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Challenges and opportunities existing in the floriculture industry in Africa: knowledge and future research prospects

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Abstract

Floriculture is a growing sector and represents an asset to the economy of most developing countries in Africa. This paper aims to access the existing knowledge gaps and how such gaps might be filled to develop the floriculture industry sustainably in Africa. Scientific information on the floriculture industry was searched on three online databases (ScienceDirect, Google Scholar African Journals Online and PubMed) to gather much reliable data on the last 30 years in Africa. Thus, 23 scientific publications distributed in eight African countries were considered and examined. East African countries are the most interested in the floriculture industry, with Kenya and Ethiopia as the leaders. There are about a hundred ornamental plant in Africa and they are dominated by exotic species that sold (50%) in northern countries. The cut flowers and foliage are mainly used to brighten up party days, insightful human well-being and the perfumery industry, as well as landscape plants, for hedging, game cover, slope stabilization, food, and aromatherapy. The most important challenges to tackle in floricultural production are related to climate change, pests, and pathogens attacks. Irrigated floricultural production, development and culture of resistant and adaptative varieties, and creation of home markets are recommended to ensure sustainable improvement of environmental quality, food security, and socio-economic aggregate for communities.

Keywords: Africa, Biodiversity, Cut flowers and foliage, Horticulture, Landscape quality, Ornamental plant

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INTRODUCTION

Floriculture is one of the disciplines of horticulture dealing with the commercial production of ornamental and bedding plants, cut flowers, potted flowering plants, foliage plants, and flower arrangements (Getu, 2009). Global ornamental production and consumption have overcome challenges in the past 20 years (Darras, 2020). The floriculture and export industry became an important sector of the economy in a number of agriculture-dependent countries with low industrial development (www.cdhal.org). Moreover, it is a very productive and attractive sector for investors. For example, the global cut flowers market is estimated at USD 36.4 billion in 2022 and projected to reach USD 45.5 billion by 2027, and over 50 percent of the world's flowers are consumed in Europe (www.marketsandmarkets.com). For over three decades, the world flower market is mainly occupied by the Netherlands, Colombia, Ecuador, and Kenya (Porter *et al.*, 2011). The profitability of this industry has led to investments in China, Mexico, Peru, Chile, Bolivia, India, Ethiopia, Zimbabwe, South Africa, Uganda, Tanzania, and Zambia (www.cdhal.org). China stood out in recent years as a major producer and has joined the European Union, a market in which Colombia has been the leader for three decades (van den Bos, 2022). With its exports by around $90 million (www.cdhal.org).

According to Belwal and Chala (2008), the demand for flowers in the international market is in increasing trend because these are identified as luxurious products with high social values which enhance the quality of life and influence human feelings more than words or other gifts. This is inevitably due to the globalization of cultural exchanges that induced people globally to use flowers to share their feelings during weddings, Christmas, Valentine's Day, Mothers' Day, Fathers' Day, New Year, and Memorial Day (Tazuddin, 2021). Such increased use of flower and ornamental plants makes marketing flowers a lucrative business in the world market (Belwal and Chala, 2008; Yeshiwas and Workie, 2018).

In Africa, several studies have revealed that the floriculture industry is a relatively new business because the interest is recent, even though it's been around for a long time. Indeed, East Africa is considered to be the flagship region of Africa for the production and commercialization of flower and ornamental products. Added to Kenya, Uganda, and Tanzania, the study carried out by Yeshiwas and Workie (2018) showed that in Ethiopia this sector is currently growing and policies are setting up for its development. However, floriculture showed a certain interest in recent years in countries such as Ethiopia, which has many advantages for the growth of the sector, including geographical advantages of the country to the world market, suitable environmental conditions for the production of most floricultural crops, and lucrative incentive packages of the government for the development of the sector (Getu, 2009).

Despite, the rapid growth, the suitable conditions of Africa, and the multiple advantages provided by floriculture, this sector is nowadays challenged by social and environmental issues which are raised by the communities (Yeshiwas and Workie, 2018). It is, therefore, crucial to review the knowledge gaps, challenges, and opportunities in the floriculture industry to give insight to the potential investors of the sector and for the governments to design intervention strategies for further development of this industry in Africa.

MATERIAL AND METHODS

Data sources

ScienceDirect, Google Scholar, African Journals Online and PubMed were the three world's leading Open Access sites explored for the literature search, considering the last 30 years (from 1992 to 2022) scientific publications. A variety of terms and combinations of terms were used including "floriculture", "horticulture", "ornamental plant", "bedding plant", "cut flower", "potted flowering plant", "foliage plant", "floricultural crops", "flower and ornamental plants", "flower arrangement", "ornamental production", "ornamental consumption", "floriculture international market", "production of flower and ornamental products", "production and commercialization of flowers and ornamental products", "producer", "arrangements", "uses", "industry

development", "social importance", "environmental importance", "existing markets", "Climate change", "conservation", "domestication", and "threats".

Article selection and compilation

Based on the titles, keywords, and abstracts, a screening analysis was carried out on all articles to summarize the available information and select those relevant for the review. Therefore, letters, encyclopedias, case reports, manuals, and guidelines, as well as those identified as duplicates were excluded. The spatial distribution of both the occurrence data (www.gbif.org) and the number of articles in the African countries was mapped using QGIS 3.10.14 (Quantum GIS Development Team, 2016).

RESULTS AND DISCUSSION

Spatio-temporal distribution of the publications

A total of 25 articles were considered and examined among the 120 eligible papers (Figure 1). These articles were distributed across eight African countries, and East Africa (76%) was the most active on studies on floriculture (Ethiopia = 48%, Kenya = 20%, Tanzania = 4%, and Uganda = 4%), followed by West Africa (Nigeria = 8%, Burkina Faso = 4%, and Côte d'Ivoire = 4%) (Figure 2), South Africa = 4% and whole Africa = 4%. About 100% of the papers were published from 2007 to 2022, with the highest number of papers (n = 3) recorded in 2008 (Figure 3). Nevertheless, no publication was recorded before 2007, and reflects the increasing research interest on floriculture industry in Africa in the last two decades. Most of these publications focused on the floriculture industry development (35%), followed by the socio-economic and environmental threats of the floriculture industry (19%) (Figure 4). Aspects such as socio-economic importance (6%), environmental importance (6%), uses (6%), production techniques (6%), business opportunity (3%), and value chain and market network (3%) of the floriculture industry have benefitted lower research attention (Figure 4). Only four publications focused on two or more aspects (Figure 4). The diversity of the studies on this species is relatively poor. This timid enthusiasm for research initiatives in this sector highlights the need to reveal the aspects that have remained unresolved until now. This must incite the research community.

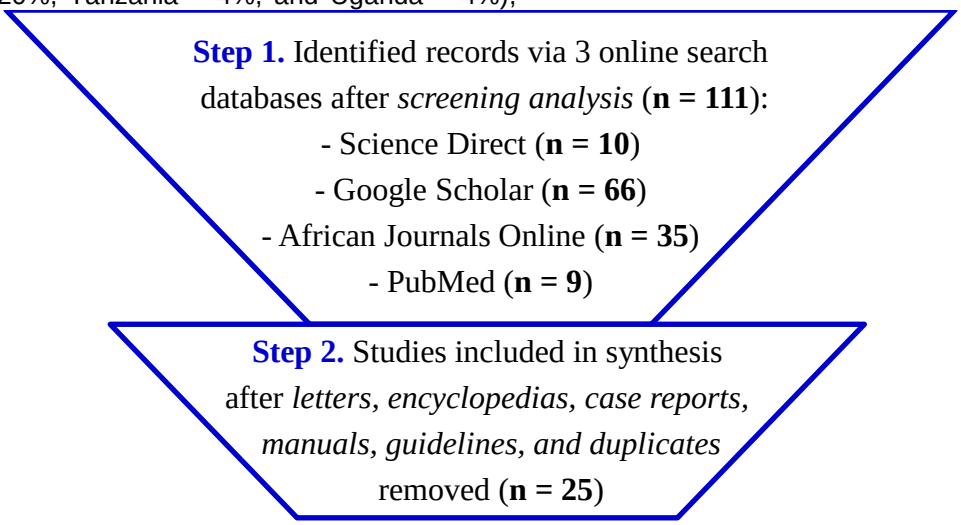

Figure 1: Diagram showing the selection of 25 studies included in the systematic review on floriculture sector

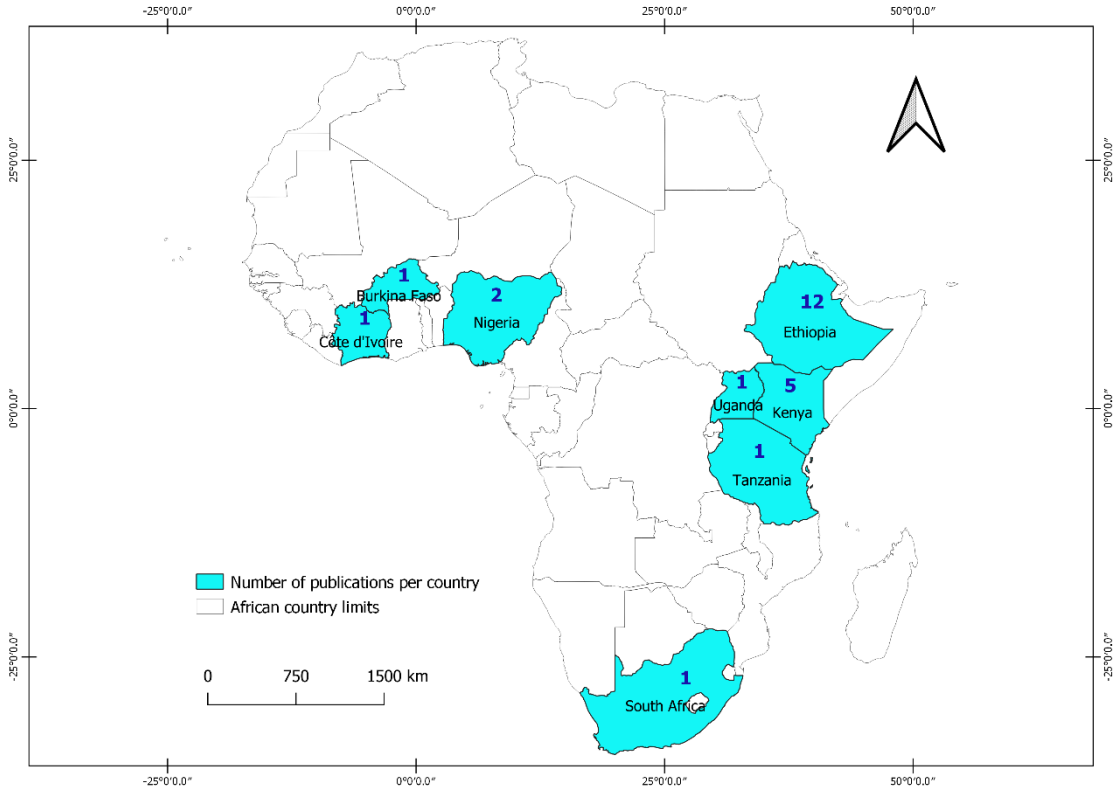

Figure 2: Spatial distribution of the 25 scientific publications recorded across African countries on floriculture sector

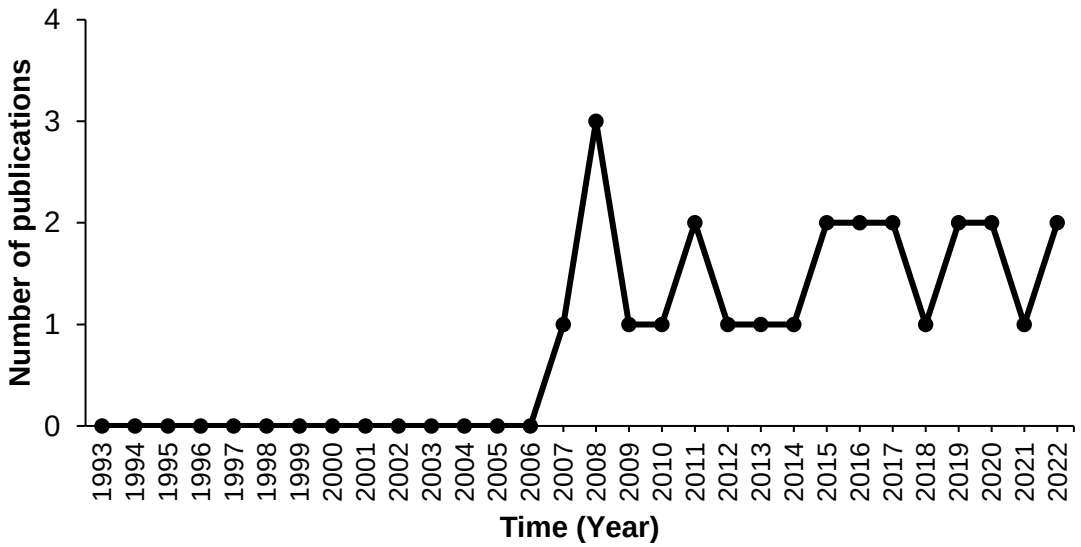

Figure 3: Temporal trends in the number of publications on floriculture sector

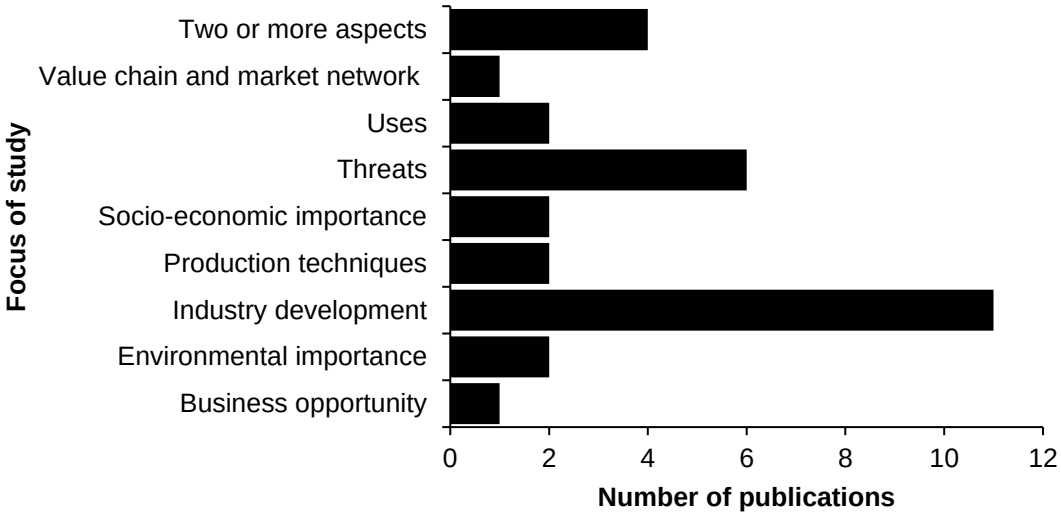

Figure 4: The number of publications recorded per field of study on floriculture sector

Ornamental production and consumption across Africa

Industry development

The floriculture industry has long evolved away from the spotlight of scientists (Awuor, 2013). In Kenya, the products sold in the international floriculture markets are of relatively higher quality compared to her major competitors (Netherland, Columbia and Ecuador), thus assuring a better price (Muthoka, 2008). However, the home market in the country is almost non-existent (Muthoka, 2008), when taking into account that the EU, Japan, and the USA have very vibrant home markets, and the imports are used (European Commission *et al.*, 2019). According to Melese (2019), this industry is insufficiently competitive and does not participate to its full potential in the global market. Indeed, African exporters need to become further integrated into the global market (Matthee *et al.*, 2006; Ndung'u, 2015) by increasing the volume and improving the value of their exports and by participating in international floriculture programs (Button, 2020) to improve their own production.

Main producers

East African countries are the most interested in the floriculture industry in Africa. Kenya is the leader in floriculture production because it produces nearly USD 750.7 million in cut flowers and foliage annually providing employment for nearly 200000 Kenyans. More than half of workers are women, with overall a million people indirectly jobs created impacting in excess of 5 million lives (https://horticulturekenya.com/kenyas-cut-flowers-and-ornamentals/). Ethiopia is the second largest flower producer and exporter in Africa (Yeshiwas and Workie, 2018). Globally, the floriculture industry is a cash and dynamic crop, dominated by south-north flows (van der Maden *et al.*, 2012). It is mainly concentrated in developed countries with an annual growth rate of 8 – 10% (Padmini and Kodagoda, 2017). At least 120 countries are involved in this industry worldwide (Ghule and Menon, 2013).

Uses of floricultural products

Flowers and ornamental plants provide many benefits to humanity from brightening up party days (birthday, wedding, Christmas, etc.), and insightful human well-being. *Rosa spp*. was the main ornamental plant and also commercial perfumery. Many other flower species are used as landscape plants, for hedging, game cover, and slope stabilization (Dujmović *et al.*, 2022). It was revealed that the use of flowers has increased globally, although not all countries in the world use them for food (Santos and Reis, 2021). While, it was noticed a renewed interest from scientific researchers, as they are considered new sources of nutrients and

bioactive compounds (Santos and Reis, 2021). In fact, although the use of flowers in natural medicine and in food is an ancient habit, their use in cooking was recently observed in some countries (Santos and Reis, 2021). This was a return to the ancestral cultural source through the change in people's habits, who have been looking for natural food or functional properties that increase health and prevent diseases (Demasi *et al.*, 2021; Santos and Reis, 2021).

Flowers are rich in specialized metabolites, with strong antioxidant capacities, and significant functional and biological values which positively impact human health (Dujmović *et al.*, 2022). Indeed, several edible flower species such as *Calendula officinalis* L. (Common marigold), *Tagetes erecta* L. (African marigold), *Tropaeolum majus* L. (Nasturtium), *Cucurbita pepo* L. (Zucchini), and *Centaurea cyanus* L. (Cornflower) were reported as having a high specialized metabolites content and antioxidant capacities (Dujmović *et al.*, 2022). Then, the essential oil extracted from some aromatic flowers is an excellent and efficient ingredient in improving mood, conquering emotions, and balancing hormones (Vladeva, 2021). Indeed, it is important to notice that, edible flowers are also used in Asian, European, Indian, and Middle Eastern food, in connection with local traditions, festive occasions, and traditional medicine (Demasi *et al.*, 2021; Kumari and Bhargava, 2021; Santos and Reis, 2021). Especially, in Central Europe, it is common to consume breaded *Sambucus nigra* L. and *Taraxacum officinale* (L.) Weber ex F. H. Wigg. flowers boiled with sugar to replace honey (Rop *et al.*, 2012; Santos and Reis, 2021). These highlighted the multiple advantages of the floriculture industry in food security and socio-economic aggregate improvement for communities.

Existing markets

There is a wide range of international markets for the floriculture industry, but there is virtually no home markets. This is the case in Kenya, one of the largest flower-producing and exporting countries, where the home market of the country is almost non-existent in contrast to the EU, Japan, and the USA with vibrant home markets where the imported flowers are exchanged (Muthoka, 2008). Unfortunately, in Nigeria (Akintoye *et al.*, 2011), as well as in most developing countries a well-developed home ornamental business market is absent, making the industry contribute little or almost no to national income despite the fact that the countries have the capability of becoming a leading flower industry in Africa. This revealed that the creation of home markets in each country to facilitate the flower trade will significantly contribute to the development of the floriculture industry.

Social and environmental standards of the industry

Only the wide job creation of the floriculture industry was unanimously agreed upon and perceived positively by different authors (Gudeta, 2012) among all major seven social (workers' health and occupational safety, problems women encounter and sexual harassment, workers' rights, surrounding community health, compensation for previous landholders and socio-cultural change) and five environmental issues (water resource utilization, water and soil pollution, air pollution, and land cover change) identified. However, the remaining social and environmental issues are the negative implication of the sector (Dibaba, 2020). As reported by Yeshiwas and Workie (2018), the floriculture industry is suffering from an insufficient infrastructure system necessary for its future development.

Threats

The floriculture industry is facing many threats. According to the global threats, Kassa (2017) showed that the floriculture sector is faced with some constraints mainly related to its expansion and the adverse effect of pesticides and chemical fertilizers, disposal of waste materials, and pollution of water bodies. Similar results were reported by Rosendahl *et al.* (2009) in Benin who reported concentrations of the metabolite endosulfan sulfate in soil and plant surfaces as a potential long-term pollutant even in tropical environments. Along with other floriculture-producing countries in Africa, Ethiopia has no strong and functional system or structure to control the impacts of floriculture farms (Gelaye, 2023). This is the case with carbendazim, a pesticide commonly used on Ethiopian flower farms, which has harmful effects on aquatic life,

invertebrates, and mammals (Wehbe *et al.*, 2022). Scientists could also consider the advantages of focusing on plant fungal pathogens (Shuping and Eloff, 2017). Even if extracts are toxic, they are still useful in the floriculture industry (Shuping and Eloff, 2017).

Getu (2009) and Mengistie (2020) proved that environmental concerns are growing because floriculture requires intensive use of chemical fertilizers and pesticides and needs huge amounts of water than conventional farming in addition to thoroughly monitored waste management systems. Substances, like nitrate, which are found in fertilizers and pesticides, are hazardous to the environment. The impact of pesticides on the environment includes degrading water and soil quality, adverse effect on non-targeted lives, air pollution, and increased pesticide resistance by targeted pests. According to Belwal and Chala (2008), the finding revealed that infrastructural bottlenecks appended by a shortage of agricultural inputs, narrow product range, and lack of adherence to international codes of practices are major among the perceived barriers. Ksoll *et al.* (2022) showed the violence induced a large negative supply shock that reduced exports primarily through workers' absence and had heterogeneous effects: larger firms and those with direct contractual relationships in export markets suffered smaller production and losses of workers.

Climate change and ornamental plant production

Challenges

The floriculture industry is a huge opportunity whose benefits for humanity are first environmental, then health, social and economic. Green and ornamental parks are renowned for their aesthetic, sentimental, and restorative effects on public health, and for compensating for the void in human life (Shanahan *et al.*, 2015; Korbéogo, 2016; Larson *et al.*, 2016). Floricultural production most often takes place under cover, for annual, biennial, or perennial plants, and includes the production of grains and seeds for the future crop (Muthoka and Muriithi, 2006).

The most important challenges to tackle in floricultural production are related to climate change (scarcity of rainfall, drought, rise of temperature), pests, and pathogens attacks. Some identified constraints were the shortage of water during the dry season in relation to the market glut in the same period, and the lack of basic nursery facilities such as greenhouses, irrigation equipment, and storage facilities (Akintoye *et al.*, 2011).

Irrigated floricultural production is one determining technical solution. Otherwise, developing resistant and adaptative accessions/varieties (to water scarcity, drought, and high temperatures) will favor the yields (Okoro *et al.*, 2016). It is known that the increase in temperature creates favorable conditions for the development of new pests. Several insects were identified such as termites, white flies, aphids, root rot, powdery mildew, swollen shoot, leaf blight, stem borer, etc. (Akintoye *et al.*, 2011). The proliferation of pests and new especially virulent pathogens and the increasingly unavoidable dependence on synthetic chemical pesticides by producers are the sources of numerous poisonings in humans and environmental pollution (Akintoye *et al.*, 2011). In addition, the scarcity or absence of quality local planting materials, and the limited availability of improved/exotic stocks are crucial constraints (Akintoye *et al.*, 2011). Indeed, several issues are raised by environmentalists that are related to the expansion of the floriculture industry and the adverse effect of pesticides and chemical fertilizers, disposal of waste materials, and pollution of water bodies (Kassa, 2017).

In Kenya, the home market is almost non-existent, unlike other countries (Muthoka, 2008). This will, therefore, mean that the unavailability of home markets remains a challenge to be met to add value to the national economy. Until now, women are identified as often not involved in decision-making relating to the floriculture industry, despite their important contribution to this sector (Miassi *et al.*, 2018). This makes it necessary to bridge the gap between men and women in agriculture generally and the floriculture industry especially.

Furthermore, agroforestry is identified as a sustainable system for minimizing climate impacts and adapting cropping systems to climate change (Mosquera-Losada *et al.*, 2018; Xie, 2018).

Opportunities

About a hundred species were reported as ornamental plants cultivated in Africa (Netnou-Nkoana and Eloff, 2012; Evers *et al.*, 2014; Mwase, 2015; Korbéogo, 2016; Kassa, 2017; Vroh and Kouame, 2022). They were mostly exotic and more than 50% are sold in northern countries (Vroh and Kouame, 2022). Like Ethiopia, several other African countries have undeniable assets to suitably develop the floriculture industry. These facilities are summarized between the availability of arable land, suitable agroecology, proximity to major flower markets, civilized population, manpower, and financial support (Gebreeyesus and Iizuka, 2012). Indeed, the flower is a fragile commodity and must reach the market in good condition and at the right time (Gobena *et al.*, 2021). For example, Ethiopia's proximity to Europe and the Middle East offers this basic assurance (Gebreeyesus and Sonobe, 2012). The products can reach these markets in a relatively shorter time, with cheaper transportation costs than most other flower-producing African and Latin American countries (Belwal and Chala, 2008).

CONCLUSION

This review showed that the African continent demonstrates innumerable advantages that create ample opportunities for developing the floriculture industry, as a promising industry. Floriculture provides benefits either in terms of the living environment improvement and stimulation of its attractiveness, job creation, contribution, national economies, and human well-being. It was revealed that the sustainability of the sector strongly depends on the existence of nearby markets for selling the products. About ten African countries are interested in this sector internationally with a very disproportionate production capacity, thus making this sector an opportunity hitherto neglected, yet a potential source of income. However, the adverse impact of pesticides on the environment and biodiversity when fighting against pests, climate change by the scarcity of rain and drought, the problems related to gender involvement, and the unavailability of home/local markets were identified as the biggest challenges to overcome. Good production practices, competitive advantage, and strategy to sustainably develop this industry should be undertaken throughout the continent. Consequently, we suggest to (i) carry out extensive genetic, agronomic, and economic research to facilitate the environmentally friendly cultivation of climate-smart flower and ornamental species, (ii) take into account gender approach in decision-making, (iii) promote the pest resistible species to reduce pesticides employment, (iv) regulate the use of chemical pesticides by putting in place laws that govern their use, (v) develop biopesticides through research, and (vi) promote credit facilities and collaboration between the florists and research institutes.

This review has utilized currently available and accessible literature. Some articles not currently accessible to the authors may also contain valuable information and could be considered in the future to update the current findings.

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Author Contributions

Mèmonsso Pierrette Pauline Deguenon, and Gbodja Houéhanou François Gbesso designed the study, carried out the research work. Mèmonsso Pierrette Pauline Deguenon wrote the first draft of the manuscript. Rodrigue Idohou, Guillaume Hounsou-Dindin and Agossou Bruno Djossa reviewed the manuscript. All authors performed data analysis and interpretation and approved the final draft of the manuscript.

Conflicts of Interest

The authors have no conflict of interest to declare.

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