irrigation purpose can damage the groundwater, surface water; create serious water pollution in the area and deficiency of water supplies for nearby communities and resulted to the areas for salinization (Getu 2009). Wastewater discharged from cut flower industries generate greenhouse gaseous to atmosphere and emit emission to water bodies (Sahle and Potting 2013).

Chemical usages of flower farms.

1. Fertilizers.

Almost all flower farms, especially Ethiopian floriculture industries use chemical fertilizers for the purpose of cut flower production. These chemical fertilizers contain high amount of nitrate, phosphate, sulphate that can play a vital role in rose development and environmental pollutions (Kassa 2017). The flower farms used about 30 various types of fertilizers to supply N, P, K, and micronutrients to the rose plants. (Sahle and Potting 2013). Nitrogen fertilizer contaminate the ground and surface water and also high amount of NO_3^- , PO_4^{3-} ions in drinking water cause serious disease to the societies which basically depend on fertilizers used in the farms, especially DAP and URE (Wainwright, Jordan et al. 2014). Nitrogen (N) and its compound cause pollution of surface water which used by local communities and it has the ability to cause infant disease known as methemoglobinemia or blue baby syndrome (Knobeloch, Salna et al. 2000). In Ethiopia there is no laws or policies that concerned on the amount (volume) of fertilizer usages per hectares and policy only focused on packaging and storages of fertilizers (Yamano and Arai 2011). Chemical fertilize that used in agricultural farmlands emit GHG to atmosphere that has great values in the climatic changes (FAO). The most known GHG emitted from synthetic fertilizer are NH_3^+ , CO_2 , CH_4 and N_2O (Xia and Yan 2011).

2. Pesticides

Pesticides are other types of chemical substances that have used as input in crop production and flower farms for controlling weeds, different types of fungi, insects, and any soil born pathogen. Those pesticides used in flower farms were included herbicides, fungicides, insecticides, rodenticides and mitecides (Mulugeta 2009, Gudeta 2012, Mengistie 2016, and Kassa 2017). At this time, approximately 500 chemical pesticides are in use globally (Mengistie 2016). The risks and impact of pesticides used in Africa has, especially in Ethiopia is much higher than elsewhere (OLOWOGBON, FAKAYODE et al., Mengistie 2016). Ethiopian rose cultivation sector used more than 212 different types of pesticides with various active ingredients in its application (Sahle and Potting 2013). According to (Konrad Sen, van der Hoek et al.

2003, Mengistie 2016) statement's there are about two types of typical symptoms of poisoning within chemical pesticides. These are acute (short-term) and Chronic (long-term) poisoning, but chronic (long-term) pesticide poisoning cause's severe health problems in the societies when compared with acute poisoning symptoms. Pesticides have the ability to pass from mother to infants through breastfeeding and can affects the men and women hormones that can create problems on reproduction systems (Jacobs and Din ham 2003, Gudeta 2012). All most all African countries, especially Ethiopia has no proper pesticide controlling techniques or mechanisms (Mengistie, Mol et al. 2015, and Mengistie 2016). In Ethiopia still now some pesticides enter into the country without officially registered (Mengistie 2016). According to (Tilahun 2013, Mengistie 2016, Natamba, and Weihua et al. 2016) still now some hazardous pesticide chemicals applicable in flower production farms that categorized as extremely and highly hazardous by WHO standard.

Energy inputs in flower farms.

Flower farms used huge amounts of energy power in cut flower production at different areas for different purposes. This included electrical power, petroleum and diesel fuel that used to pump water from sources for irrigation, transportation, to facilitate a cold room in packaging areas and for office application (Sahle and Potting 2013). These energy sources emit CO_2 , N_2O , CH_4 , NH_3^+ NO_x to the atmosphere and PO_4^{3-} , NO_3^- , NH_3^+ , SO_4^{2-} to the water bodies that create great problems on environments during transportation of input materials, products and irrigation system in the farms (Xia and Yan 2011, Sahle and Potting 2013).

Solid wastes disposal and flower farms.

The basic solid wastes in flower farms are empty chemical containers (fertilizers, pesticides), byproduct of wastes like cutoff crop parts, leaves, wasted stems, unused soil (Getu 2009). All solid wastes generated from flower farms burn in open field or in incinerator and supply pollutants to nearby environmental soil and water bodies (Tilahun 2013). In addition to this the combustion of solid wastes as agricultural biomass residues emit greenhouse gaseous (CO_2 , N_2O , NO_3^- , SO_4^{2-} & CH_4) to atmosphere (IPCC 1996) and return to environments as acid rain.

METHODOLOGY

Study area

The area selected in this study was Wolmera district which found in west shoa zone, Oromia regional states, Ethiopia where highly dense flower farms. It has about 35 km distances from Finfinnee/Addis Ababa and topographically it characterizes by plateaus, mountains, plains and valley. The agro climatic zone of the district are high land 41%, middle land 59% with average highest temperature 21°C and average lowest temperature 1.7°C and with 900-1100 mm annual rain fall. The dominant soil groups of the study district are Chromic and OrthicLuvisols (90.3%), and chromic and pellicVertisols (9.7%).

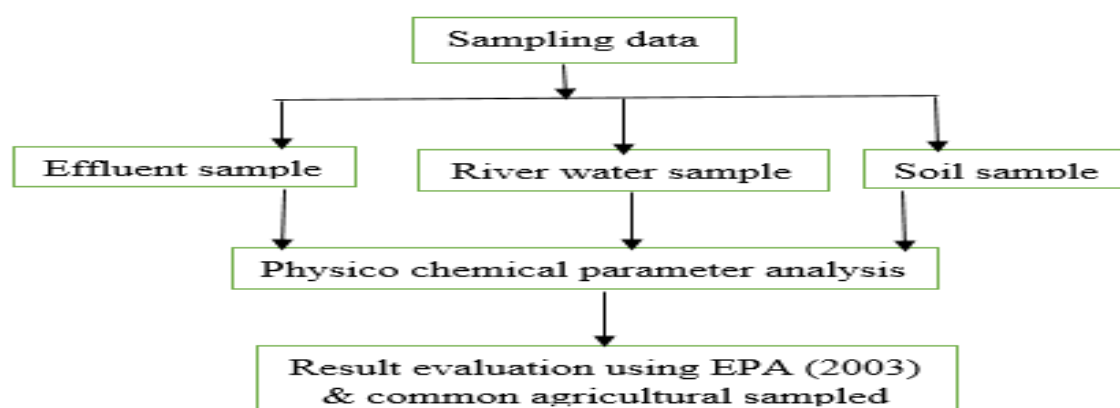


Figure 1. Over view of methodology schematic diagram.

During water sampling time, raw water was sampled from four sites along a river base with 15m gap using sterilized plastic bottle rinsed with distilled water and mixed together the sampled water. It was also labeled before analysis in laboratory; similarly, effluent discharged from flower farms also sampled in the same way along downstream of the discharging canal of the farms. The sampled materials (river water and effluent wastewater) from both water shades transported to laboratory sites using icebox that used to safe the sample from difference external influences and both samples physico chemical parameters tested in the laboratory by using different methods and instruments quantitatively (Table 1).

The pH values of effluent and river water tested by using pH meter, electrical conductivity (EC) of both samples measured by using electrical conductivity meter, Biological oxygen demand (BOD) of the samples also measured using five-day incubation

methods at room temperature based on the following equation which has direct relationship with dissolved oxygen in the effluent and river water.

$$\text{BOD}_5 = D1 - D2/V$$

Where, D1=DO (mg/l) initial sample

D2=DO (mg/l) in final sample

V= Volumetric fraction of sample used

Also chemical oxygen demand (COD), Sulfate (SO_4^{2-}), Nitrate (NO_3^-), reactive phosphate (PO_4^{3-}), and Total ammonia (T-NH_3^+) parameters were measured by using multipurpose photometry which mainly based on APHA (Table: 1 measuring methods of all physico chemical parameters) and compared using Ethiopia EPA (2003) standards whether it has impacts or not on the environments using national standard.

Table 1. Physicochemical parameter measuring methods, chemical used & instruments

Parameters	Methods	Used tablet for test/chemicals	Measured by
SO_4^{2-}	Photometer	Plain test sulphate test tablet	Plain test photo meter
NH_3^+	Photometer	Plain test ammonia test tablet	Plain test photo meter
NO_3^-	Photometer	Nitrocol tablet	Plain test photo meter
PO_4^{3-}	Photometer	Phosphate plaint test	Plain test photo meter
COD	Photometer	Dichromate and H_2SO_4	Photo meter/ photo lab.
PH	Potentiometer		PH meter
EC	Potentiometer		Electrical conductivity meter
TDS	Photometer		Conductivity probe (meter)
BOD_5	5-day incubation methods		
P	Olsen extraction	Acetic acid, distilled water, reagent	Calorimetry
CEC	Ammonium acetate	Acetic acid, KCl, ethanol, distilled water, NaOH	Calorimetry

Soil sample and evaluation or testing.

Soil sampled at both water shades taken from 15m gaps from flower farms within four marked sites and common agricultural soil approximately from one-hectare land that sampled from ten points using stainless steel auger probe. This can pick out the soil samples from 1.2m depth (Figure 2) and collected sample soil from different points mixed before laboratory analysis (Attah and Regasa 2013).

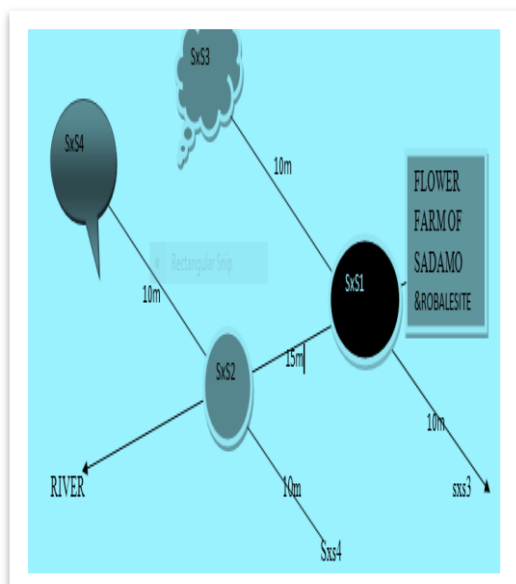
Sampled and mixed soil dried at room temperature, grinded using mortar and pestle then sieved by using sieve with 2mm diameter.

After all procedures did sequentially physico chemical parameters tested in laboratory, using their own measuring instruments (Table 1 above). The basic parameters evaluated in soil sample was pH, EC, CEC, P and T-N. Here, common agricultural soil sampled can used for comparing results with polluted soil sampled by flower farm chemicals after tested using laboratory (Beyene 2014). The basic common materials used in sampling of water and soil were listed blow in (Table 2).

Table 2. Basic common materials used in sampling of water and soil.

No	Sample types	Tools used for collection	Function of the tools
1	Soil	Auger soil probe	To collect soil sample from 1.2m deep surfaces
		Meter	Measure distance between sampled sites
		Plastic bags	To hold the samples
		Ice box	To hold sample from sites to laboratory
2	Stream water	Sterilized bottles	Hold water sampled from the rivers
		Meter	Measure distance between sampled sites with 15m gap
		Ice box	Hold sample to laboratory from sites
3	Effluent/discharge	Sterilized bottles	Hold sampled effluents to laboratory
		Meter	Measure distance between sampled sites with 10m gap.
		Ice box	To carry sample from sites to
		Paper & pen	To record the sampled data

1. ways of sampling the soil from all sites



3. collecting soil from auger prob istrument

2. soilsampling by augerprob instrument.



4. Collected soil in to containers at sites



Figure 2. Soil sampling from flower farm base line

Results of physicochemical tested in effluent & river water.

Physico chemical analysis was one parts of the current study that included pH, EC, SO_4^{2-} , NO_3^- , NH_3^+ , TDS, PO_4^{3-} , BOD and COD. These all parameters evaluated from effluent wastewater and river water sampled from both water shades. The result analyzed in laboratory organized in the flowing (Table 3 & Table 4) with comparing national standards (EPA 2003).

Table 3 physicochemical tested (laboratory results) from site one.

Parameters	Tested sample results		EPA,standard (EPA 2003)
	Effluents(E1)	Stream water site 1	
EC	585.7 $\mu\text{s}/\text{cm}$	319.70 $\mu\text{s}/\text{cm}$	100-1000 $\mu\text{s}/\text{cm}$
pH	3.75	6.85	6-9
NO_3^-	288 mg/l	25.3 mg/l	1-10 mg/l
SO_4^{2-}	42.5 mg/l	17.64 mg/l	0-315 mg/l
PO_4^{3-}	2.56 mg/l	1.2 mg/l	≤ 0.005 -0.1mg/l
T- NH_3^+	0.804 mg/l	0.492 mg/l	0.025 mg/l
COD	98.23 mg/l	85.42 mg/l	<150 mg/l
BOD ₅	25.1mg/l	28.35 mg/l	<5 mg/l
TDS	347.3 ppm	187.80 ppm	<1000 ppm

Table 4. Physicochemical tested from site two.

Parameters	Tested sample results		EPA standards (EPA 2003)
	Effluent site 2	Stream water site 2	
PH	9.52	8.1	6-9
EC	648.3 μ s/cm	240.40 μ s/cm	100-1000 μ s/cm
PO ₄ ³⁻	1.1 mg/l	0.96 mg/l	$\leq$ 0.005-0.1 mg/l
SO ₄ ²⁻	13.23 mg/l	6.39 mg/l	0-315 mg/l
NO ₃ ⁻	345 mg/l	4.5 mg/l	1-10 mg/l
T-NH ₃ ⁺	1.2mg/l	0.144 mg/l	0.025 mg/l
BOD	19.2 mg/l	24.4 mg/l	<5 mg/l
COD	87.34 mg/l	74.3 mg/l	$\leq$ 150 mg/l
TDS	368.7 ppm	137.5 ppm	<1000ppm

Discussion on effluent and river water results

The study mainly depends on Wolmera flower farms environmental performance evaluation or the ability of flower farms have to manage environmental pollution. Basically, it assesses all flower farms in the district to collect an important data from its original sources, but sampling of the soil, waste water and river water were taken from two different water shades which known as Robale and Sadamo sites. The sampled materials included effluents (E1&E2) and river water (RW1&RW2) at both sites to analysis the parameters related with operational performances of the farms. Those parameters analyzed in both sample types were physicochemical parameters (pH, EC, TDS, NO₃⁻, SO₄²⁻, PO₄³⁻, T-NH₃⁺, and BOD & COD) of the water that can used to decide about flower farms performance within the environment. Depending on above (Table 3 & 4) laboratory results all parameters were interpreted one by one as following.

Electrical conductivity result.

Electrical conductivity of water increase depending on the chemical type that have added to the water body directly or indirectly. Wolmera flower farms directly discharged polluted materials with chemical fertilizer and pesticides that had the ability to pollute environments. This discharged material added to the water bodies; change the water contents and it require testing to evaluate the performances of flower farms had within environment managements. The current study by considering this condition;

effluent and river water sampled and tested in laboratory to estimate EC values in both sampled materials. The sampled materials tested or evaluated in laboratory and evaluated results from the sampled materials at both water shades illustrated in the above (Table3 & Table 4).

This included 585.7 μ s/cm and 319.70 μ s/cm for effluent and river water at site one and 648.3 μ s/cm and 240.40 μ s/cm for both effluent and river water respectively for the site two. Both evaluated results compared with the Ethiopian EPA standard (EPA standard 2003) which have an interval of 100-1000 μ s/cm for evaluation of EC of the wastewater discharged from the industries to environments. When, EC can express the number of ions added to the water body as it understood from results, high amount of pollutants added to the river which main cause for increasing values of EC in the water bodies. The incremental values of EC can affect the micro & macro organisms live in the water body, influence the domestic use, harm the agricultural irrigation and affects the industrial process (Moore 1989). In addition to this, when both sites were compared with each other, site two had more EC values than site one and has more impacts on environments with having less operational performances. EC values direct related to discharge of industrial and domestic wastes (Alemayehu 2001),but, in this case the problems came from industry activities or environmental performance weakness of the flower farms in the areas (Figure 3).

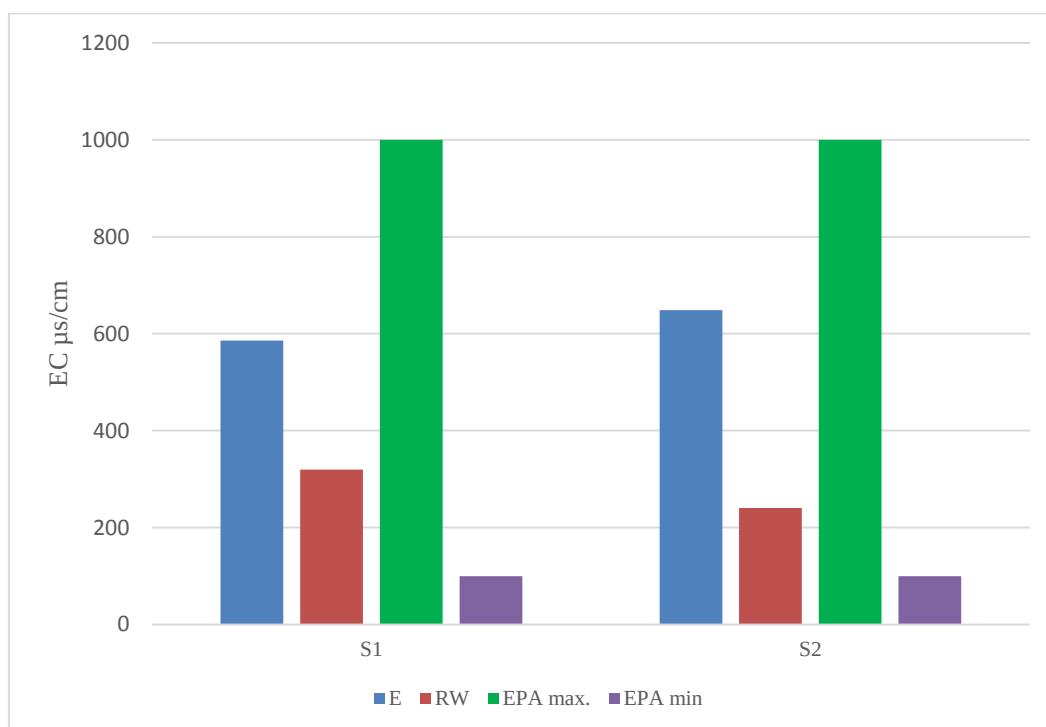


Figure 3. EC at site one and two

pH results in both effluent and river water.

The pH of water body increases or decrease within the chemical waste or simply waste added to the water bodies (Kaur and Sharma 2014). When the pH of water increases in values, the alkali substance (base) increased and when the value of pH decreases in number, acidic substance increased in the water body. In case of this study the pH values that obtained using laboratory analysis from the Robale site (site1) 3.75 & 6.85 for effluent and river water respectively (Table 3).

As it observed from the laboratory results of above (Table 4) the estimated effluent, wastewater was 9.52 and river water 8.1 at site two and EPA standard is between 6-9 intervals. When both sites compared with each other based on (Table 3&4); the result at site two had less acidic and contain more amount of base as observed from results above and site one sample contained more acidic substances. As it understood from the results, the effluent water has high amount of acid than river water in site one but the site two effluents has less acidic and contain more percentage of alkalis. Therefore, this express that concentration of chemical in the effluent has high probability to pollute the water bodies and the surrounding environments that resulted for rivers water pollution or all most acidic and basic properties of rivers emanated from weak performances of the flower farms operational process. According to FAO (2011) pH greater than 8.5 is not advisable for irrigation purpose and also which has high amount of acidic substances were the same. Therefore, from the analyzed samples the Robale and Holeta rivers with this situation impossible to use for domestic, irrigation, industry and even if for cattle drinking unless the exist problems will be solved or existed compliances corrected (Figure 4).

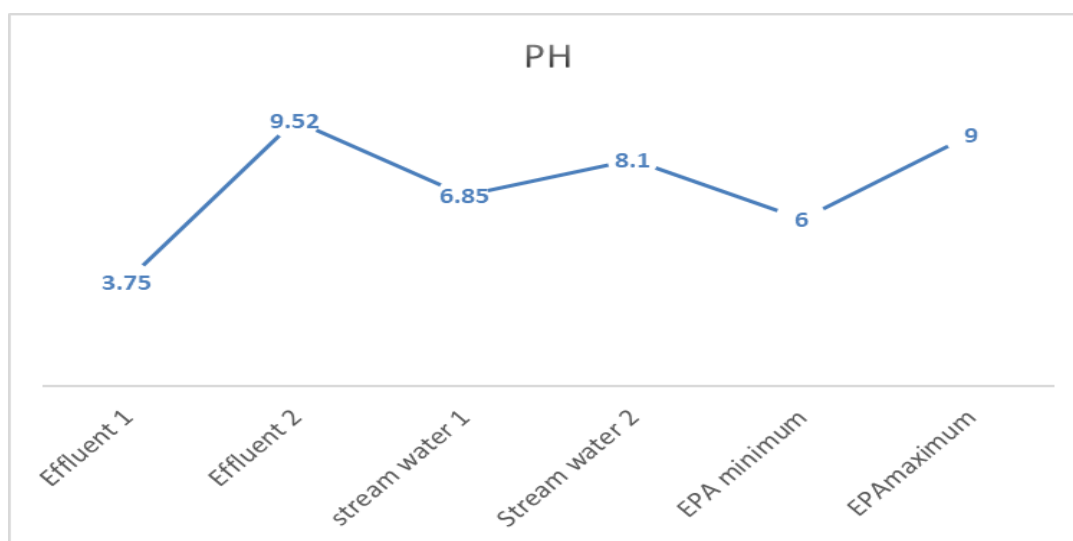


Figure 4. pH values at site one and site two sampled.

NO₃⁻ values analyzed in effluent and stream water.

NO₃⁻ is organic/inorganic ester or salt of nitric acid play major role in environmental pollution. In this study NO₃⁻ values at site one and site two or from each water shades the materials were sampled and evaluated at laboratory using spectrophotometry instrument. The concentration of NO₃⁻ at site one 288mg/l and 25.5mg/l for effluent and river water respectively and also the effluent & river water NO₃⁻ ion values analyzed at site two 345mg/l and 4.5mg/l respectively (Table 3 & 4). In addition, the Ethiopian EPA standard (2003) is 1-10mg/l to nitrate ions for the wastewater discharged from industries. As it observed from the laboratory results the effluent water from the flower farms contents high amount of NO₃⁻ at both sites and the river water greater the EPA standards at site one but the NO₃⁻ contents in river water at site two fall in the EPA standard intervals. This may be depending on the sampling season i.e. it is dry season at the effluent water could be infiltrated in to the soil and also depend on the distance between flower farm & river that may be affected by slopes of the water shades. This caused from high amount of NO₃⁻ chemical fertilizer waste discharged to the nearby river from the flower farms without any treatments and any environmental recognition. High amount of nitrate in the water bodies cause eutrophication which can cause deficiency of oxygen in the water body (Kassa 2017). In the same way when nitrate concentration high in water bodies cause different problems on human health and animals (Melaku, Wondimu et al. 2007). Water with nitrate levels exceeding 1.0 mg/l should not be used for feeding babies (Dodds, Smith et al. 2002) because of it can cause blue baby syndrome (Knobeloch et al 2000, Henry wain wright 2014). As this statement, under certain conditions high levels of nitrate (>10 mg/l) in drinking water can be toxic to human and has been linked to serious illness and even death of infants. The ambient standard to protect aquatic ecosystems of NO₃⁻ ion is 10 mg/l as stated by EPA (2003). But in current study induces 5.76 kg of NO₃⁻ ion added to water body per hectare of flower farm production that can support the development of eutrophication and acidification. In general, the water body, which find in both water shades were not comfortable or enough to domestic usages, irrigation and cattle until the problems would solved from the factory (farms) or it require professional checkup or compliance implementation in the flower farms based on EPA & EHPEA standards.

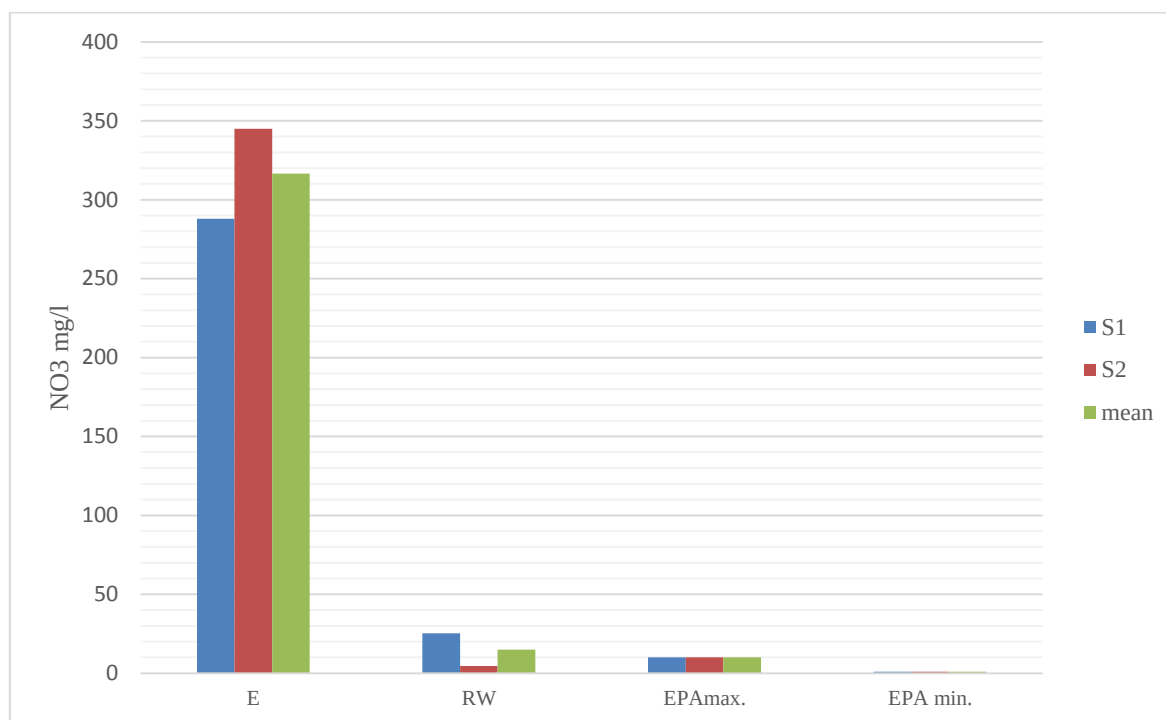
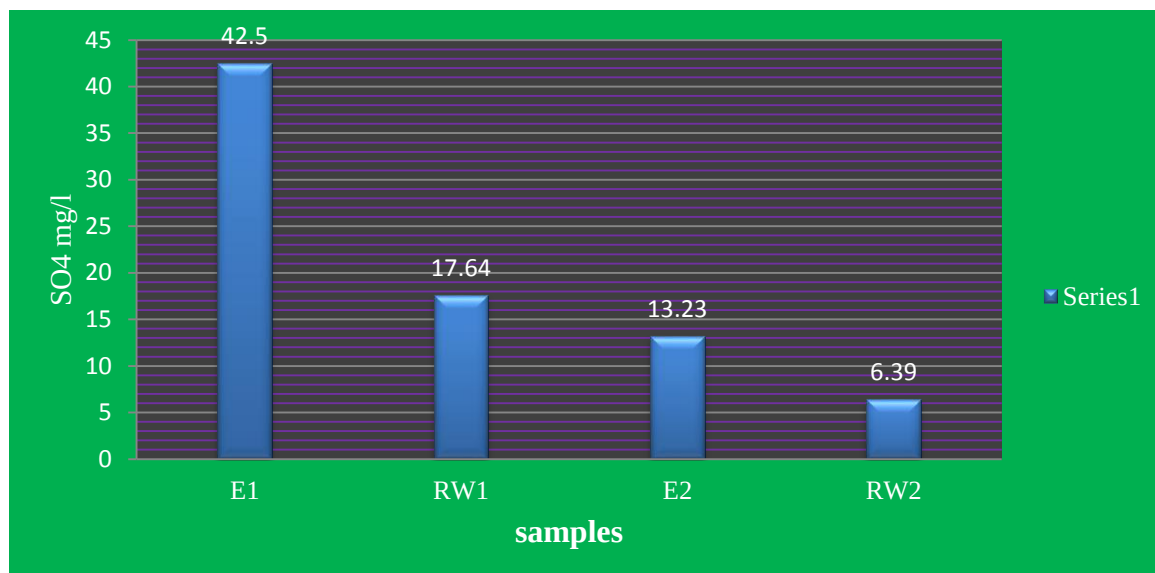


Figure 5. NO₃⁻ results in the site 1 & 2 samples.

SO₄²⁻ values analyzed in effluent and stream water.

As it aggregated in the result (Table 3 and 4) SO₄²⁻ ion was evaluated in laboratory using spectrophotometry in both effluent and river water. The total amount of SO₄²⁻ ion in the effluents and river water evaluated at site one samples were 42.5mg/l and 17.64mg/l respectively and at site two (Sadamo site) the SO₄²⁻ ions evaluated by laboratory in effluent waste water and river water were 13.23mg/l and 6.39mg/l respectively. The concentration of SO₄²⁻ ions in the effluent waste water higher at both sites and high concentration of SO₄²⁻ ions in the effluent waste water resulted from the high amount of chemicals fertilizer and pesticide had used in the flower farms be discharged to the environments (Alemayehu 2001, Melaku, Wondimu et al. 2007). Depending on the laboratory results of above (Table 3 and 4) it is possible to decide the flow of SO₄²⁻ ions and its pollution sources which indicate that more amount of SO₄²⁻ ions discharged to the river or environment at this moment (Figure 6). In addition to this the farms added at average about 27.8 mg/l SO₄²⁻ ion per hectare to the nearby river that increase acidity of the river and support the developments of acidification that may have negative consequences in the environmental sustainability's.

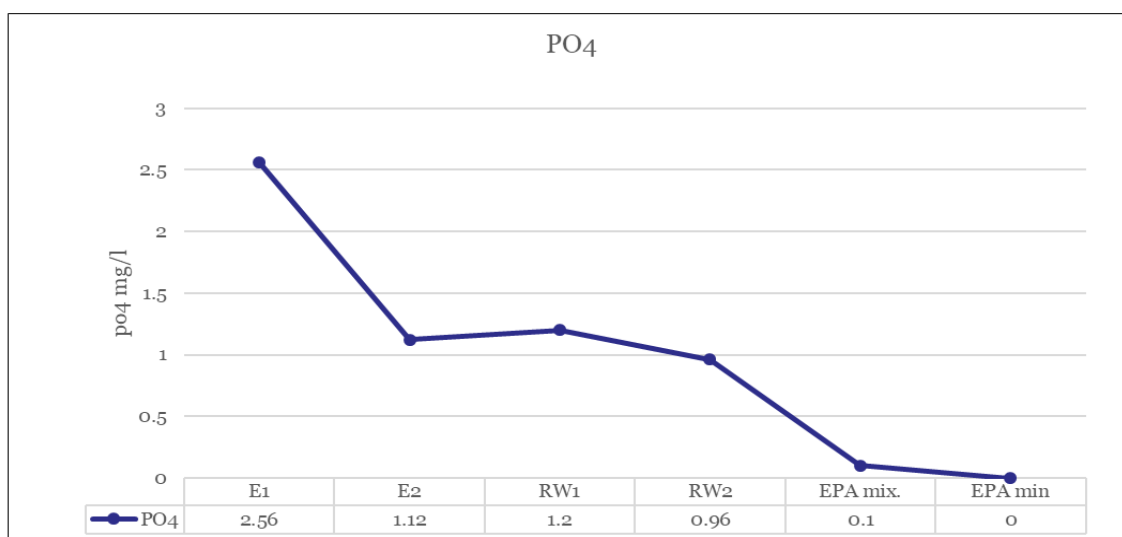
Figure 6. SO₄²⁻ values at both sites.

NH₃⁺ results from effluent and river water.

Ammonia is one of the chemical substances that examined in the flower farms effluent and river water in this study at both water shades. The total ammonia (NH₃⁺) obtained from evaluated effluent and river water were 0.804mg/l and 0.492mg/l at site one and 1.2mg/l and 0.144mg/l for effluent and river water for site two respectively which already organized on the (Table 3 & 4) above. The results show that the acquired values were greater than Ethiopia EPA (2003) standards (0.025mg/l). This was originated from discharged wastewater contain more amounts of chemical fertilizer and pesticides (fungicide, herbicide and insecticide) that have discharged from flower farms without any recognition of the environmental problems. The current study identifies not only EPA (2003) standard values but also an average amount of ammonia discharged to the rivers that support the eutrophication of environments that emanated from the flower farms (Table 3& 4) i.e. NH₃⁺ is the main compounds/ molecule that supports eutrophication in aquatic and terrestrial environments (Huijbregts, Schöpp et al. 2000).

PO₄³⁻ tested values at both sampling sites.

PO₄³⁻ ion is the other types of chemical substances that examined in the sample collected from both sites of water shades. The PO₄³⁻ ion results in the effluents and river water estimated were 2.56mg/l and 1.2mg/l at site one and 1.12mg/l and 0.96 at site two respectively. The PO₄³⁻ result in the effluent water was greater than river water at both sites (two times of stream water results) and more than Ethiopian EPA (2003) standards (≤0.005-0.1mg/l). The standards (EPA 2003) express that the highest PO₄³⁻ ion contents of water body not proceed 0.1mg/l and the minimum value not less than 0.005mg/l. The result shows that the effluent water as well as both site river water had high amount of PO₄³⁻ ion at this moment and it discharged in average 1.88 mg/l of PO₄³⁻ emission emitted to nearby river from flower farms. This occurred from excessive chemical fertilizer and pesticide used in flower farms without recognizing the environmental problems when they were discharged and disposed wastes to environments which express existences of low operational performances in the Wolmera district flower farms.

Figure 7. PO₄³⁻ graph evaluated at both sites

Total dissolved solid (TDS) results.

TDS of the effluent and river water sampled and tested using conductivity probe in the laboratory to get tangible information on floriculture environmental performances. The total dissolved solid (TDS) tested at site one 347.3ppm and 187.80ppm in the effluent and river water respectively (Table 3) and TDS tested values at site two 368.7ppm and 137.5ppm for effluent and river water respectively (Table 4). This belongs that high amount of dissolved substances existed in the effluents leads to the rivers found near the flower farms or environments. Even if the results found in the interval, it can create the pollution. This shows that the existences of low operational performance existed within flower farms, which resulted to environmental pollutions in the district.

Biological Oxygen Demand (BOD₅) results.

BOD₅ evaluates the quantity of Oxygen consumed (required) by microorganisms during decomposing the organic material in the water bodies (Wondie 2009). Microorganism or bacteria need sufficient oxygen in the water bodies to decompose materials to another material, unless the organism in the water body affected by deficiency of oxygen gases. BOD₅ can be used as a gauge of the effectiveness of waste water treatment plants (Lokhande, Singare et al. 2011) and it is one of the water pollutant indicators. In this study paper the BOD₅ estimated in laboratory using five day incubation methods at 20 C° and the evaluated results were 25.1mg/l & 28.35 mg/l for effluent and river water respectively at site one and 19.2mg/l and 24.4mg/l for effluent and river water at site two respectively.

But the results at both sites were out of the Ethiopian EPA (2003) standards (<5 mg/l). This shows that flower farms are discharged high amounts of nutrients or organic materials to the environments without treating the polluted water in the farms and existences of low operational performances process in the flower farms. Unless this condition solved from the organization, pollution of an environments can continuous and need proper compliances or valuable management of the operational performances in the district flower farms with excellent super vision from governmental and non-governmental authority (EPA, water resource management authority office, WHO &FAO).

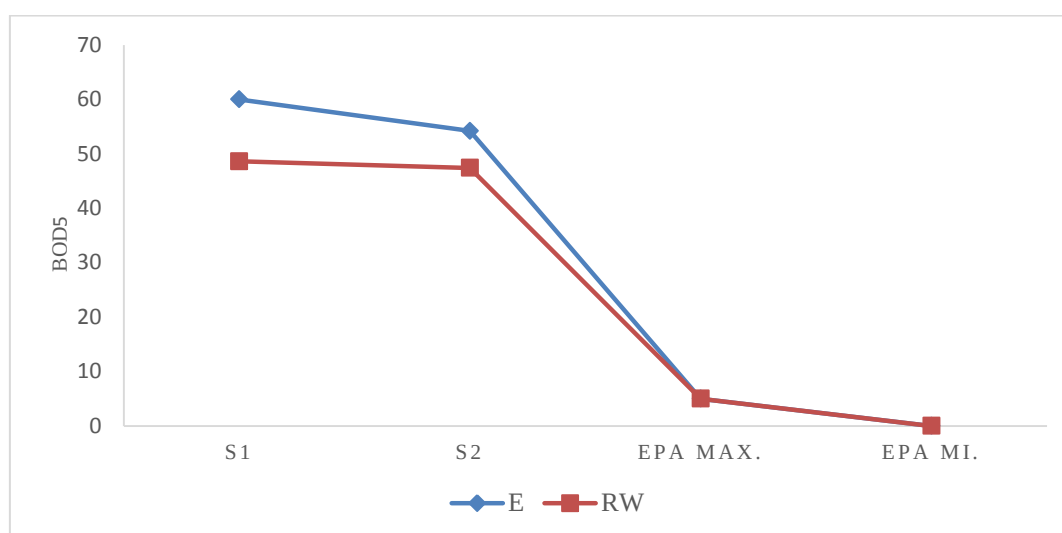


Figure 8.BOD graph at site

COD results at both water shades.

COD is a measure of the total quantity of oxygen required to oxidize all organic and inorganic material in to carbon dioxide and water. High levels of COD and BOD values in the area could be due to excessive organic and inorganic wastes in the farm effluent (Patil, Sawant et al. 2012) and it is one of the main case of water pollutants in the environments (Mesfin Kebede 2014). In this study, COD of effluent and river water tested using spectrophotometry after sample wastewater; dichromate and sulfuric acid mixed together reacted in reactor for 2 hours with 140 C°. The COD evaluated at site one was 98.23 mg/l and 85.42 mg/l for effluent and river water respectively. In the same ways, the COD tested values at site two 84.34mg/l and 74.3mg/l for effluent and river water respectively. As observed from tested results high COD measured in the effluent at both sites than river water. Even if, both values were scored in the EPA (2003) intervals or the Ethiopian EPA standard (<150mg/l), approximately high amounts of organic and inorganic substances have discharged or disposed to the field and rivers as recognized from sample tested results in laboratory and for more clarification both site results and EPA (2003) standard were illustrated on (Figure 9).

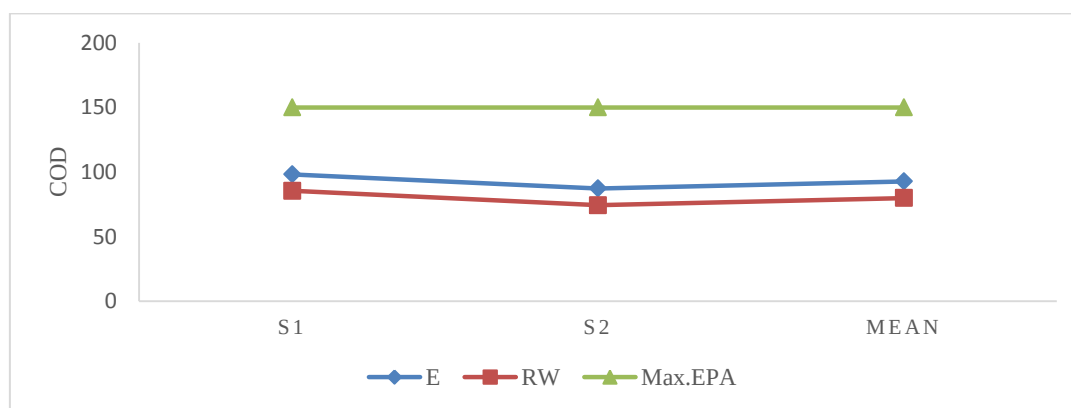


Figure 9.COD results at both sites / water shades.

Table 5 soil parameters evaluated results

Tested parameters	CEC	T-N	pH	EC	P
Unit	Cmol/kg	%	-	µs/cm	mg/l
Laboratory result at site 1	107.405	0.205	6.85	661.325	86.95
Laboratory result at site 2	99.72	0.19025	7.688	678.26	88.43
Laboratory result at site 3	30.68	0.12	7.82	367.52	27.5

Soil samples laboratory evaluation results.

Soil is another sampling material in this paper (study) and the samples taken from two water shades of flower farms and common agricultural land to compare the results with common agricultural soil evaluated results by following (Tan 2005). In the study, the most five important (common) parameters were evaluated which included electrical conductivity (EC), pH, cat ion exchange capacity (CEC), total nitrogen (T-N) and phosphorous (P) contents of the soil. These parameters used to determine whether the flower farms affect the environments or not; by compare the results of both water shades base line sampled soil with the common agricultural soil sample examined. In this study, based on the tested results floriculture effluent emission seriously affecting the soil parameters found near the flower farms when compared with common agricultural soil sample evaluated. The sample tested from base line of cut flower production farms measure high amount of values that can create impacts on environments when compared with common agriculture tested soil and previous articles to kills useful organisms in the soil and it disturbs the biodiversity in the environments as (Kebede, Beyene et al. 2012).

Therefore, if it continuous in similar ways, after a long period of time it may create soil sterilization in the areas (Getu 2009/11). In general, all sampled sites (three water shades) of sampled soil and evaluated results illustrated on (Table 5) above and results of each parameters discussed blow one by one comparing with common agricultural evaluated soil results.

CEC results in soil.

Cat ion exchanging capacity of soil sampled at both sites and common agricultural land sampled evaluated. Each sampling sites had about four sample results at both sites for the laboratory testing purposes and the result on (Table 5) above based on mean values of all tested samples. The average value evaluated at site one 107.405 Cmolc/kg, at site two 99.72 Cmolc/kg and at site three 30.68 Cmolc/kg. As it recognized from three results, the evaluated

results had highest values at first two sampled sites. Since, CEC measure the soil's capacity to retain and release cat ion substances (K, Ca, Mg, and Na) in soil, current study results show high amount of cation retain in the surrounding soil. These results may related to high clay existences in the areas, which tend to have a high CEC as (Tilahun2013). Since, cat ion exchanging depending on the nutrient (wastes) removed from the flower farms; site one has high values than site two and both values were greater than the values of common agricultural soil sample results. These express that at both sites had high dosages of chemical fertilizer and pesticides were discharged to the environments. Accumulation of cation in soil increase through time unless it treated properly (Tilahun, 2013). This result express that the areas within a time may be leading to high salinity that may sterilized the soil that caused from operational performance problems in the flower farms regarding to environmental managements value of the firms.

T-N tested in soils.

T-N also another parameter that analyzed in the soil sampled of this study. The laboratory-tested results for both sites of total nitrogen percentage were evaluated from four sampled soil at all sites (S1, S2, S3) and took mean of them for each of sampled soil (Table 5). The T-N evaluated results were 0.205, 0.19025 and 0.12 percent for site one, site two and site three respectively. As it understood from three site results by comparing with each other the values of both flower farm base line samples were had the highest values than the common agricultural soil sampled from the farmland. This resulted from using high dosage of fertilizer & pesticides and express low operational performances existences in the flower farms. According to Marx et al (1999), a typical agricultural soil contains about 0.10 to 0.15 percent of N. From this study we can recognized the flower production farms base line soil contain more nitrogen than common agricultural soil, which can harms the environments. High amount of N in the soil cause terrestrial and aquatic eutrophication (M. Nasir khan 2014,

Bobbink et al, 1998) and N contents of the soil near flower farms increases with percentage increment of effluent discharged to the soil (Mesfin Kebede 2014). As this statement, the increasing amount of N substances or high dosage of N substances in soil within current study mainly based on UN treated effluent water of flower farms discharged to the environments that related with low operational performance existences in organizations. This situation can lead the areas to terrestrial and aquatic eutrophication, acidification and global warmings (Xia and Yan 2011).

EC results at all water shades in soil.

It estimates the amount of total dissolved salts or the total amount of dissolved ions in the soil. High electrical conductivity indicates high dissolved solids concentration or salts (Sarin, Krishna swami et al. 1989). In this study, the EC of soil examined from three water shades. The tested laboratory results were 661.325, 678.26 and 367.52 $\mu\text{S}/\text{cm}$ for site one, site two and common agricultural soil respectively. When it concluded from the aggregated data results, site two flower farms discharge more amounts of salty chemicals (fertilizer and pesticides) than site one. However, both site results were greater than the common agricultural soil sample result. These indicate that both flower farms use more amounts of chemicals that harm the environments. According to Patterson (1999), any effluent having pH and EC higher than 7.0 and 1000 $\mu\text{S}/\text{cm}$ respectively could affect the physicochemical properties of soil. In these soil samples, EC not more than 1000 $\mu\text{S}/\text{cm}$, but it found in the interval. Therefore, even if found in the interval; it indicates that the farms have used high amounts of chemicals and discharges to the environments as it under stood from the laboratory results. When the amounts of EC become high the exchangeable elements in soil become high and the salinity of soil maximum. EC of newly established greenhouse is higher than the former one; this might be the continuous usage of fertilizer and pesticide, in order to improve the fertility of soil (Tilahun 2013). Concerning on Tilahun 2013 the scored results express that the flower farms in the district are not new. But they are extending from time to time on the reserved land. Therefore, the firms may cause nutrient imbalances and affecting physicochemical parameters of the soil if continuous just like this without any attention to environments.

pH results in soil at all water shades.

pH is one of parametric indicator of the relative concentration of hydrogen ions (H^+) in the soil solution. In this study testing of soil pH was a basic criterion to know the discharged materials whether it is alkali or acidic wastes. In addition, it used to know the operational performances of the flower farms whether it is good or bad. Based on the condition pH values estimated for all sampled soil using sampled materials from all water shades. The result obtained for site one, site two and site three were 6.85, 7.688 and 7.82 respectively. The results evaluated at site one was more acidic than site two and common agricultural soil tested result when compared with each other's. Also, the results of site two concentrated with alkali materials than both site one and common agricultural results. However, as Patterson (1999) any effluent has pH greater than 7.0 could affect the physicochemical properties of soil. Therefore, the pH values of this study might be affecting the soil property when related with Patterson (1999) statements.

Phosphorous results at all water shades.

Flower farms use chemical fertilizers and pesticides to maximize the production at different sites with different times in the flower farms for production process of cut flowers. Concerning of these study phosphorous substances analyzed from both Robale and Sadamo flower farm base line soil sampled and common agricultural soil sampled. The results tested by laboratory expressed for site one, for site two and common agricultural soil samples were 86.95, 88.43 and 27.5 respectively. The values of P at site two was greater than site one and both sites results were greater than the common agricultural soil sampled results. This indicates that both Robale and Sadamo sites use more amounts of chemical fertilizer and pesticides that discharged and pollute the environments with existence of low environmental performances that emanated from low operational performances in the flower farms. High phosphorus (P) existences in the soil can causes excessive growth plants and algae on surface of water, damaging aquatic ecosystems when leached to river with runoff (Marx, Hart et al. 1999).

So, it cause acidification of the territory and aquatic ecosystems with having the ability of contributing eutrophication in the environments (Babbink et al 1998) with limit the environmental significance fates.

BOD/COD ratio indication for pollutant load

By utilizing the ratio of biological oxygen demand (BOD) to chemical oxygen demand (COD) (BOD/COD), wastewater evaluation systems can determine whether organic or inorganic contaminants are more concentrated in the wastewater. According to Kruis (2014), an assessment reveals that wastewater with a BOD to COD ratio of 0.1 to 0.3 contains a high concentration of organic materials, while wastewater with a ratio larger than 0.5 contains fewer organic compounds. This demonstrated the concentration of organic contaminants, both degradable and non-degradable, in wastewater released by flower farms. The effluent and raw water evaluation results at site one were 0.25 and 0.33, respectively, whereas the results at the study's second site were 0.21 and 0.31 for each. Therefore, flower farm wastewater need not only conventional wastewater treatment system but also, it need to use advanced oxidation process (AOP) to safe environmental sustainability and to recommend the fate of our environments with its components.

CONCLUSION

Wolmera flower farms use excessive amounts of resources and release a significant quantity of trash into the environment, which has an impact on the environment and its constituent parts. Input-output materials are evaluated and identified within the company through the use of inventory and sampling data gathering techniques. Using laboratory analysis techniques, the physicochemical qualities of soil, effluent, and river water were assessed. The results showed that the materials did not meet national criteria, which might lead to pollution of the environment. Similar to this, laboratory data were used to assess the fundamental causes of eutrophication and acidification materials (NO_3^- , PO_4^{3-} , NH_3^+ , and SO_4^{2-} from wastewater & N, P from soil). The study found that the wastewater released from the farms was heavily contaminated with non-degradable organic pollutants, based on the pollutant qualities measured by the biological oxygen demand (BOD_5) to chemical oxygen demand (COD) ratios. This analysis

indicates that the farms generally perform poorly operationally and are not as significant environmentally.

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