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Flower production prospects and sustainability challenges in Ethiopia: A systematic review

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The people, planet, and profit sustainability concerns emerged as a novel concept in the ethical business governance system in the floriculture industry. In Ethiopia, however, the sectoral sustainability concern is in its infant stage. Currently, the floriculture industry faced many criticisms because its improper cultivation greatly worsened social well-being and the environment. Therefore, the industry needs to examine the current findings about sustainability and explain the apparent discrepancies. As a result, a systematic review was conducted to analyze the sustainability challenges in the floriculture business and its impact on the environment and society. Relevant studies were collected using the Web of Science, Science Direct, PubMed, and Google Scholar databases. Gray literature search from private and governmental institutions was also conducted. Papers outside the topic's scope or published articles with a weak methodology setup and numerous editorial issues were eliminated. While documents with high relevance to the topic of interest were used as inclusion criteria. Accordingly, 80 articles through databases and 29 papers *via* gray literature search were collected and chosen for synthesis. In this article, therefore, the Ethiopian floriculture industry sustainability challenges were analyzed along with various empirical findings. The effects of unsustainable flower farming on society, soil and water health were also enclosed. The underlying factors that led to sectoral sustainability problems were addressed and used as debating points for discussion. The paper also contributes to the scientific discussion by highlighting the areas that need further study and the policy ramifications of sustainability in the flower business.

KEYWORDS

floriculture, people, planet, profit, sustainability challenges

1 Introduction

Floriculture is one of the freshly evolving industries of Ethiopia. The sector created job opportunities for thousands of people, especially women and generates a huge amount of foreign exchange earnings for the country. Around 212 million USD was received from the export of the cut flower in 2017 (NBE, 2020). According to Gebreeyesus and Iizuka (2010), the Netherlands, Germany, the United Kingdom, Japan, the United Arab Emirates, and Saudi Arabia are the major market destinations for Ethiopian flowers. The report of Petal Republic (2022) placed Ethiopia as the fifth-largest producer and exporter of flowers in the world, after the Netherlands, Colombia, Ecuador and Kenya.

Despite its significance, the industry is having problems with sustainability in terms of people, planet, and profit issues. Ethiopian flower farms' profitability is impacted by several factors. However, inadequate infrastructure and logistics systems (Debela, 2013; UNDP, 2017), growers' inability to access market information, a lack of skilled workers (Joosten, 2007), the absence of fundamental floriculture inputs in the nation, and constrained product ranges (Belwal and Chala, 2007; Sorsa, 2011) is the major profit issues requiring immediate action for its future development. Debela (2013) pointed out that a country's wealth and capability to compete in the global market depend on its ability to transport commodities promptly, affordably, and dependably. However, the Ethiopian logistics system is characterized by a lack of coordination in the transport of goods, a lack of development in the infrastructure, insufficient fleets of freight vehicles in terms of size and age, and damage and quality deterioration of goods during handling, transportation, and storage. Due to this circumstance, Ethiopian products are not competitive in the international market. The issues with investing in floriculture, according to Janko and Alemu (2009), also include the producers' inability to understand the requirements and preferences of customers, capture the new market, communicate effectively with customers, and fill knowledge gaps in the marketing channels.

Moreover, low wages, issues with workers' health and occupational safety, sexual harassment, regular violations of workers' rights and freedoms, surrounding community health issues, and low compensation for former landowners are other issues associated with the Ethiopian floriculture industry (Gezmu, 2013). Ethiopia, for example, differs from Kenya in that it does not have a legal requirement to accommodate employees, according to Ergon (2015). The report also revealed that the National Federation of Farm, Plantation, Fisheries and Agro-Industry Trade Union (NFFPFATU) is the only trade union federation representing employees in Ethiopia and it is not industry-specific. However, Kenya has two additional labor organizations called the Agricultural Workers Union (KPAWU) and the Agricultural Employers Association (AEA), which are in charge of handling wage concerns not addressed by the sectoral collective bargaining agreement (CBA). As a result, Kenyan flower farm wages are higher than Ethiopian flower farm wages.

Other significant global challenges to floriculture include environmental pollution and the depletion of water resources (Getu, 2009). For instance, according to Gudeta (2012), more than 90% of the rose producers were dependent on groundwater resources despite the huge amount of water requirements for the rose plant. As a result, communities, organizations and researchers started questioning the water depletion issues of the floriculture industry. Higher contents of PO4-, NO3-, and total NH3 in Wedecha river and Ziway lake were also reported due to poor waste management and disposal systems of flower farms in Ziway and Debre Zeit (Tamiru and Leta, 2017). Additionally, most flower industries did not prepare an Environmental Impact Assessment (EIA) document even though preparing this document is an important step to protect the environment (EFCCC, 2018a).

To address the aforementioned social and environmental sustainability challenges, both mandatory national (Council of Ministers' code of practice for the floriculture sector) and voluntary international (EHPEA-CoP, MPS A/B/C, MPS GAP, MPS SQ, Fairtrade, and FFP) standards were developed (Rikken, 2010). However, significant improvements were not yet achieved in most flower-producing and -exporting companies. For instance, along this line, during the 2018 fiscal year, the EFCCC's Directorate of Legal Compliance Control and Monitoring of Development Institutions department performed monitoring and control work on 70 flower farms (EFCCC, 2018a). The assessment results showed that the majority of flower farms performed poorly and did not meet the minimal bronze-level requirements. Regardless of the compliance criteria, three ranks—best, medium, and poor—were developed by contrasting the farms with one another, and it was concluded that 20% of the flower farms were ranked as best, 47% as medium and 33% as poor level.

Reviewing and synthesizing the existing findings concerning floriculture sustainability challenges is, therefore, vital for asserting the current issues of sustainability, explaining the apparent inconsistencies, and identifying the required research areas in the sub-sector. Therefore, the paper aimed to assess and analyze the concepts and issues of sustainability in the floriculture industry and its impact on the environment and society, and actions to be taken for admissible development of the sub-sector in the country.

2 Literature review

2.1 Floriculture industry in Ethiopia

Flower exports and imports are an essential component of international trade, yielding 30 billion euros in earnings per

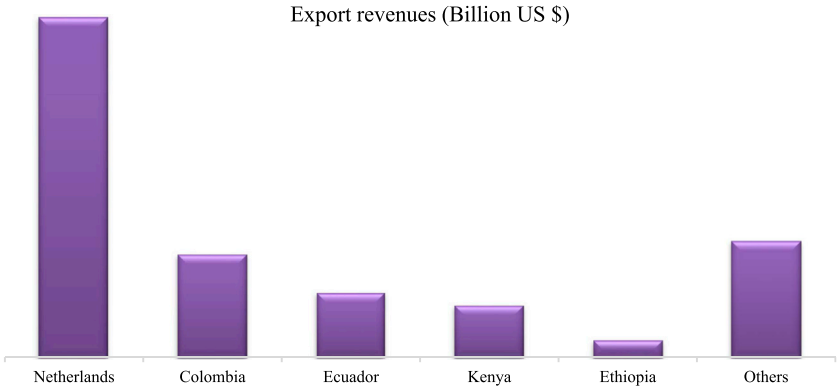

FIGURE 1
Top five countries by flower export revenues and shares in 2019. Petal Republic, 2022.

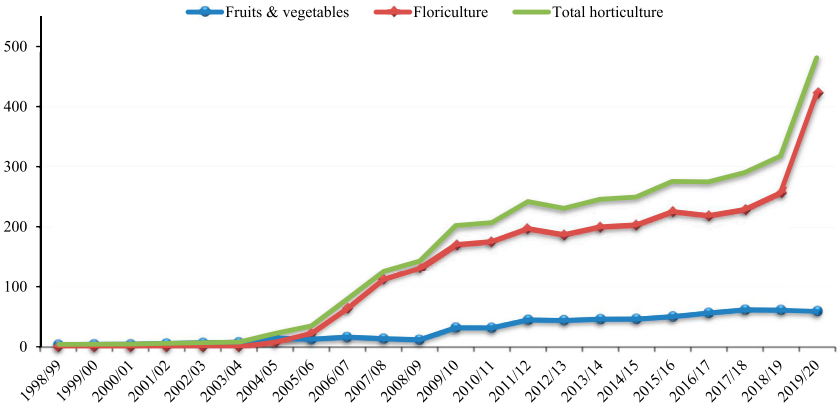

FIGURE 2
Export value of horticultural crops between 1998/99 to 2019/20 (in $ million). Oqubay, 2015; Oqubay, 2017; NBE, 2020.

annum (PRE, 2022). Netherlands is the hub for global flower trading centers for several years. Besides being the home to the world's biggest flower auction (FloraHolland), the nation is also the largest flower exporter (48.9%) worldwide (Figure 1). The second-and third-largest world flower exporters are Colombia (14.9%) and Ecuador (9.3%), respectively. Kenya ranked fourth (7.5% share) while Ethiopia took fifth place (2.6% export share).

Because of its capacity to generate employment creation, foreign exchange, and the country's geographical advantage, the government of Ethiopia is helping both domestic and foreign investors to invest in the sector (Embassy of Japan in Ethiopia, 2008). As a result, the flower sector became the second most important export commodity next to coffee, accounting for more than 14.1% of the nation's total export earnings (NBE, 2020). Between 1998/99 and 2019/20, the industry earned more than $2.8 billion for the country. Currently, Ethiopia has 84 active flower farms rooted in high-quality flowers (EHPEA, 2017). Besides rose farming, five farms are engaged in the production of cuttings. While eight other flower farms produce other flower types such as *carnations*, *Hypericum*, *Amysanthemum*, *Gypsophila*, etc.

However, floriculture was almost non-existent in Ethiopia before 2004 (Figure 2). Immediately after its establishment, the export earnings grew rapidly from 0.32 million USD in 2003/04 to 422.3 million USD in 2019/20 (Oqubay, 2015; EHPEA, 2017; NBE, 2020). Within the horticultural sector, floriculture dominates with an 88% share of total horticultural export earnings in 2019/20. Oqubay (2015) pointed out that 1) the presence of worldwide flower auction markets, 2) the less stringent international standards in flower products, 3) the feasibility nature of air transport in flower export, and 4) the shorter period required for its production are the factors behind the success of the flower sector compared with fruits and vegetables. Hence, flower growers can enter easily the global

auction markets if minimum requirements are satisfied. However, the story is different for food items like fruits and vegetables; levels of maximum and minimum pesticide residue in food items are strictly controlled. Moreover, investment in the flower subsector has a shorter payback period than most fruits with long gestation periods.

Apart from contributing to the overall economic development of the country, the floriculture industry has created job opportunities for about 183,000 people, of whom more than 80% are women (EHPEA, 2017). This is making an important contribution to local economies, the empowerment of females in the community, and household food security. Because women in Africa have some difficulties in having their job it is turn out to be an important source of income and one way to escape from being dependent on family.

In addition, some flower-producing companies have engaged in community support programs involving school construction and renovation, teacher employment, clean drinking water provision, road maintenance, healthcare services provision, and meal provision (often subsidized) in primary schools (Kirigia et al., 2016; EHPEA, 2017). While these interventions have addressed the needs of the local populations, healthcare and meal provision had not managed to reach the target groups due to the financial limitations of the companies and a lack of consultation on the exact needs of local communities. However, none of the companies incorporated specific activities to stimulate technology transfer to local farmers, and thus such transfer was not observed in these cases.

2.2 Concepts of the people, planet and profit sustainability

The term 'sustain' comes from the Latin language 'sustenare' meaning "to hold up or to support" (Sutton, 2004). The closest synonym and usage of the word is 'maintain'. Sustain and its derivatives i.e., sustainability, sustainable, sustaining, etc. were firstly used by the Swiss and German foresters who created a form of forestry designed to keep the forest going as a productive system over the very long term called sustainable forestry (Grober, 2007). The concept was then expanded to another agriculture sector e.g., sustainable fisheries. The usage of environmental sustainability was established at the time of the 1972 UN Conference on the Human Environment held in Stockholm (UN, 1972). The 1980 World Conservation Strategy, an International Union for the Conservation of Nature and Natural Resources (IUCN), officially used the concept of sustainable development with the connotation of "development that would allow ecosystem services and biodiversity to be sustained" (IUCN, 1980).

The Brundtland Commission, an institution established by the United Nations in 1987, defined sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (UN, 1987). Sustainability is, therefore, a holistic approach that considers ecological, social, and economic dimensions, recognizing that all must be considered together to find lasting prosperity (Basiago, 1999; Crowther and Aras, 2008; Kuhlman and Farrington, 2010; Morelli, 2011).

The 1992 UN Conference on Environment and Development (UNCED) in Rio (WHO, 1992) stressed the importance of integrating environmental and social concerns into all development processes to achieve socially inclusive and environmentally sustainable economic growth (Figure 3). Conventional economists focused principally on the capacity of the market to allocate resources efficiently and assumed the supply of natural resources is limitless (Basiago, 1999). They thought that economic growth would bring the technological capacity to replenish natural resources destroyed in the production process. However, nowadays, it has been realized that natural resources are limited and, a constraint for the growing scale of the economic system (Neumayer, 2000).

The level of the business, type of project, and geographic extent, according to Slaper and Hall (2011), determine what sustainability indicators should be included. For instance, van Uffelen and de Groot (2005) described the triple P-concept of sustainability as a way of making money (Profit), with care for the environment (Planet), and a socially responsible way (People). The term Profit comprises assets, return on investment, partnerships, mergers, etc. Planet denotes soil, air, water, and the effects of the use of fertilizer, chemicals for pest control, use of energy, and the amount of waste. 'People' refers to the attention paid to human rights, poverty, workers, health, and security. However, recently, Oželienė (2017) came up with technological sustainability besides the triple bottom line. The author noted that every company's success depends on the proper utilization of technological processes. The technology used by people helps to accomplish corporate aims and enhance resource conservation, and hence should be part of sustainability dimensions.

Working on sustainability by entrepreneurs is generally referred to as corporate social responsibility (Samson and Shibre, 2011). In reality, however, it needs effort and regular work for the balance of the three P's (people, planet, and profit) in a business to occur (Kambewa, 2007. Nowadays, CSR has become the pioneer business issue in ethical business governance systems to safely handle environmental and societal critics (Blowfield and Frynas, 2005) although such a business idea is at the infant stage in East Africa. Ismail (2009) and Revathy (2012) pointed out the key potential benefits of firms implementing CSR. It helps for 1) better anticipation and management of an ever-expanding spectrum of risk; 2) improved reputation management; 3) enhanced ability to recruit, develop and retain staff; 4) improved innovation, competitiveness and market positioning; 5) enhanced operational efficiencies and cost savings; 6) improved ability to attract and build effective and efficient supply chain relationships; 7) enhanced ability to address change; 8) more robust "social license" to operate in the

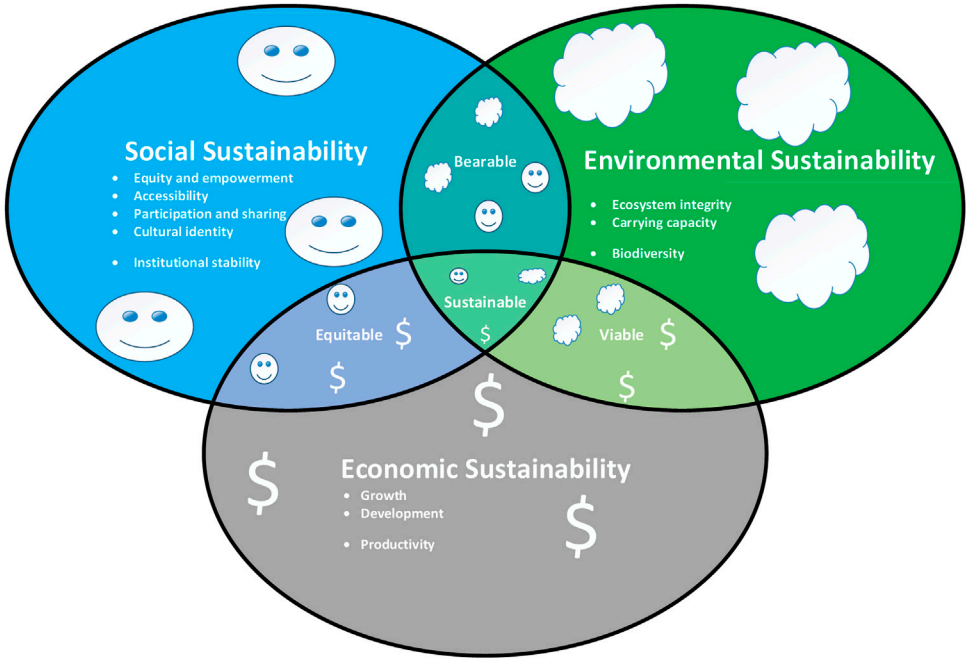

FIGURE 3
Sustainable development. Mcguinn et al., 2020.

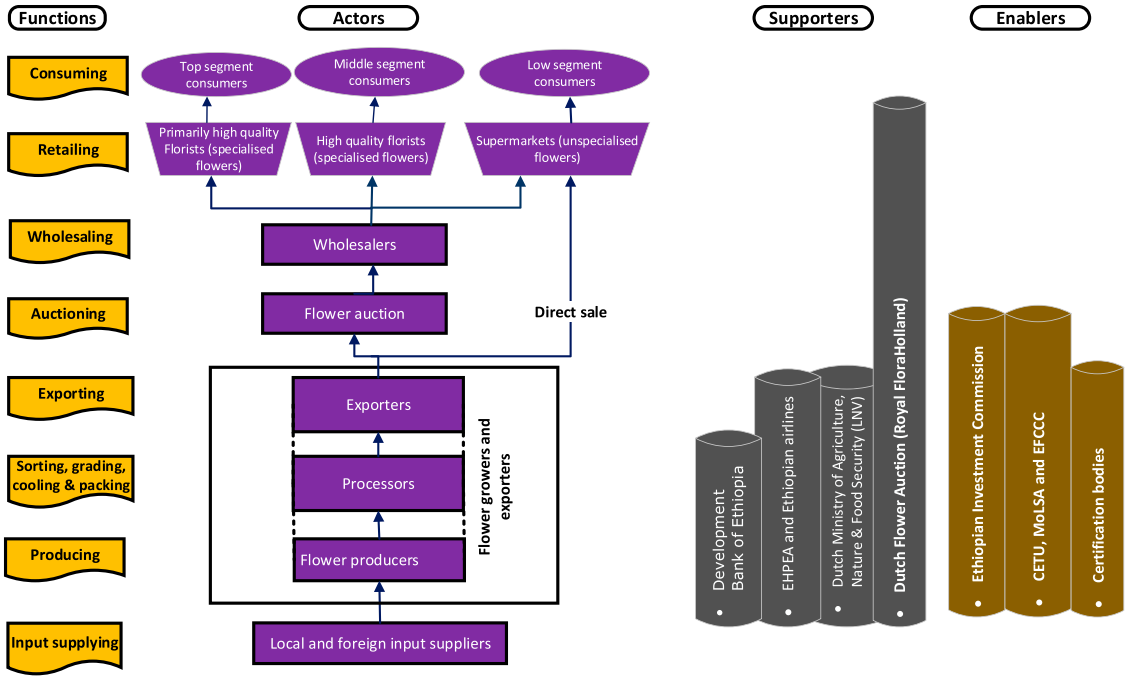

FIGURE 4
Value chain map of Ethiopian flowers in Europe. Mebrat, 2019.

community; 9) access to capital; 10) improved relations with regulators; and 11) a catalyst for responsible consumption.

2.3 Sustainability in the ethiopian flower industry

Netherlands is the main importer of flowers from Ethiopia (90% of the nation's total flower export) and an exporter to the different EU countries (Figure 4). The Dutch auction, FloraHolland, is characterized by relatively loose trading relationships based on a market-based form of coordination between growers and buyers (Melese, 2018). It serves as a marketplace and distribution center for flowers coming from all over the world. The main customers of the auction are the wholesalers who typically focus on export. Participation in any social and environmental certification scheme is not a mandatory requirement for supplying flowers to this auction (Mengistie et al., 2017).

For the satisfaction of all types of customers, VBN (FloraHolland) has developed general and specific requirements (Rikken, 2010). The general requirements are related to the quality of the product such as freshness and maturity, variety, country of origin, quality (damage and diseases), length, and the number of stems per bunch. Without satisfying these minimum criteria, it is not possible to enter the Dutch auction. While the specific requirements are voluntary standards (EHPEA CoP, MPS-ABC, MPS-SQ, Global-GAP, Fairtrade, Fair Flowers Fair Plants-FFP, Flower Label Program-FLP, and Ethical Trade Initiative-ETI) satisfying the preferences of some customers mainly the supermarkets as these segment consumers are giving higher weight on sustainability issues than the quality of the product. Becoming sustainable flower producers for these customers is, therefore, helpful to obtaining market chances for the product.

The demand for social and environmental certification differs significantly between the florist and supermarket channels (Mengistie et al., 2017). Compared to supermarkets, florists dominate the distribution of flowers in most EU countries. However, social and environmental certification is less important in this segment of consumers. Florists do not often ask for certification although MPS certification is transferred through the auction system, they do not incorporate this information in their communication with customers. For instance, Rikken (2010) reported that 14 out of the 18 interviewed Dutch florists do not ask for certification. As a result, high-quality rose growers in Ethiopia are not giving higher emphasis on social and environmental sustainability issues as fulfilling such issues might decrease their profit margins.

Because they want to be seen as responsible companies, certifications became a real license to export in the supermarket chains, especially through the direct sales market channel (Melese, 2018). To distinguish themselves from others and to make their efforts visible, supermarkets, therefore, use consumer certification schemes such as FFFP, ETI, FLP, etc. For example, MPS is largely adopted for the Dutch auction system, FLP is for the German flower market, and ETI is for the UK retailers. Because voluntary standards differ significantly in origin, as well as in content, implementation, and monitoring procedures (Rikken, 2010), fulfilling demands from several different standards is required for Ethiopian flower growers to supply to several market segments. For instance, only environmental issues in the MPS-ABC scheme and social issues in the MPS-SQ and Ethical Trade Initiative (ETI) schemes are considered (Figure 5). Moreover, EHPEA-CoP, MPS-ABC, MPS-SQ, Global-GAP, etc. are business-to-business (B2B) standards because the information is not communicated to consumers. Whereas others such as Fairtrade, Fair Flowers Fair Plants-FFP, Flower Label Program-FLP, Ethical Trade Initiative-ETI, etc. are consumer tags and communicated to the end-users of the product.

To find more sustainable solutions for social and environmental issues in the floriculture sector, the producers, traders/wholesalers, retailers, and civil society organizations founded an international organization called FSI (Floriculture Sustainability Initiative) in 2012 (FSI, 2018; Wani et al., 2018). Producer associations in developing countries also introduced new codes of practice to safeguard the social and environmental issues of the sector; KFC Code of Practice in Kenya, Asocolflores in Colombia, and EHPEA CoP in Ethiopia. Standards and schemes such as producer associations' codes of practices in developing countries, MPS-ABC, MPS-SQ, Global-GAP, Fairtrade, Fair Flowers Fair Plants-FFP, Flower Label Program-FLP, and Ethical Trade Initiative-ETI were recognized and included in the FSI Basket of standards.

Moreover, in collaboration with the council of ministers, the environment, forest, and climate change commission of Ethiopia has developed its code of practices called the "code of practice for sustainable flower production" (EFCCC, 2018b). Three main compliance criteria; 1) management practices, 2) implementation of good agricultural practices, and 3) employment practices and welfare of employees are considered while the commission assesses flower farms. Concerning the management practices compliance criteria, the auditors are considering the complaints handling procedure, farm site risk assessment, farm site mapping, soil maintenance conditions, management of records, and documentation pertinent to the code of the flower companies. Good agricultural practices compliance criteria of the code comprise 1) monitoring and evaluation of the use of inputs, 2) restrictions to the use of inputs (the use of methyl bromide, untreated sewage water for post-harvest or irrigation, WHO Class 1 chemicals, and other banned products), 3) use and handling mechanism of concentrated acid, 4) inorganic and organic fertilizer use and storage practices, 5) management of the crop protection program, 6) pesticide products, properties register, storage, transport, spraying equipment, measurement, mixing, and spraying practices, 7) postharvest chemicals, and 8) waste management.

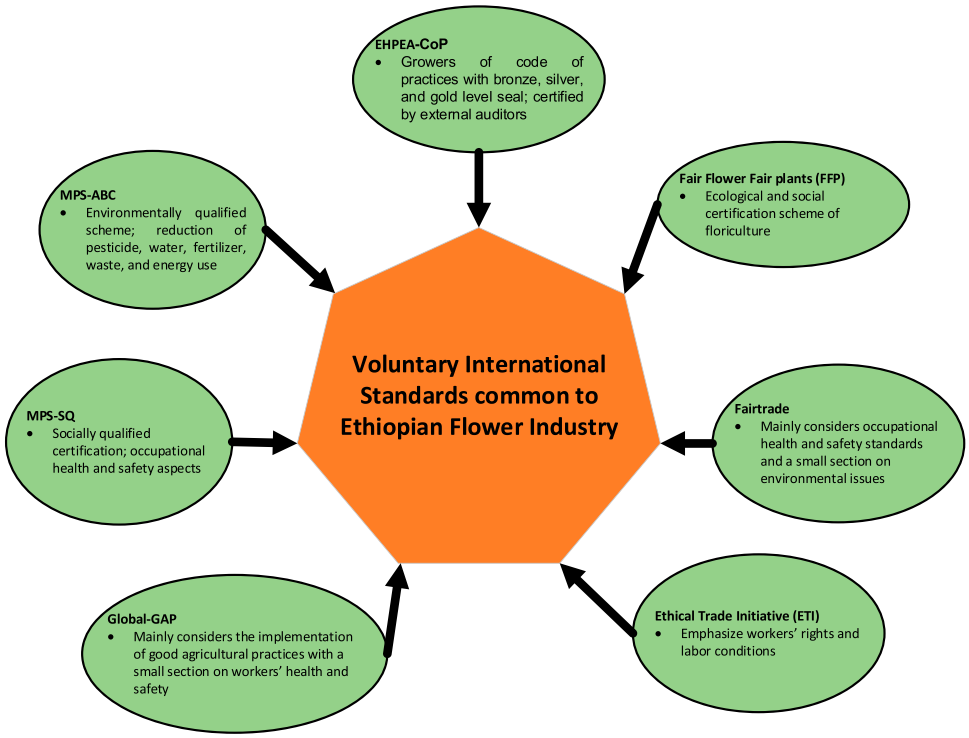

FIGURE 5
Common social and environmental standards in the Ethiopian flower industry. Rikken, 2010; Mengistie et al., 2017.

While 1) employment practices (contracts of employment, hours of work, wages and benefits, freedom of association, grievance handling procedures, staff recruitment, and promotion, forced labor, female staff, workplace harassment, child labor issues, and induction training), 2) occupational safety and health (policy, safety, health, and hygiene briefing, and training, protective clothing, and safety equipment, HIV/AIDS policy, first aid, medical check-up for staff working with pesticides, accident and emergency procedures, hygiene, facilities for eating and drinking), and 3) commitment to continuous improvement were included in the employment practices and welfare of employees compliance criteria. Because the Council of Minsters' code of practice was mainly adapted from the producers' association code of practice, the bronze, silver, and gold level compliance categories are included. All flower growers and exporters in Ethiopia are expected to comply with the bronze-level criteria. However, the report of EFCCC (2018a) showed that most flower growers in Ethiopia do not comply with such minimum national-mandatory criteria.

Another important dimension of sustainability of the floriculture industry, not reflected in standards, is the profit issues. Economic sustainability is mainly related to the cost and profit structure in the value chain (Stebek, 2012). It implies fair distribution of wealth along the supply chain from input suppliers to consumers, fair wages and prices, responsible use of natural resources, and investment in sustainable innovation (London and Bonn, 2016).

Regardless of the finest management methods used, investing in floriculture affects the environment and society. Therefore, the sector's profit needs to be redefined so that it incorporates actual cost or the cost of impact on people and the environment in addition to financial returns. The actual costs and profit margins of the various players in the floral value chain, however, have not been the subject of empirical research. As a result, the article did not address any other areas of profit but solely the difficulties related to growers' financial returns. As a result, the main factors reducing the profit margins of flower growers and exporters were identified as infrastructure and logistics conditions (Debela (2013); UNDP, 2017), market knowledge, and linkage of growers with buyers (Joosten, 2007), availability of fundamental floriculture inputs in the nation, and product diversifications (Belwal and Chala, 2007). Therefore, all of these circumstances were taken into account when creating a sustainability index for floriculture (Figure 6).

3 Methodology of the desk study

Standardized searching strategies, i.e., database and gray literature search strategies, were used for the identification of studies included in the present review. Both electronic and non-

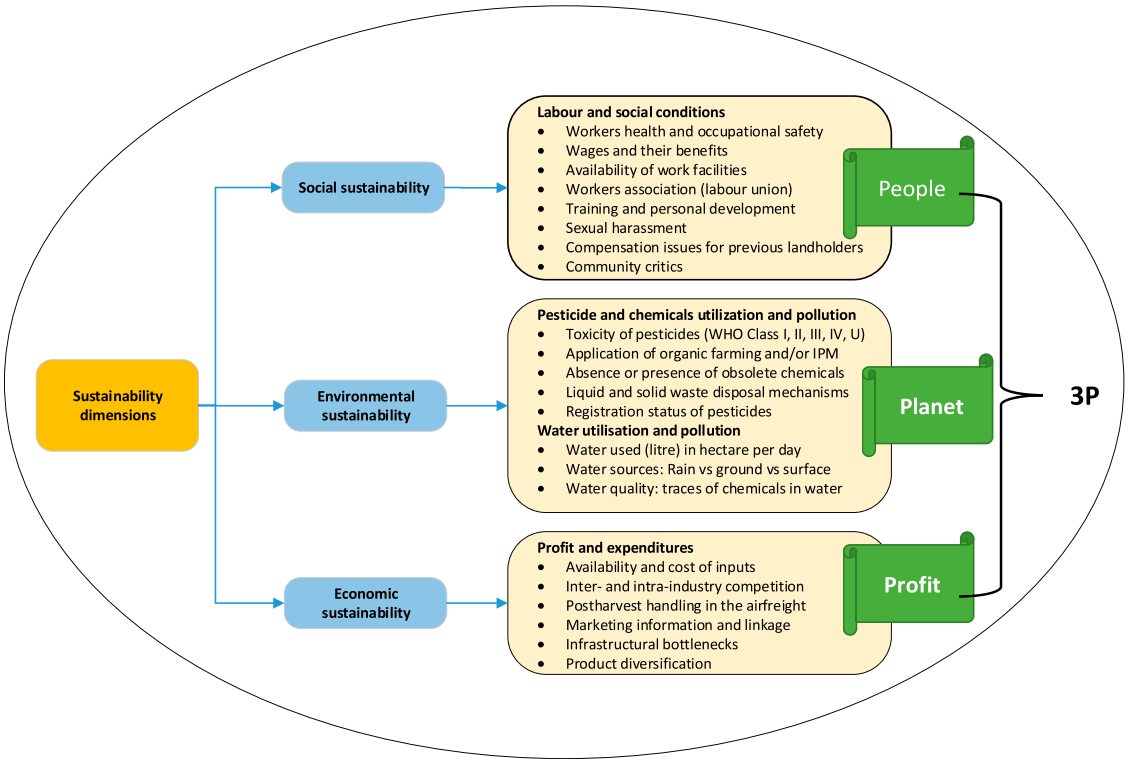

FIGURE 6
Sustainability index of floriculture in Ethiopia.

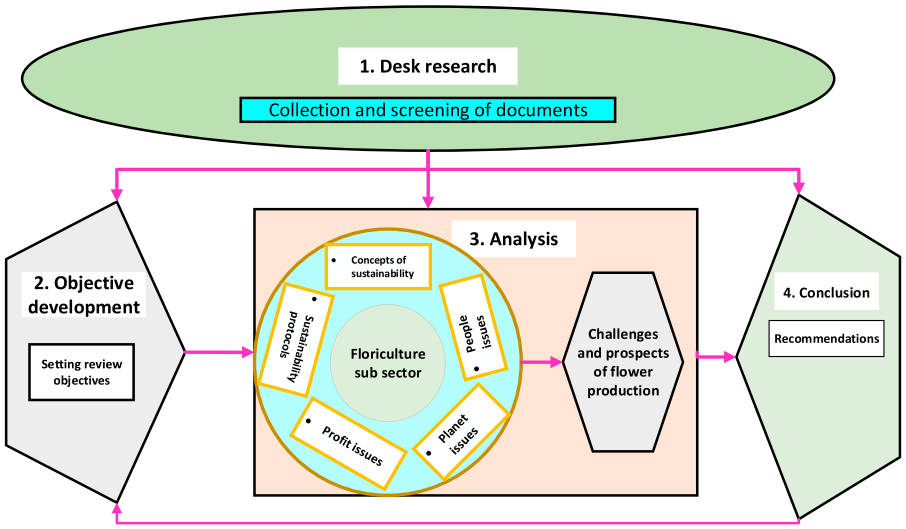

FIGURE 7
Methodology of the desk study.

electronic search was accomplished while developing and preparing the manuscript. The preferred reporting items for systematic review analyses (PRISMA 2020) diagram and checklists were used to illustrate how identification, screening and inclusion of studies were conducted and used for synthesis (Page et al., 2021).

3.1 Searching strategies

The literature searches of this paper consisted of four phases (Figure 7); scoping the sustainability issues of the subsector, developing objectives, conducting a relevant literature search, and forwarding major areas of improvement. In the first phase, relevant non-electronic literature searches from Oromia Labour and Social Affairs Bureau and EFCCC were collected and used to explain the sustainability issues of the subsector. From phase 1, the objectives of the paper were developed (phase 2). Then, the electronic literature search for conceptual and empirical evidence was conducted without any publication date or language specifications (Phase 3). Web of Science, Science Direct, PubMed and Google Scholar databases were used. The keywords used in the search strategy were "floriculture," "social, environmental, or economic," "sustainability," "prospects, challenges, or issues," and "Ethiopia". A gray literature search from private and governmental sources was also conducted to identify and include very important studies. The manuscript was then written with the goals, and recommendations and significant areas for improvement were forwarded (phase 4).

3.2 Inclusion and exclusion criteria

Inclusion and exclusion criteria were developed and applied following the gray literature and keyword searches in the aforementioned databases. Documents and/or literature that fit the following categories were included in the review forum: 1) Pertinent unpublished government regulations, protocols, research, and annual reports; 2) published articles in reliable peer-reviewed journals; or 3) other literature reports from websites and organizations with interest in the topic "floriculture sustainability issues" and outcomes of the topic of interest "impacts of unsustainable flower cultivation". While studies that were 1) outside the topic's scope, 2) outside the scope of outcomes of the topic, or 3) published articles with a weak methodology setup and numerous editorial issues were used as the exclusion criteria.

4 Results

4.1 Included studies and documents in the systematic review

About 175 papers were identified using databases, while 88 documents and reports were collected using other methods (published reports from private and public organizations) (Figure 8). Additionally, one research product (ORLEPB, 2016) from the Oromia Labour and Social Affairs Bureau, 70 case study reports in Amharic, a manual of code of practice for sustainable flower production, and regulation from the EFCCC called "Council of Ministers Regulation to Provide the Code of Practice of the Floriculture sector: Regulation No. 207/2011" were all gathered. The EFCCC conducted 70 case study reports in 2018, and they were all collected into one document. The "70 case study reports" are implied by EFCCC (2018a), whereas "A handbook of Code of Practice for Sustainable Flower Production" is denoted by EFCCC (2018b).

After the exclusion of 82 records that were disqualified by topic of interest and 41 duplicate records, a total of 168 studies (119 and 49 studies from databases and other methods, respectively) were admitted to the screening phase. The final selection stage resulted in the elimination of 39 studies in the databases and 20 papers in the gray literature search. In this systematic review, therefore, only 80 papers from the databases and 29 studies from other sources were utilized. Regarding the included studies' content, there were 47 peer-reviewed publications from various journals as well as 15 research-based reports, 18 theses/dissertations, and 29 papers from government and private organizations.

Studies gathered from databases were primarily used to explain the sector's People, Planet, and Profit sustainability challenges. They were also employed to demonstrate the impact of unsustainable flower production on biodiversity and human and animal health. The ideas of sustainability, corporate social responsibility, sustainability protocols in floriculture, sustainability index, and sustainability status of floriculture farms in Ethiopia were described and explained using studies gathered through other methods (mainly governmental reports). The discussion of the paper was generated from the analysis results of sustainability challenges with a primary focus on identifying the root causes to provide concrete recommendations. Table 1 provides a summary of the references used for each relevant subtopic.

4.2 Sustainability challenges

4.2.1 People issues

4.2.1.1 Workers' health and occupational safety

The floriculture industry is characterized by the intensive application of chemicals such as fertilizers and pesticides. Workers' health and occupational safety are, therefore, the paramount important social issues raised by the communities. Unless pesticides are properly applied and utilized, they can cause 1) cancer diseases and respiratory problems, 2) head- and stomach aches, 3) cancer, 4) birth defects and nervous system damage, and 7) death of workers (Fatuma, 2008). For instance,

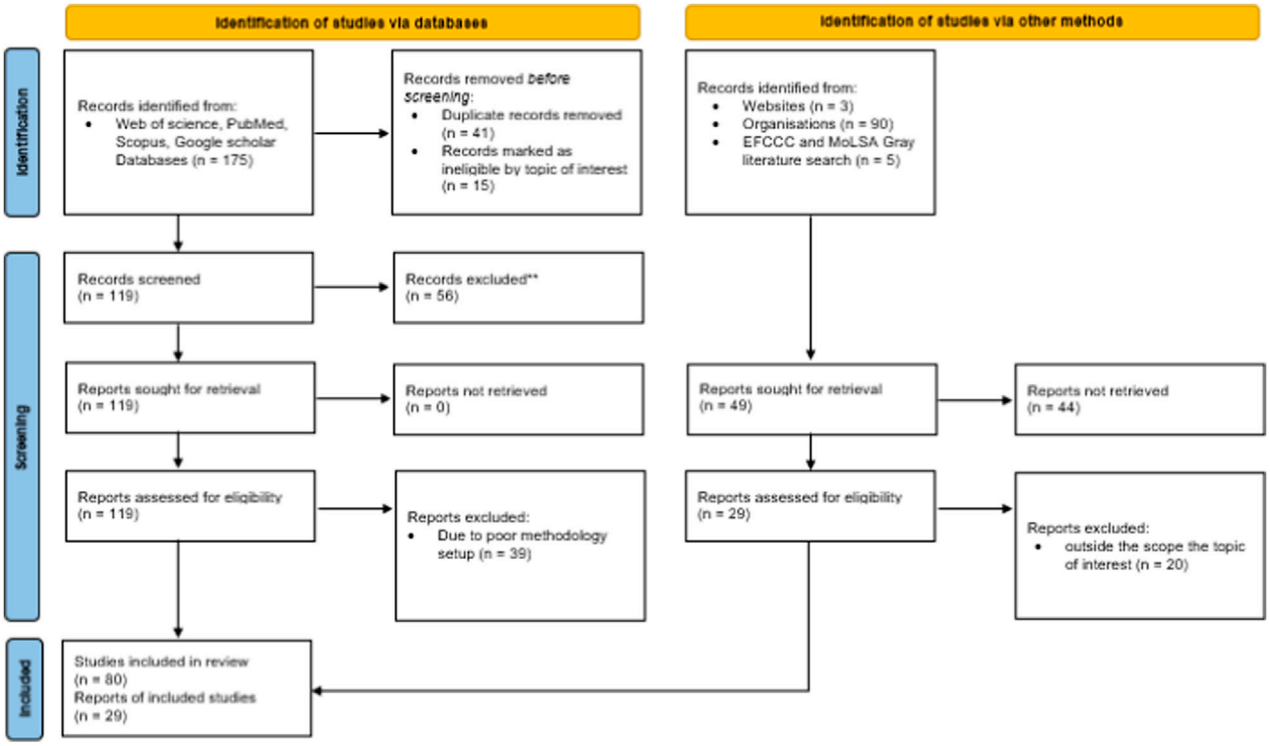

FIGURE 8
PRISMA 2020 flow diagram for the included studies in the systematic review.

Negatu et al. (2017) studied respiratory symptoms among 1104 subjects and reported increased risks for chronic cough and shortness of breath among the exposed subjects (142 applicators and 64 re-entry workers) as compared with unexposed individuals. Nigatu et al. (2015) also found that greenhouse workers at flower farms had a higher prevalence of blocked noses than workers outside. Because long-standing hours of workers in green-, and pack-houses cause swellings of feet and kidney problems, it was also reported as health and safety issues happening in flower farms in Ethiopia (Getu, 2009).

Regarding health and safety issues, the studies of Gezmu (2013), Dibaba (2020) and Negatu et al. (2021) revealed that Ethiopian flower farm workers faced a variety of difficulties, including 1) exposing workers to dangerous pesticides without wearing any kind of protective materials, 2) a lack of clean and proper toilets, washing and drinking water facilities, and 3) the absence of first aid and free medical care services. Most workers lacked protective clothing, and spray operators had no or insufficient training. The employees of flower farms were not aware of the inherent risks associated with the chemicals utilized. Workers usually remained at their jobs while sprayers were spraying chemicals, or they went back to the contaminated field before it was safe. For instance, Belay (2014) found that only 67% of flower farms in Ethiopia were providing PPE to their workers. While 33% of flower farm workers were using their clothes and some old and torn gloves. This study also reported that only 71%, 68%, 62%, 57%, and 13% of sprayers were provided with spray suits, rubber boots, respirators, impermeable gloves, and impermeable goggles, respectively. As a result, all sprayers in this study reported incidents of pesticide-related health symptoms including eye irritation, permanent sight reduction, skin irritation, headache, and abdominal pain after routine pest application.

Some workers complained that their protective cloth was not suitable and of not the right quality. For example, Mebrat (2019) conducted case study research on four flower companies (Ethio-Agri-CEFT, ET Highland Flora, and Ziway Roses) and reported that the PPE of Dream flowers was of poor quality compared to the other three flower-producing companies. Samson and Shibre (2011) also reported the import of chemicals by flower farms that were not on the MPS codes of practices list. Moreover, most flower farms in Ethiopia were not providing training about the importance of implementing occupational health and safety procedures (Taylor, 2011; Gudeta, 2012; Hanssen et al., 2015) despite their workers' illiterate nature.

Additionally, the levels of knowledge and safety practices of workers regarding occupational hazards were very low. The use of PPE and the degree of workers had a significant impact on

TABLE 1 Summary of the subtopics of the manuscript with citations used.

Topic of interest	References
Introduction	Gebreeyesus and Iizuka (2012), Petal Republic (2022), Debela (2013), UNDP (2017), Joosten (2007), Belwal and Chala (2007), Sorsa (2011), Gezmu (2013), Getu (2009), Tamiru and Leta (2017), Gudeta (2012), EFCCC (2018a), Rikken (2010), Page et al. (2021)
Floriculture industry in Ethiopia	Petal Republic (2022), Embassy of Japan in Ethiopia (2008), NBE (2020), EHPEA (2017), Oqubay (2015), Oqubay (2017), Kirigia et al. (2016)
Concepts of the People, Planet and Profit Sustainability	Sutton (2004), Grober (2007), UN (1972), IUCN (1980), UN (1987), Basiago (1999), Crowther and Aras (2008), Kuhlman and Farrington (2010), Morelli (2011), WHO (1992), Neumayer (2000), Mcguinn et al. (2020), Samson and Shibre (2011), Blowfield and Frynas (2005), Ismail (2009), Revathy (2012), Slaper and Hall (2011), Oželienė (2017)
Sustainability in the Ethiopian flower industry	Melese (2018), Mengistie et al. (2017), Mebrat (2019), Rikken (2010), FSI (2018), Wani et al. (2018), EFCCC (2018), Stebek (2012), London and Bonn (2016), Debela (2013); UNDP (2017), Joosten (2007), Belwal and Chala (2007)
People issues	Fatuma (2008), Negatu et al. (2017), Nigatu et al. (2015), Getu (2009), Gezmu (2013), Dibaba (2020), Negatu et al. (2021), Belay (2014), Mebrat (2019), Samson and Shibre (2011), Taylor (2011), Gudeta (2012), Hanssen et al. (2015), Geleta et al. (2021), Tizazu and Workie (2018), ILO (2006), FNG (2019), ORLEPB (2016)
Planet issues	Sutton and Kellow (2010), Tadesse and Melkamu (2018), IFC (2004), Gudeta (2012), Getu (2009), Samson and Shibre (2011), Kassa (2017), ORLEPB (2016), Tilahun (2013), Tamiru and Leta (2017), Belay (2014), Kirigia et al. (2016), FNG (2019), EHPEA (2017), FNG (2010), Getu (2013), Vieira and Abarca (2009), IFC (2004), Shentema et al. (2020), Martínez (2004), Haylamicheal and Dalvie (2009), Loha et al. (2018), Mengistie (2016), Biruk et al. (2020), Mengistie et al. (2017), Damtie and Bayou (2008), EPA (2000)
Profit issues	Joosten (2007), Janko and Alemu (2017), Debela (2013), UNDP (2017), Hatch and Wells (2012), Oqubay (2015), Belwal and Chala (2007), Sorsa (2011); Button (2020), Mebrat (2019)
Impacts of unsustainable flower production in Ethiopia	Biruk et al. (2020), ORLEPB (2016), Mebrat (2019), Belay (2014), Shentema et al. (2020), Ismail (2009), Loha et al. (2020), Kirigia et al. (2016), Hengsdijk and Jansen (2006), Samson and Shibre (2011), Mesfin et al. (2012), Tsion (2015), Tilahun (2013), Aguirre (2003), Bolo (2008), Tizazu and Workie (2018), Merga et al. (2021), Teklu et al. (2018), Getu (2009), Fikadu (2020)
Causes of sustainability issues	Joosten (2007), Hatch and Wells (2012), Joosten (2007), Sorsa (2011), Button (2020), Debela (2013); UNDP (2017), Belwal and Chala (2007), Mengistie et al. (2017), Mebrat (2019), Damtie and Bayou (2008), Getu (2013), EPA (2000), Gudeta (2012), Kirigia et al. (2016), Gezmu (2013), Dibaba (2020), Negatu et al. (2021)
Discussions	Abate (2020), Chikaura (2016), Derege (2021), Elias et al. (2019), Endalew et al. (2022), Gubena (2016); Janka (2012), Kubwalo (2006), Leo et al. (2016), Mekuriaw and Teffera (2013), Mengistie and Kompuok (2020), Mengistie (2016), Teklu (2016), Woldeyohannes (2016), Worke et al. (2020), Wittstock and Quinto (2008), Isaak and Lentz (2020), Rombach et al. (2018)

TABLE 2 Impacts of floriculture on soil physical and chemical characteristics.

Flower cultivation	Impact	Sources
Significantly increased soil pH in Ziway and Debrezeit (Ethiopia)	Neutral or slightly alkaline soils around the farm were changed to saline soils	Mesfin et al. (2012), Tsion (2015)
Significantly increased soil EC, total N, exchangeable K, and Na in Ziway and Debre Zeit (Ethiopia)	Increased the amount of sodium and soluble salt concentrations	Mesfin et al. (2012), Tilahun (2013), Tsion (2015)
Significantly decreased CEC, OC, Exchangeable Ca, and Mg	Decreased fertility and organic matter content of the soil	Tilahun (2013), Tsion (2015)
It is a cause for land use and/or cover changes	About 145-ha of smallholder farming/food production lands were changed to flower farms	Kirigia et al. (2016), Tilahun (2013), Tsion (2015)
Significantly reduced soil microbial biomass in Ecuador	Degradation of soil health, quality, and fertility	Aguirre (2003)
Significantly increased the concentration of most pesticide residues in soils in Ecuador	Changes in the physical, chemical, and microbiological characteristics of soils	Aguirre (2003)

safety procedures. Accordingly, Geleta et al. (2021) indicated that the level of knowledge of occupational hazards was affected by the level of education [AOR: 20.03; 95% CI (16.30, 23.75)], work experience [AOR: 5.97; 95% CI (4.22, 7.72)], and type of employment [AOR: 5.35; 95% CI (2.50, 8.19)]. Higher ranked and experienced workers had a higher level of knowledge on safety precautions than illiterate and inexperienced workers. The study also added that the regular use of PPE [AOR:17.53; 95% CI (13.36, 21.71)], the level of knowledge [AOR: 7.29; 95% CI (3.87, 10.73)], and the provision of appropriate PPE [AOR: 4.59; 95% CI (2.34, 8.86)] all had an impact on the level of safety practices.

TABLE 3 Five years Impact of chemicals on physicochemical properties of Lake Ziway Tsion, 2015.

Parameter	2009	2015	EPA/WHO	Remarks
Turbidity (mg/L)	31.32	48.85	<25	Showed significant increment; aquatic life threatened due to cloudy layers
Suspended solids (mg/L)	0.094	58.5	<25	Showed significant increment; affects aquatic life forms
TDS (mg/L)	470.4	697.5	>450	Slight to a moderate irrigation problem
OD (ppm)	1.60	3.88	<4	Create stresses for most aquatic organisms
EC (μs/cm)	829.8	1009	700–1000	Slight to a moderate irrigation problem
pH	8.64	7.89	6.5–8.5	Showed a decreasing trend; a cause for acidity and nutrient solubility
COD (mg/L)	111	675	<150	Showed significant increment with time; high risk for aquatic life

4.2.1.2 Wages and benefits

The minimum wage in Ethiopia was not determined yet. As a result, flower companies in Ethiopia were paying the workers shockingly low wages (average wage of € 38.93 per month), which is lower than the average monthly wage of Kenya (€ 119.73) and Tanzania (€ 46.63) (Kirigia et al., 2016). As a result, all (100%) respondents from Belay's (2014) study were dissatisfied with their wages. Most workers got the difficulty meeting their daily needs with their insufficient salaries (Gudeta, 2012). One of the factors behind this problem may be the government's policy to attract foreign investors by pointing at cheap labor. The complaints of workers in the floriculture industry in 2017 and 2018 have resulted in the establishment of collective bargaining agreements (Mebrat, 2019) since the labor law proclamation of the country promotes and recognizes such agreements. Thus, collective bargaining agreement was made between the employers and employees in most flower industries, and agreed to pay 1450 Birr per month as a minimum salary. Moreover, some growers developed mechanisms to allow workers to earn more such as allowances for transportation, no-absenteeism, a bonus for productivity, and overtime during "pick seasons" such as Valentine's Day, Christmas, and Mother's Day.

4.2.1.3 Labour union and workers' rights

The floriculture sector workers mostly have short-term contracts, and the majority of them are daily laborers. Due to the risk of direct subjection and unfair dismissal, it is challenging to defend their rights and liberties (Tizazu and Workie, 2018). Because of this, the labor proclamation of Ethiopia (FNG, 2019) guaranteed all workers the rights to 1) form and join trade unions and engage in collective bargaining; 2) access to jobs and training on an equal basis regardless of their gender, age, ethnicity, or other differences; 3) work in a safe and hygienic working environment; 4) obtain a copy of their contract; and 6) refrain from performing unpaid and involuntary overtime.

To improve working conditions, safeguard workers' rights and interests, and represent workers in collective bargaining and labor disputes, a workers' association is essential. Despite its importance, most flower farm owners in Ethiopia were not willing to allow workers to form effective associations (Gudeta, 2012) due to the fear that these enabled workers to become aware of their rights and incurred additional costs. Mebrat (2019) also reported the presence of interference between labor union leaders and their members' activities by the top management bodies of the farm.

Because of the lack of effective and functional labor unions in Ethiopia, floriculture workers were enforced to do extra time without asking for their willingness (Gudeta, 2012; Tizazu and Workie, 2018). As far as it is not extreme and risky as well as workers are salaried correctly and chosen freely, overtime work is not necessarily problematic. However, it was not voluntary and workers were not allowed to refuse overtime work. Moreover, Oromia Labour and Social Affairs Bureau inspection report in 2006 indicated that, out of 27 inspected farms, none of them were found respecting any one of the legal work leaves. ILO (2006) reported that, in the Ethiopian floriculture sector, there was a gap in satisfying the minimum labor conditions; unlawful contractual agreements, absence of weekly rest days, failure to implement maternity, annual and sick leave, involuntary overtime work, and overtime work not payable as per the proclamation were the major labor issues raised.

4.2.1.4 Equality of treatment and social problems women encounter

Samson and Shibre (2011) and Gudeta (2012) reported grievances, harassment, and safety worries about returning home at night as the major social difficulties that women workers encountered in the floriculture sector. Most women working on flower farms were vulnerable to sexual harassment and exploitation. Embarrassing comments/jokes, unwanted comments about clothing or appearance, intentional abuse, bothersome physical contact, requests for sexual favors, and physical assault were all prevalent forms of sexual harassment in the Ethiopian floriculture sector. Sexual harassment disrupts and obstructs a worker's ability to execute their job, makes them feel frightened and humiliated, and endangers the workplace environment.

4.2.1.5 Compensation issues for previous landholders

The right to advance payment of compensation equal to the replacement cost of any property on the land and any improvements, such as the worth of capital and labor put into the land, is guaranteed under the country's labor proclamation (FNG, 2019). Any displaced individual because of a flower investment has, therefore, the right to receive 10 times his/her average annual income within 5 years. However, practically, it was applied only to farmers who had land as a legal title, but not others. In this regard, the Oromia investment research team did not find any flower producers who offered compensation for the lost lands and/or jobs. Instead, some of them were offered employment by the investor.

4.2.2 Planet issues

The negative environmental implication of the floriculture industry is related to the intensive use of pesticides, water and fertilizers, waste management, and energy consumption (Sutton and Kellow, 2010; Tadesse and Melkamu, 2018). Consequently, IFC (2004) advised flower-producing companies to take all necessary precautions including Environment Impact Assessment (EIA) to safeguard the environment and residential areas, reduce pollution, and implement sustainable resource use (water, soil, air, etc.). However, Ethiopia's investment law does not require the EIA report to be prepared and submitted for the issuance of investment provisions (Gudeta, 2012). Because of this, many flower-producing companies got investment permission without EIA report preparation and submission (EFCCC, 2018a). Therefore, unsustainable use of natural resources and environmental pollution are the major challenges occurring in the floriculture industry.

4.2.2.1 Water utilization

One of the major environmental concerns within the flower industry of Ethiopia is its heavy water consumption nature (Getu, 2009; Tilahun, 2013; ORLEPB, 2016; Kassa, 2017; Tamiru and Leta, 2017). For instance, Belay (2014) reported that the higher average water consumption of flower cultivation in Ethiopia was about 60,000 L of water ha-1 day-1; nearly three times Columbia's and two times the world's average water consumption. Gudeta (2012) and ORLEPB (2016) also showed that there were no proper water management and conservation practices. Neither recycling nor water treatment was properly implemented. Only a few farms were recording the amount of water used each day although the proclamation enforces them to do.

Despite the abundant amount of annual rainfall in the country, flower growers in Ethiopia are very reluctant to use rainwater as their water source. Out of the 84 active flower producers, none of them have constructed rainwater harvesting structures; they sourced water only from Lakes, ground and surface water, according to the report of Kirigia et al. (2016). There was no action implemented by the government to tackle such a problem. This intensive utilization of water resources without consideration of its consequences will lead to a reduction of the groundwater table and question the sustainability of the firm. In the future, water is expected to displace oil as the greatest resource challenge (Gudeta, 2012).

4.2.2.2 Chemical utilization

Misguided chemicals application and utilization impose problems on the environment, leading to adverse effects on the safety and security of society. The utilization of chemicals shall be seen from the perspective of environmental and economical sustainability. Chemicals utilized correctly will increase flower production since more production is an indicator to obtain more revenue. However, the intensive use of chemicals was blamed as an environmental challenge of Ethiopian floriculture (ORLEPB, 2016). The leftover chemicals due to the excessive application will move from the site of application to the sink (water, soil, and air) *via* drift, volatilization, leaking, and runoff. Consequently, IFC (2004) and FNG (2019) advised flower growers to adopt the following good agricultural practices: 1) Implement organic farming and/or IPM practices, 2) ensure the necessary pesticide/chemical registration protocols, 3) timely and safe removal of obsolete pesticides, 4) refrain from using WHO prohibited chemicals, and 5) utilize proper disposal of liquid and solid waste mechanisms.

Integrated Pest Management (IPM) is an effective and environmentally sound tactic for pest management that relied on a combination of rational practices. EHPEA (2017) also advised the necessity of implementing IPM in flower farms and described the importance of practicing it. IPM makes an important contribution to operator safety, protection of the environment, and production of safe food. Despite its importance, many flower farms in Ethiopia were not implementing IPM as good agricultural practice. In line with this, Belay (2014) reported only 3 out of the 29 farms studied were applying integrated pest management (IPM) as good agricultural practices.

Moreover, flower farms' pesticides must be registered with the necessary protocols to ensure that they will not harm people, non-target species, or the environment when applied with their labels. As a result, the new pesticide registration and control proclamation (PRCP) No 674/2010 was developed by the government (FNG, 2011). However, the government of Ethiopia during the early establishment phase of the industry made an interim decision allowing the flower growers to import pesticides without following the necessary registration procedures. This decision resulted in an increment in the introduction of unregistered chemicals in the country. For instance, between 2007 and 2014, flower farms in Ethiopia imported 1) 96 types of insecticides and nematicides and 2) 105 types of fungicides; of these, 37 were not officially registered

(Vieira and Abarca, 2009). The international certification codes and guidelines strongly oppose the usage of WHO-prohibited chemicals (banned, highly toxic WHO Class I or carcinogenic pesticides and/or chemicals) (IFC, 2004). However, some growers in Ethiopia were using WHO class I or carcinogenic pesticides (Dichloruos and Cadusafos) (Belay, 2014). Moreover, some WHO-prohibited pesticides were imported and utilized. For instance, Shentema et al. (2020) found a total of 154 different trade names of pesticides; 31 (27%) were classified as moderately hazardous by the WHO classification, and 9% were organophosphates. Organophosphate pesticides have significant toxicological consequences (Vieira and Abarca, 2009).

Obsolete pesticides, as described by Martnez (2004), are substances that can no longer be used for the intended purpose. It consists of the following: 1) Outdated pesticides (pesticides with a shelf life of 2 years from the date of release); 2) banned pesticides; 3) deteriorated products; 4) unwanted pesticides; 5) unidentified products; 6) products contaminated with other ingredients; 7) pesticide wastes produced in fire or other accidents; and 8) strongly chemically contaminated materials. Obsolete pesticides must be disposed of because they are hazardous pollutants. However, it was noted that many obsolete pesticides, including TOG.75, were found on Ethiopian flower farms (Vieira and Abarca, 2009). Haylamicheal and Dalvie (2009) and Loha et al. (2018) reported the accumulation of 1500 tons of obsolete pesticides in Ethiopia. Of these, 258.3 tons were organochlorines, 155.4 tons organophosphates, 58.5 tons carbamates, 14.9 tons coumarins, 30.2 tons inorganics, 70.4 tons mixed pesticides, 307.1 tons unknown pesticides and 257.2 tons were others.

About 40% of the farms included in the ORLEPB assessment were unable to know the source of the pesticide/fertilizers and whether they were legal or not. The use of obsolete pesticides was not properly documented, and those who registered no longer reported to any government agency. In many of the stocks, they were found mixed with the functional chemicals with no care. Flower farms were wrongly or intentionally using these chemicals or releasing them into the environment. Moreover, open-field flower farms were spraying hazardous pesticides called parathion affecting the residents by wind drift (ORLEPB, 2016). For its safe disposal, several farms were asking the government's assistance. One of the places with the highest concentration of outmoded pesticides was the Oromia Regional State, where 71 of the 85 flower farms were situated. This highlights the urgent need for a system designed for pesticide registration and management, including efficient implementation and disposal.

A study regarding the import, disposal, and health effects of pesticides, as well as many related policies, was conducted by Loha et al. (2018). The findings revealed an increase in pesticide imports into Ethiopia between 2013 and 2016, Tanzania between 2006 and 2011, Kenya between 2008 and 2015, and Uganda between 1980 and 2004. East African Rift Valley nations ship these chemicals to European nations for incineration since disposing of outdated pesticides is very expensive and requires adequate infrastructure. For instance, in the first (2000–2003) and second (2005) phases, Ethiopia and the FAO jointly disposed of 1574.5 and 926 tons of outdated pesticides, respectively. Therefore, there was no doubt that outdated pesticides accumulated across the country. Mengistie (2016) examined the discrepancy between the state's adopted pesticide policy and its implementation concerning pesticide registration, distribution, and use. The results of the survey showed several problems that prevented the implementation of the state's pesticide policy, including inadequate monitoring of pesticides after registration, a lack of regulations and instructions to implement the policy, a shoddy inspection of dealers and end users, and a lack of cooperation between the MOA 2022 and the pesticide advisory board.

4.2.2.3 Liquid and solid waste disposal mechanisms

The primary solid and liquid wastes produced by flower farmers include chemical containers and their washing waters, diseased plants, the residue of cut flower stems (green wastes), obsolete solid chemicals, and plastics (Biruk et al., 2020). Liquid wastes that cannot be reused or recycled should be collected and kept in impermeable containers or solar evaporation ponds. Moreover, flower farms must have an incinerator, which is often an old steel barrel used to burn empty chemical containers. However, the sector was heavily criticized for not having an adequate waste management system (Gudeta, 2012). Some flower farmers were 1) disposing of green wastes in an open field and 2) burning empty pesticide containers together with damaged cloths used for spraying, cartons, boxes, and plastics. The observation of 13 outlets of micro watersheds by ORLEPB (2016) showed that 1) 85% of the farms discharged untreated wastewater to the soil outside their compound; 2) 75% of the farms' green wastes were not composted but were piled for a long time on the soil of the farm compound and the edge of rivers and streams thus affecting soil and water; 3) 85% soak away pits were not closed/protected from rainwater thus it overflowed when the rain comes and contaminated water bodies and 4) majority of the farms' trenches/wastewater canals were intentionally directed to the nearest water lines.

Another environmental concern in flower farming is the unsafe management of pesticide containers (Tilahun, 2013; Mengistie et al., 2017). Residents of flower farms in Ziway were receiving and/or buying empty chemical containers/bags for their day-to-day activities. The communities were using these containers mainly to 1) fetch and store water, 2) collect and store cultural alcoholic drinks such as 'Tella' and 'Araki', 3) sell for other users, and 4) shade houses (Biruk et al., 2020). The containers were also irresponsibly dumped and disposed of by some producers, where they could end up in water bodies and be eaten by grazing animals.

4.2.3 Profit issues

The main profit issues impeding the sustainability of floriculture in Ethiopia, according to Joosten (2007) and Janko and Alemu, 2017, are a lack of well-trained human resources, insufficient market knowledge, and linkage, and an inability to satisfy foreign market demands. The production, marketing management, post-harvest handling, phytosanitary services, and chain quality management sections of the floriculture sector lacked well-trained and experienced managers. Despite the essentiality of obtaining price trend information, conducting market studies, and establishing and maintaining direct contacts with the main buyers, flower growers in Ethiopia had wider gaps in retrieving market information compared to other competitors from Europe, Latin America, and African counterparts. This placed them as disadvantaged growers when bargaining contracts with potential buyers.

Other influences related to flower production chain performances are infrastructure bottlenecks, poor logistics systems, and high cost of transport (Janko and Alemu, 2017). The infrastructure system of Ethiopia is very weak and needs immediate solutions for the future development of the sector. The truck fleet in the country is old, inadequate by modern standards (most are general-purpose vehicles), slow to load/unload, and expensive to operate (Debela 2013; UNDP, 2017). There is a very high rate of traffic accidents and congestion in cities inlets and outlets. Moreover, the general air cargo terminal suffers from delays in the removal of goods, which, in turn, results, in congestion and low productivity. There are also some limitations in accessing telephone lines in remote areas and repeated electric cut-outs. Hence, logistic inefficiencies and infrastructure problems directly or indirectly affect the profitability of growers and exporters as well as other actors in the chain.

The unavailability of competent service providers such as freight forwarders, clearing agents, storage/warehousing facilities, and insurance provisions for post-harvest losses are also challenges existing in the floriculture sector (Joosten, 2007; Hatch and Wells, 2012). Growers load flowers directly into air shipment from their cold trucks and took the risk in case the flowers lose quality as a result of delays or mistakes by any of the links in the logistical chain. Phytosanitary inspections are also taking place on the flower farms although changing the inspection site towards export inspection consignments at Bole airport was advised. In addition, there are no cargo service facilitators to coordinate handling and maximize cargo space utilization. Trucks with cooling services in the country are limited in number and outdated. Skill and knowledge gaps of phytosanitary monitoring and surveillance experts were also mentioned as a challenge to the sector. Oqubay (2015) stated a high airfreight charge for flower export in Ethiopia with the major (Ethiopian airlines) and others (KLM, Lufthansa, etc.) carriers. The airfreight cost of flowers in Ethiopia was estimated at 59%; higher than the cost of fertilizers and chemicals (19%), labor (11%), and packaging materials (11%) altogether.

The floriculture business is very dynamic and periodic in terms of the variety and production preferences of consumers. Demands are high during Valentine's Day (February to April) followed by Christmas (November to December) when every single stem of roses produced is exported and sold in foreign markets. Nevertheless, there are slow seasons (summer and fall seasons) where the competition is strong in the global market (Belwal and Chala, 2007). There is also high intra-industry competition, as experienced foreign companies from Netherlands and Israel are participating in the sector. Hatch and Wells (2012) reported that foreign-owned firms had wider knowledge, expertise, and advantage in using direct sales channels in the international flower market than local firms. Moreover, it is also important to check the current competitors as there is no assurance for the sustained competitiveness of Ethiopian export floriculture. Ethiopia in this respect has exceeded the export volumes of some of its main competitors such as Egypt, India, Morocco, and Zambia. However, due to an increase in the level of production by competing countries, African exporters generally incurred an annual average price decline of 10% from 2002 to 2007 (Joosten, 2007).

Another feature of the Ethiopian flower sector is the lack of domestically produced inputs that flower producers can access. Most planting materials, fertilizer mixers, packaging materials, and greenhouse equipment are mainly imported from abroad and are quite expensive (Belwal and Chala, 2007; Sorsa, 2011). Because Ethiopia is lacking large-scale agricultural input manufacturers, flower growers are incurring high costs for inventing, purchasing, and transporting inputs. Rose is the dominant flower type produced in the floriculture industry. Hence, the country has narrow product ranges; making the industry highly vulnerable to the risk of diversification bleak. Product differentiation depends on the specifications and demands of the changing markets. A particular grower shall consider growing various types of flowers, opting for both: 1) A very limited range of high-producing varieties in the middle price segment suitable for supermarket trade, and 2) a broader range of high-quality and specialty flowers and bouquets suitable for the specialized flower retail trade.

4.3 Impacts of unsustainable flower production in Ethiopia

According to Biruk et al., 2020, the majority of nearby residents were complaining about flower farms. The main concerns that locals had with the floriculture industry were 1) health and safety issues of workers, 2) high flood from the greenhouse and bad smell, 3) decreased volume and quality of surface and groundwater, 4) chemical contamination of nearby lands, 5) loss of market acceptability particularly on local vegetables and fish products, 6) displacement of farmers from their fertile lands, and 7) unfair wage of laborers.

FIGURE 9
Green waste used for animal feed. ORLEPB, 2016.

4.3.1 human health

The main difficulties that employees encountered while working on flower farms included occupational injury, employee rights violations, and health issues related to their jobs. According to ORLEPB (2016), of the total spray workers surveyed, about 80% do not wear eyeglasses; 65% spray with non-functional respirators; more than 50% do with thorn protective clothes and boots. As a result, many flower workers showed symptoms of acute poisoning such as headaches, respiratory difficulties, eye problems, weight loss, disability and death, diarrhea, nervous system disorders, dizziness, fatigue, vomiting, abdominal pain, and skin rashes. Moreover, most flower farm sites were found near residents of locals, which is not a good sign for the long-term growth of the sector. Because of this, the pungent and irritating smell of chemicals in the early morning and evening was causing health-related risks (discomfort, headaches, and pains) and the locals were raising the issue (Mebrat, 2019). People with asthmatic problems were suffering the most from the situation (Mengistie, 2016). Moreover, Shentema et al. (2020) discovered 97 workers (16.5%, 95% confidence interval 13.7–19.7%) with abnormal serum cholinesterase levels after drawing blood from 588 employees from 15 different flower farms (above 140 Michel units).

4.3.2 Death of animals and loss of acceptance of agricultural products

The death of cattle and fish and loss of acceptance for agricultural and/or fish products due to the wastes of flower farms were reported by Biruk et al., 2020. Cattle and shoat were observed eating flower residues during dry seasons (Figure 9). Residents in Ziway were buying flower green waste when they encountered a scarcity of fodder (ORLEPB, 2016). For the short-term benefit, the feedstuff of green wastes helped pastoralists to sustain the life of their cattle. However, Ismail (2009) reported green waste affected the milk quality and volume when cows were fed the green waste from flower farms. Moreover, pesticide residues on vegetables were also detected in the Central Rift Valley (CRV) of Ethiopia. For instance, Loha et al. (2020) assessed the status of seven pesticides in tomatoes and onions, including profenofos, metalaxyl, λ-cyhalothrin, 4,4′-DDT, 4,4′-DDE, and α- and β-endosulfan. According to the findings, profenofos, metalaxyl, and, α- and β-endosulfan were identified in 2.5, 12.5, and 2.5% of tomato samples and profenofos, metalaxyl, and - and -cyhalothrin in 5, 7.5, and 5% of onion samples, respectively, exceeding the European maximum residue limits. All of these situations have the potential to harm both people's and animals' health.

4.3.3 Soil health and land use changes

Land-use modifications and changes are other societal effects of the floriculture sector in Ethiopia. According to the report of Kirigia et al. (2016), about 145 ha of land were changed from food to flower production. The changes in the land use system in the Ziway and Abyata catchments were also stated by Hengsdijk and Jansen (2006). Locals were consequently uprooted from their productive farms and/or relocated to an area with inadequate infrastructure (Samson and Shibre, 2011). Smallholder farmers, for instance, were changed into wage laborers, and state employees became private employees. Because of such changes, previous landowners were raising their complaints about investors.

Continuous applications of pesticides and chemical fertilizers to plants and soils indicate that the soil is the final destination for any leftovers. Flower farms were using ineffective soak-away pits to dispose of their liquid wastes (ORLEPB, 2016). However, none of the flower producers was found to check the efficiency of this cultural technique. Solid wastes such as empty chemical plastic containers and bags were damped to the soil and made to leach their content. The liquid and solid wastes of flower farms were also reaching the nearby farmers' fields *via* runoff. All these unwise management practices of floriculture farms impacted the soil's physical, biological and chemical conditions (Table 2). For instance, Mesfin et al. (2012) showed that the increased floriculture effluent application (0, 15.0, 30.0, 45.0, 60.0, 75.0, and 90.0 mg pot-1) increased pH, EC, P, S and basic cations (K, Ca, Mg and Na), and decreased micronutrients (Cu, Fe, Mn and Zn) and heavy metals (Mo, Ni, Cd and Cr). Consequently, the neutral nature of Debre Zeit soil was changed to saline soil.

4.3.4 Water pollution and depletion issues

Unsustainable water consumption is yet another significant issue facing the floriculture industry. Water use efficiency in flower farms is generally very low and there are major concerns regarding resource depletion and persistent conflicts over water rights in East African countries (Belay, 2014). The decreasing water levels of lakes and rivers in the Awash River valley made the local communities irritated, and unstable and put their future livelihoods in threat. Hengsdijk and Jansen (2006), Tilahun (2013), and Tsion (2015) all found that the Rift Valley

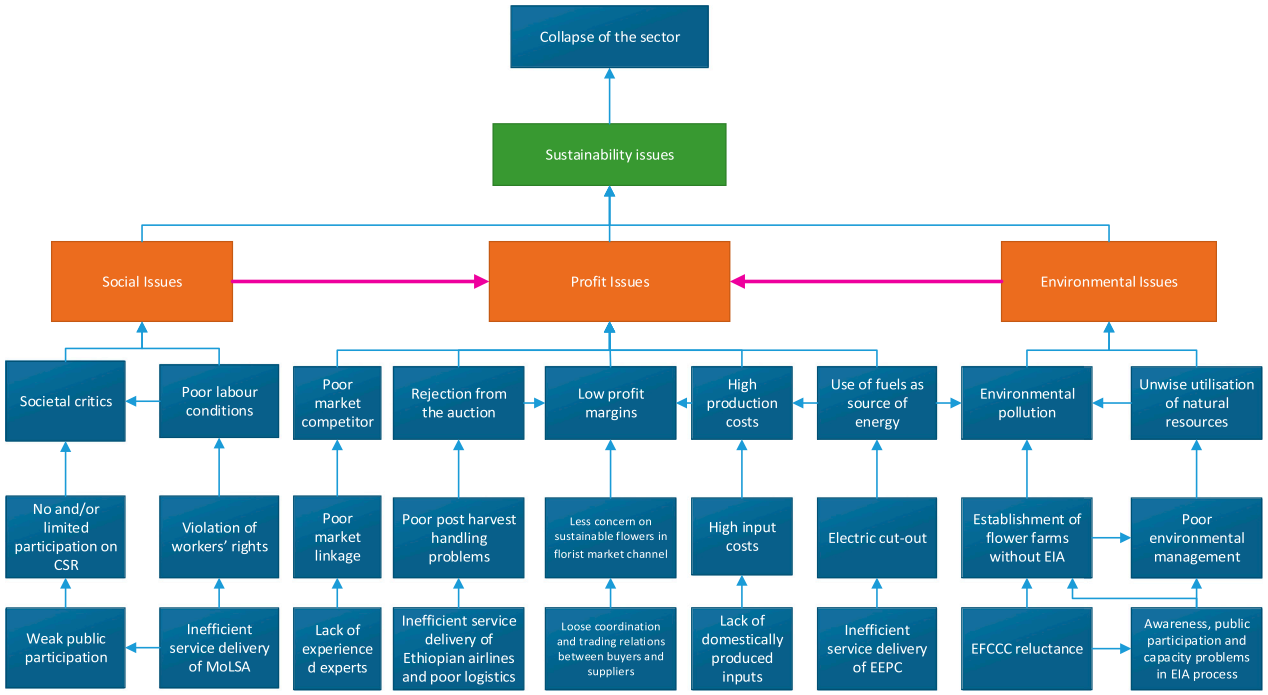

FIGURE 10
Analysis of the root causes of sustainability issues of floriculture in Ethiopia.

Region's surface and groundwater levels have decreased. However, no measures were taken to address this issue.

Mismanagement of liquid and solid wastes in flower farms possibly causes adverse impacts on the aquatic ecosystem (Table 3). Water pollution due to solid wastes and toxic chemicals may develop water-borne diseases. The case study of Bolo (2008) in the Lake Naivasha region of Kenya showed that the floriculture agrochemicals threatened fishing and community health. Surface waters of the Rift Valley Region had unusually high levels of nitrate, reactive phosphorus, chemical oxygen demand, electron conductivity, and iron, according to ORLEPB's 2016 study. Samson and Shibre (2011) also reported most nitrogen-containing inorganic fertilizers will produce toxic nitrates in water bodies and cause infants to die. Furthermore, Merga et al. (2021) analyzed the concentrations of insecticides, fungicides and nutrients in water and sediment samples of Lake Ziway. The sites receiving wastewater effluent from the floriculture farms showed higher chlorophyll-a, EC, TDS, COD and NO3- levels, compared to the sites influenced by agriculture and urban settlements, but were the lowest at the reference site. Malathion, dimethoate, metalaxyl, fenitrothion, diazinon, chlorpyrifos and endosulfan were frequently detected in water samples with detection frequency (DF) >60%.

Similarly, Loha et al. (2020) discovered that the Bulbula River's maximum profenofos concentration (1700 g/L) was found in the floriculture effluent, followed by 900 g/L in the tap water at the Batu drinking water supply and 890 g/L close to the agricultural land north of Lake Ziway. Groundwater cannot be protected from contamination because the majority of flower companies were using the outdated soak-away pit method of wastewater treatment instead of wetlands. Some of these chemicals can readily percolate into the ground and contaminate the water.

Societies that depend on Rift Valley rivers and lakes for their livelihood got frustrated which led them to migrate to other places for better water resources (Samson and Shibre, 2011). The locals residing near the flower farms perceived 1) a decline in crop production, soil degradation, ground and surface water pollution and depletion, and 2) an increase in newly emerging diseases. Recently, local farmers started opposing flower farms and conflicts were arising regarding access to water (Mebrat, 2019). For example, flower farms located near Ziway lake were discharging their liquid waste into rivers, streams, lakes, and ponds (Tilahun, 2013; Tsion, 2015). While the local communities were using pesticide-polluted water for bathing, cleaning, cooking, and irrigating vegetables. Herdsman specifically comprised of children was observed swimming and bathing in contaminated lake shores at Ziway Lake. However, the Batu town residents stopped drinking the Ziway water as they believed that the water was polluted by the floriculture liquid wastes. Teklu et al. (2018) also showed that more than 50% of the pH,

potassium and iron values in Lake Ziway's water were above the maximum permissible limit of the Ethiopian standard for drinking water.

4.3.5 Biodiversity losses

Affecting water, soil and the local environment means directly affecting biodiversity (Getu, 2009; Tilahun, 2013; Tsion, 2015). Pesticides have an enormous effect on non-target organisms i.e., about ten million non-target organisms are poisoned each year around the globe. They also have an antagonistic effect on the pollination process as honey and wild bees are vital for the pollination of about one-third of fruits, vegetables, and other crops worldwide. The use of pesticides also disturbs wild creatures and birds. The ethical issue arising nowadays is the extent to which it is correct to destroy thousands of species to kill the "harmful" few.

For example, Fikadu (2020) reported that beekeepers in Ethiopia lost their colonies and contaminated hive products due to unwise use and improper practice of pesticides. ORLEPB (2016) showed that the flower farms adjacent to Ziway Lake released their liquid waste to the lake affecting the lake's overall ecosystem including fish. The open flower farms such as Yalkoneh of Sebeta; and Margen par of Holeta were also polluting honey bees and other associated soil organisms. Earthworm, which is very important for soil fertility, is not immune to the current pesticides in use. The law enforces flower farms to carry out risk assessments related to biodiversity, but no farm implemented the law.

4.4 Causes of sustainability issues

Regardless of the existence of several international standards, the sustainability of the Ethiopian floriculture business remained in jeopardy. To support the main areas of change for the sustainable development of the sector in the country, it is crucial to analyze the flower production potential and sustainability difficulties. Given this information, the sector's sustainability concerns were analyzed and examined utilizing the empirical data already in existence. According to the analysis, the high cost of inputs, particularly air freight costs, the ineffective service delivery of input suppliers, the lack of coordination and trading relationships between growers and buyers, government reluctance, and weak political commitment were identified as the main root causes for the occurrence of sustainability issues in the floriculture sector in Ethiopia (Figure 10).

4.4.1 Weak political commitment and inefficient service delivery of MoLSA

Different research results and reports (Gezmu, 2013; Dibaba, 2020; Negatu et al., 2021) indicated the presence of a frequent violation of workers' rights and freedoms, health and safety issues in flower-producing companies besides the lower salary and overtime pay rates. However, appreciable actions were not taken yet despite the tangible evidence. Because of government reluctance and unwillingness, the minimum wage was not determined and studied well. As a result, flower-producing companies are currently paying 1450 Birr per month to their employees as a minimum sector salary. However, this salary cannot cover the living expenses of workers; even not enough for breakfast and lunch.

Moreover, most flower producers in Ethiopia had limited participation in fulfilling corporate social responsibilities despite the impact of the sector on the local community. As a result, different civic organizations have developed negative images and/or bad impressions of the sector (Mebrat, 2019) since the community services provided by the companies are very little compared to the societal and environmental impact of the sector. Government reluctance and inefficient service delivery of MoLSA, are, therefore, the main root cause of social sustainability issues.

4.4.2 Weak political commitment and inefficient service delivery of EFCCC

Flower investments especially roses require a huge amount of water. Despite its heavy water consumption, most flower growers did not implement water-saving strategies such as *in-situ* and *ex-situ* rain-water harvesting structures; instead, only relied on the depleted ground and surface water resources (Gudeta, 2012; Kirigia et al., 2016). Moreover, only a few flower companies are implementing proper soil fertilization, pest control methods, and waste management system. Hence, the depletion of natural resources and pollution of water, soil, and air became critical problems for the sector as there are no proper regulatory functions and service delivery from the government (Damtie and Bayou, 2008; Getu, 2013).

In addition, EFCCC has conducted case study research in 2018 to detect whether flower-producing companies are complying with the Council of Ministers' code of practice or not. The research result indicated that most producers were not complying with the standard and some companies were established without preparing environmental protection plans. Hence, poor waste management systems and the unwise utilization of natural resources are the common features of flower producers in Ethiopia. Despite this fact, actions were not taken yet on those poorly performing producers due to the assumption that the sector will get paralyzed if measures are taken (Mebrat, 2019).

4.4.3 Lack of awareness and weak public participation in EIA processes

The EIA law and its structures were ratified and established without adequate participation and discussion of all stakeholders (Damtie and Bayou, 2008). As a result, very little is known about EIA in Ethiopia by its main players; project owners, local communities, local administrations, and other government

officials. Many government officials are looking at EIA as a process designed to make development activities difficult. Getu (2013) also reported the environmental values stipulated in environmental laws and policies are shadowed by the recent investment laws. Many people believe that developing countries demand rapid economic growth, but not environmental luxuries. Moreover, investors observe it as bureaucratic trouble and do not comprehend that the absence of EIA could mean the depletion of resources, public resistance against their projects, or difficulty in accessing market opportunities.

Public participation is key to a successful EIA and is responsible for providing input and comment at various stages in the EIA process, i.e., during the scoping phase, assessing and mitigating impacts, and review of the environmental impact study reports (EISR) (EPA, 2000). However, community participation and partaking in the EIA process are very weak (Getu, 2013). As a result, some project owners list the names of a few individuals with their signatures or thumb marks as those who have participated in the EISR. Damtie and Bayou (2008) also reported that the absence of public participation is a clear violation of the constitutionally guaranteed rights of the people. The FDRE Constitution Article 43 2) guaranteed that: "Nationals have the right to participate in national development and, in particular, to be consulted concerning policies and projects affecting their community".

4.4.4 Problems of capacity and absence of effective mechanisms for the EIA process

Getu (2013) assessed the Ethiopian laws and fourteen EIA reports of floriculture farms and interviewed the experts to get a clear picture of the EIA regime. Despite the existence of many laws and multiple institutions, the author of this paper argued that the EIA regime is too weak to safeguard the environment owing to multiple factors. The problem of capacity in EIA processes is related to consultants and competent agency (EPA) abilities and capabilities (EPA, 2000). Consultants, on behalf of the project owners, are working to comply with the EIA process. They are responsible for 1) environmental assessment and management; 2) managing the required participation process; 3) producing readable and sound reports; and 4) having good knowledge of EIA and management strategies, regulations, and guidelines. However, there are almost no consultants who can meet the draft guidelines of the EPA and are not qualified to conduct EISRs (Damtie and Bayou, 2008).

The other aspect of capacity is related to the power, finance, infrastructure, environmental laboratory, and expert sufficiency status of the EPA (Damtie and Bayou, 2008; Getu, 2013). The EPA is expected to regulate the activities carried out not only by private project owners but also the government projects. However, EPA's organizational structure does not allow for effectively regulating the activities of government-owned projects as most government offices are hierarchically at a higher level than the EPA. An inadequate number of experts are available in EPA despite the bulky and difficult nature of EISR documents. It is very difficult to get a quality EIA process in such a stressful environment since the employees of EPA are overburdened. Additionally, EPA is not a financially strong government organ with a lot of infrastructure problems. It lacks internet service, environmental laboratories, and good library services.

4.4.5 Loose coordination and trading relationships between growers and buyers

Wholesalers rely on the certification report handed by the supplier and do not 1) randomly visit the farm or 2) check imported flowers on pesticide residues or active ingredients (Mengistie et al., 2017). The presence of single botrytis of fungus in the product can result in an entire shipment rejection, but none of the flower growers experienced import denial due to the presence of above-standard active ingredients or chemical residues. Moreover, public awareness of the sustainability impact of flowers is limited. As a result, the readiness of consumers, especially in the florist market segments to acquire higher fees for sustainable flower products is relatively low (Mebrat, 2019). Many consumers consider flowers as a luxury product and do not give higher attention to environmental and social issues.

4.4.6 Unavailability of competent service providers and underprivileged leadership

Cargo and postharvest handling practices during loading and unloading in the airport are operated by Ethiopian airline employees. However, flower producers were raising their complaints that most of the product rejections, losses, and shelf life-shortening in the auction were due to poor handling practices of workers in the airfreight (Joosten, 2007; Hatch and Wells, 2012). In addition, there is a regular electric cut-out in the country; forcing the producers to use fuels (Mebrat, 2019). Fuels are not safe for the environment and costlier than electric power; besides air pollution, it increases production costs. This is a simple challenge that Ethiopian Electric Power Corporation could tackle, but remained the main problem for flower-growing and exporting companies.

Experienced international production and postharvest handling experts for socially and environmentally sound management practices, and competent international marketing experts for obtaining recent price trends information, conducting market studies, and establishing/maintaining direct contact with the main buyers are highly essential in the floriculture sector. Despite this demand in the sector, the country is in a state of an acute shortage of experts in production, marketing management, post-harvest handling, phytosanitary services, and chain quality management sections (Joosten, 2007). In line with this, Sorsa's (2011) findings indicated that poor management, poor business planning and poor marketing are responded as the main causes of floriculture investment

failure in Ethiopia. Around 85% of the respondents responded that floriculture investment fails because of poor leadership, i.e., lack of management experience (business knowledge) and management experience. As a result, flower growers in Ethiopia have wider gaps in satisfying their customers' social and environmental standards as well as retrieving market information compared to other competitors. Moreover, there is a huge difference between foreign-owned and local companies as the former firms have wider knowledge and expertise in the international flower market than local firms and have the advantage of using direct sales channels compared with local firms. Therefore, the acute shortage of well-trained and experienced international production and marketing managers in the sector is another root cause of the people, planet, and profit sustainability issues.

4.4.7 Infrastructure bottlenecks and lack of domestically produced inputs

Africa lacks a competitive advantage in high export earning industries because the air transportation logistics are thin, fragile, and incomplete even for the sectors in which it has a comparative advantage in production (Button, 2020). Traffic congestion and delay in city inlets and outlets are the main features of the Ethiopian logistic system (Debela (2013); UNDP, 2017). Accessing telephone lines in remote areas is also very challenging. The country lacked competent freight forwarders, clearing agents, and storage/warehousing facilities. Bole international airport also lacks phytosanitary inspection areas, i.e., growers load flowers directly into air shipment from their cold trucks. Trucks with cooling services in the country are limited in number and outdated. Cargo service facilitators are not available although they are essential to coordinate handling and maximize cargo space utilization. All these situations, in one way or another lower productivity and market information, and raise the costs of production and postharvest losses.

Due to the absence of largescale agricultural input manufacturers, flower growers are importing planting materials, fertilizers, mixers, packaging materials, and greenhouse equipment from other countries, i.e., mainly from Kenya, India, Israel, and the Netherlands (Belwal and Chala, 2007; Joosten, 2007; Sorsa, 2011). As a result, growers are suffering from unnecessary costs for inventory and transport while importing inputs from abroad; a very serious issue for Ethiopia with a poor logistic system. Besides production cost increment, it takes the foreign currency reserves of the country.

5 Discussion and limitations

5.1 People, planet and profit sustainability issues

The major people issues identified in this systematic review were workers' health and occupational safety, minimum wage, workers association, sexual harassment, and compensation issues. Many workers lacked the required protective clothing, toilets, showers, and drinking water facilities. The employers were also giving the employees astonishingly low earnings, which was insufficient to pay for their basic needs. These results concur with those of Chikaura (2016) who reported the dearth of decent work for women in the Ethiopian floriculture sector. The study also found that wages for both men and women working in the horticultural sector were below the living standard (less than $1 per day). Fewer workers received health and medical treatment, and only a few positions received protective gear. Permanent supervisors appeared to be the ones wearing protective gear.

In Ethiopia, the majority of flower farm owners were unwilling to let workers organize strong unions. Due to the absence of strong and functional labor unions, floriculture employees were enforced to work overtime without their consent. The sexual exploitation and abuse of women were the other social issues in the sector. Moreover, flower producers offered compensation only to farmers who had land as a legal title, but not others. Similarly, Mengistie and Kompuok's (2020) reported the frequent violation of employees' rights, including the absence of compensation. The study also found that freedom of association was often limited. Moreover, Chikaura (2016) and Worke et al. (2020) also verified that sexual harassment and violence against women were extremely common in Ethiopian workplaces.

The industry was not offering enough training on the value of putting occupational health and safety procedures into practice. Because of this, the workers at flower farms were unaware of the risks connected to the chemicals used. In line with this, Endalew et al. (2022) findings also showed only 33.3% of the participants in the survey had a good understanding of pesticide use. The report also added that workers' pesticide handling practices were substantially correlated with their knowledge of the environmental effects of pesticides, their awareness of the health risks connected with pesticides, and their willingness to wear PPE and invest in PPE supplies. If employees were not aware of the health dangers posed by pesticides, they were 36% less likely to adhere to good practices. Workers were 53% less likely to have good practices than those who agreed with wearing and purchasing PPE. Workers without a PPE supply were less likely to have good practices than their counterparts.

The findings of this study also showed that the floriculture industry in Ethiopia hurts the planet due to its high-water consumption, improper water management, reliance on chemical pest control methods rather than IPM, importation of pesticides without adhering to the necessary registration procedures, and inadequate waste management systems. Ethiopia used a lot more water than the world average to grow flowers. Water on the farm was not managed adequately. Despite being required to do so by the proclamation, very few farms were keeping track of their daily

water usage. Ethiopia has a lot of rain each year, but the country's flower farmers were particularly hesitant to use rainwater as their supply of water. None of the active flower growers installed rainwater collection systems; instead, they only use lakes, groundwater, and surface water as their water sources. Similar results were found by Mekuriaw and Teffera (2013) who reported water resource depletion was the most serious problem of flower farms. The authors also added that the water consumption by flower farms around Bahir Dar was beyond its potential. The local community was using the surface and groundwater for small-scale irrigation and for their cattle, which may result in potential conflicts.

The industry faced harsh criticism for having an unsatisfactory waste management system. Some flower producers were burning empty pesticide containers and damaged spraying cloths, cartons, boxes, and plastics while also disposing of green waste in an open field. The farms released untreated sewage onto the ground outside of their property line. Green waste from the farms was not composted; instead, it was stacked for a very long time on the farm compound's soil. The soak-away pits were not covered or shielded from rainwater, so when it rained, they overflowed and poisoned the waterways. The majority of the farms' waste water canals and trenches were designed to flow to the closest water lines. Additionally, residents living in flower fields were obtaining or purchasing empty chemical containers or bags for their daily tasks including fetching and storing water, gathering and storing traditional alcoholic beverages like "Tella" and "Araki" selling to other users, and building shade structures. Accordingly, Mekuriaw and Teffera (2013) revealed the environmentally detrimental effects of floriculture projects, including water pollution, soil degradation, problems with human health, the appearance of new pests, and poor waste disposal systems.

Many of the farms lacked information about where their pesticides and fertilizers came from. In addition, obsolete pesticides were not adequately documented and those who registered stopped reporting to the government agencies. These pesticides were also frequently discovered carelessly mixed in with the useful compounds in the stocks. Some flower farms in Ethiopia used pesticides classified by the WHO as carcinogenic or class I. Dangerous pesticides called parathion were being sprayed on open-field flower farms, endangering the health of the locals by wind drift. The outcome of Mengistie (2016) demonstrated that there were large discrepancies between the documentation and the actual application of pesticide policy. The main obstacles to the implementation of the nation's pesticide policy were poor information accessibility, low stakeholder motivation to adopt policies, and a lack of resources. As a result, it is common to observe unregistered and unreported obsolete pesticides in the stock.

Lack of qualified human resources, a lack of market knowledge and connections, an inability to meet the demands of overseas markets, infrastructure constraints, inadequate logistics, and high transportation costs are the key profit-related obstacles to the sustainability of floriculture in Ethiopia. Flower growers in Ethiopia had greater gaps in obtaining market information compared to rivals from Europe, Latin America, and African counterparts. The global market is highly competitive in the sluggish seasons of summer and fall. Due to the presence of seasoned international corporations from Israel and Netherlands, there is also intense competition within the industry. The results were in agreement with Derege (2021) who reported the Ethiopian floriculture industry had difficulties because of the intense rivalry from other partnering countries.

Ethiopia's infrastructure is extremely underdeveloped, and its fleet of trucks is old, outdated, sluggish to load and unload, and expensive to operate. There are also a few dated trucks with cooling services in the country. Experts in phytosanitary monitoring and surveillance lacked skill and knowledge. The airfreight cost is another issue to be tackled. The increased cost of air freight and the scarcity of locally produced inputs that flower producers may access are other features of the Ethiopian flower industry. Button (2020) also revealed the emerging long-term challenge with African air transportation logistics is getting sufficient investments, especially human resources, into the air cargo supply chain. The industry is extremely exposed to the risk of diversification due to its limited product ranges.

5.2 Effects of unsustainable flower production

Many flower workers showed acute poisoning symptoms such as headaches, respiratory issues, weight loss, impairment, and even death, as well as dizziness, nausea, abdominal discomfort and skin rashes. Because most flower farms were found near the residents, the pungent and irritating smell of chemicals in the early morning and evening was causing health-related risks. Workers with elevated levels of serum cholinesterase were also found. Similarly, Endalew et al. (2022) findings also showed the most common pesticide entry routes into the body were the eyes (72.3%), skin (67.3%), and ingestion (67.0%). Wittstock and Quinto (2008) also reported the most common symptom experienced by farmers were eye irritation, itching of the skin, red rashes, dizziness, nausea, numbness of extremities and respiratory problems. Moreover, waste from flower farms caused the death of cattle and fish as well as a decline in consumer interest in agriculture and/or fish products. During dry seasons, cattle and shoat have been seen consuming flower leftovers. Pesticide residues on vegetables were found in Central Rift Valley.

The efficiency of water use in flower farms was often relatively low, and locals were most concerned about the issue of water scarcity. Societies who relied on the lakes and rivers of

the Rift Valley for their survival were frustrated. They cleaned, cooked, and irrigated their vegetables using pesticide-tainted water. At Ziway Lake, herdsmen were seen bathing and swimming in contaminated lakeshores. Similar findings were also obtained by Woldeyohannes (2016).

Additionally, the pH, potassium, and iron levels in Lake Ziway were higher than the Ethiopian standard for potable water's upper allowable range. Exceptionally high concentrations of nitrate, reactive phosphorus, chemical oxygen demand, electric conductivity, and iron were found in the surface waters of the Rift Valley Region. The water samples frequently contained malathion, dimethoate, metalaxyl, fenitrothion, diazinon, chlorpyrifos, and endosulfan. The profenofos concentration in the Bulbula river was higher in the effluent from floriculture and lower in the tap water. Because most flower companies were using the antiquated soak-away pit method of wastewater treatment instead of wetlands, groundwater cannot be protected from contamination. The low water quality of the Lake Ziway and Wedecha-Belbela irrigation system was also reported by Teklu (2016). The author also noted that the higher fungicide spiroxamine content of the lake caused a high chronic risk when the water was used as drinking water. Deltamethrin and endosulfan insecticides were also found at possible acute risk concentrations for aquatic organisms. Organochlorine pesticides, such as endosulfan, were still listed as registered pesticides in Ethiopia though they were long ago outlawed in the European system.

Other negative social repercussions of the floriculture industry in Ethiopia include changes to land use, soil health degradation, and biodiversity losses. Locals were evicted from their productive farms and/or transferred to an area with poor infrastructure as a result of the land that was utilized for food production being converted to flower cultivation. State employees became private employees, and small-scale farmers were changed to wage workers. Similarly, Abate (2020) verified the existence of land grabs in peasant families for flower farm developments in Ethiopia's Walmara area and Holeta town. Through the "eminent domain" principle, the state took 1487 ha from the farming communities between 1996 and 2018 for the flower industry with little to no compensation. Moreover, Wittstock and Quinto (2008) revealed the shift to floriculture and the conversion of vegetable farms to flower gardens has affected the food security of the Philippines society. However, Elias et al. (2019) reported the land use land cover types in the Central Rift Valley region remained the same between 1995 and 2015. These contradictory reports require verification by the upcoming new studies.

The physical, biological and chemical characteristics of the soil were also influenced by the careless waste management activities of floriculture farms. Enhanced application of floriculture effluent increased pH, EC, P, S, and basic cations while lowering micronutrients and heavy metals in the soil. In this line, Leo et al. (2016) reported the frequent usage of nitrogenous fertilizers and pesticides in flower farms contaminated Ugandan soils. Because of the inappropriate application and careless use of insecticides, beekeepers in Ethiopia lost their colonies and discarded tainted hive products. Ziway Lake's adjacent flower farms leaked liquid waste into the water, which hurt the fish and the lake's general ecosystem. Honey bees and other related soil organisms were also harmed by open flower fields like Yalkoneh of Sebeta and Margen par of Holeta. The earthworm, a vital component of soil fertility, is not immune to the pesticides now in use.

5.3 Causes of sustainability issues

Social and environmental sustainability problems were mainly a result of the MoLSA's and EFCCC's ineffective service delivery and poor political commitment. As there were inadequate regulatory roles and service delivery from the government, the depletion of natural resources, contamination of the water, land, and air, frequent abuses of employees' rights and freedoms, and problems with health and safety emerged as major concerns for the industry. The majority of manufacturers did not adhere to the requirement for social and environmental sustainability. Some of them were founded without preparing environmental protection plans. Employee pay rates for overtime were lower and not per the proclamation of the country. The minimum wage was not established and researched by the government due to their hesitation and unwillingness. Moreover, most flower producers in Ethiopia had limited participation in fulfilling corporate social responsibilities. As a result, different civic organizations developed negative images and/or bad impressions of the sector. Despite these facts, actions were not taken yet against those poorly performing producers. In this regard, Janka (2012) and Mebrat (2019) also raised similar reports.

Environmental sustainability issues were mostly caused by a lack of knowledge, low public participation, capacity issues, and ineffective EIA process procedures. The key participants in Ethiopia's EIA, including project owners, local people, local administrations, and other government officials, knew very little about it. EIA was viewed by many government representatives, residents and investors as a procedure intended to make development operations challenging. They are unaware that the lack of an EIA may result in resource depletion, public opposition to the projects, or trouble accessing market prospects. As a result, there was virtually little community involvement in the EIA processes. Additionally, consultants who could adhere to the EPA's draft criteria were hardly available and were ineligible to conduct EISRs. Because most government agencies were hierarchically above the EPA, the organizational structure of the EPA prevented it from efficiently regulating the

development projects that were controlled by the government. Even though EISR required a lot of effort and was a challenging task, EPA had an insufficient number of professionals. Furthermore, the EPA had numerous infrastructure issues and was not a financially sound federal agency. Accordingly, Janka (2012) and Gubena (2016) pointed out that the lack of implementing laws, awareness, capacity, qualified consultants, and absence of incentives were the challenges hindering the implementation of EIA in Ethiopia.

According to this study, the core causes for the occurrence of economic sustainability issues in the Ethiopian floriculture industry were the high cost of inputs, the inefficient service delivery of input suppliers, and the lack of coordination and trading relationships between growers and buyers. inadequate handling practices by airfreight personnel were to blame for the bulk of product rejections, losses, and shelf-life reductions in the auction. There were also frequent power outages in the nation, which forced the companies to consume fuel. A lack of managerial expertise and business acumen in the fields of production, marketing management, post-harvest handling, phytosanitary services, and chain quality management were other factors that affected the floriculture investment's ability to generate profits besides inadequate infrastructure and logistics. Similarly, Kubwalo (2006) reported the lack of expertise, the inability to acquire financing, and the high freight costs were the main issues hurting the Malawian cut flower sector.

Moreover, the FloraHolland wholesalers and/or retailers relied on the certification documentation provided by the supplier and did not randomly visit the farm or inspect imported flowers for pesticide residues. Because of the presence of excessive chemical residues, none of the flower farmers had their imports rejected at the auction. There was also a low level of public understanding of the impacts of unsustainable flower cultivation. As a result, consumers were generally not willing to pay more for sustainable flower products, especially in the florist market segments. These results are consistent with Rombach et al. (2018) research, which demonstrated that German consumers place a higher value on intrinsic flower characteristics such as appearance, freshness, and scent than on the extrinsic characteristics they were looking at such as price, country of origin, and certification. Isaak and Lentz (2020) also revealed that, in comparison to food horticulture, non-food horticulture placed less emphasis on social sustainability. Generally, this study showed the impossibility of making the floriculture business sustainable and long-lasting without considering the social and environmental conditions.

5.4 Strengths and limitations of the study

The very recent topics of People, Planet, and Profit Sustainability Issues of the Floriculture investment in Ethiopia were raised in the article. It embraces a clear technique and aim that can be replicated, along with explicit inclusion and exclusion criteria. Relevant grey literature from organizations and websites was also gathered to decrease publication bias and incorporate very important studies and/or reports. Nevertheless, not every item on the PRISMA 2020 item checklists was used in this study because some of them were not applicable or useful for a systematic review of randomized studies. Hence, the systematic risk of bias for each identified study was not inspected. Additionally, automation tools were not used in the selection processes. Because the fair distribution of wealth, wages and prices along the value chain actors in Ethiopia was not studied, only issues related to the financial returns of the flower companies were considered profit issues. Furthermore, the energy consumption trends of the flower companies were excluded due to the absence of empirical evidence.

6 Conclusion and implications

To improve sustainability in the sector, the flower industries shall focus the following recommendations into practice. Besides correcting the regular electric cut-out of EEPC, supplying competent service providers, and upgrading the telecommunication and transport services are essential for the improvement of profit sustainability issues of the sector. To reduce product rejection, losses, and shelf life-shortening in the auction, flower companies are highly demanding freight forwarders, clearing agents, warehousing facilities, and facilitators in the airport. Flower-growing companies shall also give due attention to obtaining and producing internationally competent experts in production, postharvest handling, and marketing sections as this will help them to satisfy their customers' standards and to compete and retrieve market information from their global competitors. To reduce production costs and save the foreign currency reserves of the country, establishing large-scale agricultural input manufacturers is also essential. Stakeholders in the floriculture chain shall also work in changing consumer behavior toward sustainable products, especially in the florist market channel.

The negative image of society in the sector is the main challenge as was explained in several research outputs. Besides evaluating technologies, conducting preliminary research to understand community critics of the sector is very essential for the sustainability of the sector. Moreover, supplying new PPE to the workers whenever necessary, high care to workers while spraying chemicals, and permitting labor union and their members to exercise their rights and freedoms shall also be given due attention. To create a suitable working environment for employees, toilet- and shower-rooms amendment is essential for some companies that lack these facilities. Supplying free food services, especially for their breakfast and lunch shall also be considered as part of corporate social responsibilities.

The salary and overtime payment rates of many companies are below the sector minimum salary and labor proclamation of the country, respectively. Furthermore, there was a salary payment delay. Hence, salary increments (at least the sector minimum salary) and the country's labor proclamation-based overtime payment rate shall be adopted. Supply of the right quality of PPE with definite time intervals, full medical coverage of workers, and active involvement in corporate social responsibilities are also other labor and social conditions to be considered in the future. Unlike labor conditions, there is no effective environment-related organizational structure in flower farms. Recently, labor conditions showed notable progress because of the establishment of an effective labor union in the sector. The establishment of such an organizational structure on environmental issues is highly essential. In addition, the wise use of water resources such as harvesting rainwater shall also be adopted as the sector is accused of its heavy water consumption.

All sustainability issues in flower industries especially the social and environmental ones are not only created by growers, but also by the averseness of the government at the establishment stage. Before criticizing the flower industries, the government shall conduct preliminary research about the problems of the sector to come up with effective solutions. Thus, adequate support from the government is necessary to improve economic, social, and environmental issues. Recording and reporting the consumption trends of chemicals, pesticides, and fertilizers and evaluating recent technologies are also other areas of focus. Replacing the soak-away pit method with a wetland and proper handling of chemicals with experts shall also be considered. An Environmental Impact Assessment and protection plan shall be prepared and submitted to concerned regulatory bodies. Moreover, the minimum wage was not fixed yet. The minimum sector salary was developed in floriculture. However, this is a temporal solution, it could not be a permanent solution for the sector unless determined. Recently, farmworkers have started complaining about the minimum sector salary. Thus, the government shall take responsibility to fix the minimum wage, which can cover the living expenses of workers.

Generally, case study research to analyze the major economic, environmental, as well as labor conditions, and social issues of each flower company in the country shall be conducted. Unless otherwise, community critics and rumors will continue, and a collapse of the sector might occur. Thus, policymakers shall consider the case study research as a means to improve working conditions and the sustainability of the flower industry in Ethiopia.

Author contributions

This work was carried out by all authors. SM designed the review paper and wrote the first draft of the manuscript. AD managed the literature searches and wrote about the planet's issues and their impact on soil health and quality. TM managed the profit issues. AM accomplished the people issues of floriculture and their impact on animal and human health. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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