Addis Ababa University School of Graduate Study

Civil Engineering Department

Under

Road and Transport Engineering Stream

Evaluation and Development of Floriculture Supply Chain in Ethiopia, to Attenuate Environmental Impact and Logistics Cost

M.Sc Thesis

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SCHOOL OF CIVIL ENGINEERING GRADUATE PROGRAM IN ROAD AND TRANSPORT

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Declaration

I declare that the thesis is my original work and has not been presented for a degree in any other university.

_____

Date

This thesis has been submitted for examination with my approval as university advisor.

Advisor

ACKNOWLWGMENT

Many people have generously cooperated and contributed for the success and completion of this thesis. My special thanks, first and foremost, goes to Pro. Girma Gebresenbet. I would not hesitate to state that the merit that is in this paper is on account of the supervision of my advisor. I am deeply grateful for the encouragement and help offered by him.

I also thank Ethiopian horticulture agency for supporting me in providing information that help me for my work.

I would also like to thank my brother Bizuwork Hailemichael for his cooperation on data collection.

Daniel Hailemichael

January, 2013

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Abstract

Ethiopia is now Africa's second largest flower exporter after Kenya, with its export earnings growing by 500% over the past year. In 2008, there were 81 flower farms employing around 50,000 workers (over 70% women). Ethiopia's flower exports reached 100 million USD and the industry is one of the top four sources of foreign exchange for the country. In less than a decade of experience, Ethiopia ranks second in Africa for flower exports, and fifth in Extra-EU exporters to the EU market. Annual average growth in number of firms and exports in 2003 to 2008 is around 380% and 638% respectively.

Ethiopian growers can produce a very high quality product, which has a big demand on the market in the advantage of higher altitude of the country but at this moment it is still quiet important to bring this product correctly and on time into that market. This can be achieved by designing a good logistic system. That is why the main objective of this research is being describing the supply chain of floriculture in Ethiopia, determine main bottlenecks and develop efficient methodology in line with coordination possibilities and route optimization to reduce logistic cost and environmental impact.

The majority of the farms are located in about 50 km radius of the capital city, Addis Ababa. These cluster areas will create an opportunity for collaboration among producers. From analysis results there is a probability of collaboration between farms found in these three clusters in transporting their products inland and they can save the inland transport cost significantly.

Supply chain of floriculture in Ethiopia consists of different activities categorized as farm operations, inland transport, and cargo activities. In the farm activities the operation starts from cutting. Cutting is done by leaving two leaves at bottom of the rose tree. After cutting, the stem is collected in water bucket and taken to pre-cooling room and kept for 8-10hrs at temperature of 4-6 ^{o}c. After pre-cooling the sorting and packaging process begins. The packed flowers kept in cold room for 1 and ½ days at temperature of 2^{o}c. Finally the bundles of flowers are placed in carton (23 bundles/carton) and placed back to the cold room. The next activity is inland transport operation and the last activity is the cargo transport to the Dutch auction market or other whole sellers.

Most farms in Ethiopia use ground water for irrigation purpose this will create continues depletion of ground water. The use of chemicals will also create contamination of ground water and streams near to the farm locations are also getting contaminated by the chemicals used even if the effect is not significant the proper use of chemicals and safe disposal of west should be made by trained professionals for chemical protection. The chemical sprayers wear mask during chemical spraying but most of the workers are not trained for this special purpose. This will put the health of the workers in danger.

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1. Introduction

1.1 Background

A modern, export oriented and private sector based floriculture industry began to emerge in Ethiopia in the late 1990s. Until 2003 only five farms were involved in exporting. The flower industry took-off in 2005 and continues to grow rapidly. By 2007, the number of firms involved in flower production and exporting reached 67. The sector created above 50,000 employment (permanent and temporary), and has become among the five top foreign exchange earning commodities with above 120 million USD in 2007. In no more than 7 years Ethiopia became the second largest flower exporter in Africa (next to Kenya) to the EU market. This remarkable growth was partly due to initiatives taken by the government to promote the sector which has met with the interest of the private sector. Since then the government decided to get engaged in promoting the sector. To scale-up, government came in with a multi-faceted support starting from 2003, focusing on: access to land, access to long-term credit, infrastructure, and air transport coordination. Some of the investment incentives are; five-year tax holiday, duty-free machinery imports, easy access to bank loan and up to 70% bank funding, cheap and easy acquisition of leased government land. This governmental support will greatly attract investors to participate in floriculture industry but it cannot alone guarantee the competitiveness of Ethiopian flower products in the world market without providing efficient and effective logistic system which is a critical method for any product to be competitive in any market and increase the firm profitability by decreasing the total cost of production.

Ethiopian growers can produce a very high quality product, which has a big demand on the market in the advantage of higher altitude of the country but at this moment it is still quiet important to bring this product correctly and on time into that market. This can be achieved by designing a good logistic system. For example The Dutch ambassador in Ethiopia describes the Ethiopian floriculture as a very dynamic sector with several challenges. “There are issues that one has to deal with, logistics is one. There should be liberalization in this field. There should be a logistical system that enables production to move fast into the market.” Chairman of the Ethiopian Horticulture Producers and Exporters Association (EHPEA) Tsegaye Abebe, also says, “Freight was a serious problem. We used to dump flowers due to lack of transport facilities.” The manager of Dutch branch of Florensis, Duijnisveldin Ethiopia also says. "Logistics, transportation and transport to the Netherlands are very time consuming.”[23]

The majority of the farms are located in about 50 km radius of the capital city, Addis Ababa. The largest cluster Holeta accounts for 31.3% of the total number of farms. The second and third biggest clusters are Sebeta and Debre-Zeit accounting for 15.6% and 10.9% flower farms respectively. These cluster areas will create an opportunity for collaboration among producers. On average the cost of plant materials, and chemicals and fertilizers account for about 6%, and 7.6% of total sales respectively. Packaging cost, transport cost (sum of both road and air) account for about 2% and 21.6% of total sales respectively. Technical advice fee accounts for less than one percent; while marketing cost measured by commissions and agents fee accounts for about

4.8%.[24]. The transport took the highest cost and this will give insight that great work has to be done in decreasing the transportation cost. That is why the main objective of this research is being describing the supply chain of floriculture in Ethiopia, determine main bottlenecks and develop efficient methodology in line with coordination possibilities and route optimization to reduce logistic cost and environmental impact.

1.2 Literature review

1.2.1. Global view of Floriculture industries

Floriculture includes all commercially grown flowering and ornamental plants in greenhouse based pots, trays, troughs and contained beds, or in field settings. [3]

In 2009, the world trade in cut flowers was worth roughly US$7 billion. As the world's leading hub for cut flower trade, the Netherlands maintained its leadership position by exporting roughly half of all cut flowers traded in the world in 2009 (US$3.6 billion). Other major exporting countries include Colombia (US$1 billion in 2009), and Ecuador (US$500 million); on an annual basis, these three countries combined export roughly three quarters of the world's cut flowers. [9]

Table 1: Top 10 cut-flower exporters into the EU market 2001-2007

2001			2003			2007		
country	share in EU market	Rank	country	share in EU market	Rank	country	share in EU market	Rank
Kenya	25.90	1	Kenya	31.71	1	Kenya	39	1
Israel	18.35	2	Colombia	15.15	2	Colombia	14.17	2
Colombia	15.40	3	Israel	14.08	3	Ecuador	13.6	3
Ecuador	12.10	4	Ecuador	11.15	4	Israel	8.94	4
Zimbabwe	10.04	5	Zimbabwe	8.69	5	**Ethiopia**	**5.05**	**5**
Thailand	2.84	6	Thailand	2.71	6	Zimbabwe	2.82	6
Zambia	2.67	7	Uganda	2.66	7	Uganda	2.56	7
Uganda	1.87	8	Zambia	2.61	8	Thailand	2.52	8
South Africa	1.60	9	South Africa	2.24	9	Zambia	1.96	9
Tanzania	1.45	10	Turkey	1.67	10	South Africa	1.62	10
Ethiopia	**0.14**	**24**	**Ethiopia**	**0.50**	**15**			

(MuluGebreeyesus and Michiko Iizuka, #2010-025)

Table 2: Cut Flowers Exports, Sub Saharan Africa, 2009 (US$ thousands)

Exporters	Exported value in 2005	Exported value in 2006	Exported value in 2007	Exported value in 2008	Exported value in 2009	% of World	% of Africa
'World	$5,617,103	$ 6,811,428	$ 7,121,896	$ 7,705,355	$7,305,167	100%	
Africa	$ 346,263	$ 1,134,251	$ 636,271	$ 804,636	$1,012,821	14%	
'Kenya	$ 242,561	$ 274,946	$ 313,412	$ 445,996	$ 421,484	6%	42%
'Zimbabwe	$ 33,658	$ 765,230	$ 201,056	$ 185,772	$ 334,117	5%	33%
'Ethiopia	$ 12,128	$ 25,137	$ 68,827	$ 104,740	$ 131,518	2%	13%
'Nigeria		$ -	$ 4,585	$ 9,905	$ 67,725		7%
'South Africa	$ 24,408	$ 22,064	$ 25,439	$ 28,412	$ 26,467		3%
Tanzania	$ 9,282	$ 7,791	$ 8,812	$ 13,428	$ 14,075		1%

Global Development Solutions LLC from ITC/Comtrade data.

The largest importers of cut flowers are Germany, the Netherlands, and the United Kingdom, each of which import, on average, US$1 billion worth of cut flowers annually. France, Italy, Russia and Japan make up the bulk of the remaining cut flower imports. Sub-Saharan Africa is a significant region in the global cut flower trade by the virtue of having three big exporters of cut flowers, namely: Kenya, Zimbabwe and Ethiopia. [9]

1.2.2. Ethiopian floriculture industry

Ethiopia is a country of agriculture, which accounts for more than 50 percent of its GDP, and about 80 percent of the population lives in rural areas as subsistence farmers [8]. Her economy has so far depended on coffee for nearly 50% of the total exports. State farms started to export cut flowers to Europe in 1980 [8], but the rapid development of this sector is originally due to the attempts by several private cut flower farms which began operation in the early 1990s.[26] These farms included both foreign and domestic farms. [5]

Cut flower export is in the top 5 export products of countries like Kenya and Ethiopia. Producing high value export products, such as flowers, supports the employment of many people: approximately 25 employees per ha. Furthermore, the export value of 1 hectare roses is for instance USD 150,000 which is equivalent to 1000 tons of wheat or to 600 to 700 ha wheat land in Ethiopia. [16]

Kenya is the largest cut flower exporter in Africa, and it is indeed the fourth largest in the world, after the Netherlands, Colombia, and Ecuador. Kenya's export value increased from USD 91 million in 2000 to USD 446 million in 2008, while Ethiopia's cut flower export has more drastically increased since 2004, from USD 2 million to USD 104 million in 2008. Although Ethiopia's export value is still only about one quarter of Kenya's as of 2008, Ethiopia has become the third largest cut flower exporter in Africa. [2]

The area under cultivation was about 1,000 ha at the end of 2008, most of it under greenhouse cover. In 2008, 80–85 flower farms were operating, with some large companies operating more than 100 ha and many small companies with less than 10 ha. [7]

The cut flower industry has emerged much more recently, but is now one of Ethiopia's main export sectors. Most farms produce roses, but some are diversifying into new products such as Hypericum, Gypsophilia, carnations, lilies, and freesias. In the case of roses, high altitude allows buds to grow larger, which is important to fetch premium prices. [7]

Ethiopia is an increasingly important player in the regional and global market for cut flowers. In 2005, the country exported US$12 million worth of cut flowers. By 2009, its cut flower exports increased by tenfold to US$131 million, which represented 13% of African exports and 2% of world exports. In the first ten month of 2010 alone, Ethiopia exported an estimated US$250 million of cut flowers. The industry employs roughly 35,000 people – mostly women (80%) employed on temporary basis (80%). [9]

There are 89 producers and exporters of cut flowers in Ethiopia, cultivating a total of about 1,240 ha of land. While none of the producers are within Addis Ababa city limits, their mean distance from Addis Ababa city center is 51 kilometers. Addis Ababa International Airport, the only cargo outlet to export markets, is undoubtedly the determining factor for flower producers to locate within proximity to Addis Ababa. In terms of ownership, most of the flower producers are either fully foreign owned or are joint ventures with foreign firms. [9]

1.2.3. . Emergence of the industry

During the 1980s and early 1990s, some initial efforts were undertaken to produce summer flowers for export, first under the Derg governance on state farms, then by two domestic private entrepreneurs. Success, however, came only with Indian and Dutch foreign investment in the late 1990s and early years of the new millennium. [7]

The history of the Ethiopian floriculture industry dates back to 1980, 27 years ago, when state farms started to export flowers to Europe. Meskel Flowers Plc. was the first private company to engage in export oriented commercial flower farming in Ethiopia. A second private farm, Ethio-Flora, was established (in Zeway, 98kms south of Addis Ababa) soon after. Both farms are Ethiopian owned and produce summer flowers (field produced) such as alliums, statice, and carnations for export to EU markets. Despite their early exit, these farms contributed to the initial accumulation of flower industry knowledge in Ethiopia and the feasibility for Golden Rose, a new entrant, relied on the experience of these farms. [1]

In 1999, Golden Rose Agrofarms Ltd. (Golden Rose, hereafter) – a foreign owned firm – started rose production using steel structure greenhouses, 42 kms South West of Addis Ababa. Although the pioneers (Meskel Flower and Ethio-Flora) had laid the foundations for the flower industry growing summer flowers, Golden Rose is considered to be the pioneer by many followers due to its introduction of modern technology (e.g. steel structure greenhouses). Golden Rose began exporting in 2000 through Dutch auction. [1]

The entry of Sher-Ethiopia in 2005 was a landmark in the Ethiopian flower industry growth. The company had been engaged in flower farming business in Kenya for over 15 years with production on 300 ha of farming land (Africa News, 2008). In 2007, it sold its Kenyan farm and moved to Ethiopia to become the largest investor in the sector. It leased about 500 ha of land from the government in an area about 170 km from Addis Ababa (known as Zeway) near the highway between Addis Ababa and Nairobi. [1]

The Ethiopian flower industry represents an extraordinarily fast and successful diversification into a non-traditional export product. Despite its late entry into the flower export industry, Ethiopia became the 5th largest non-EU exporter to the EU cut-flower market and the 2nd largest (after Kenya) flower exporter from Africa in 2007. [1]

1.2.4. Growth of the industry

Ethiopia is now Africa's second largest flower exporter after Kenya, with its export earnings growing by 500% over the past year. In 2008, there were 81 flower farms employing around 50,000 workers (over 70% women). Ethiopia's flower exports reached 100 million USD and the industry is one of the top four sources of foreign exchange for the country. In less than a decade of experience, Ethiopia ranks second in Africa for flower exports (after Kenya), and fifth in Extra-EU exporters to the EU market. Annual average growth in number of firms and exports in 2003 to 2008 is around 380% and 638% respectively. [1]

The sector has expanded rapidly as seen in the annual growth rate of this sector of 444% in 2008 [27].

The cut flower industry in Ethiopia is a fast growing industry, having increased its total value of export from USD 2 million in 2004 to USD 104 million in 2008, almost equivalent to 20 percent of the export value of coffee from this country. [5]

The rapid growth of the industry fuelled hopes that flower exports might even overtake coffee as Ethiopia's main export product in the near future. [7]

1.2.5. Factors contributing for the fast growth of the industry

1.2. 5.1 Climate and topographic factors

Ethiopia has wide underdeveloped highlands around its capital city, Addis Ababa, a climate of high daily temperature and cool nights, and sufficient sunlight and rainfall, which are all favorable for flower production. In addition, the country has an abundant labor supply with a low wage rate, compared to other African countries. [2]

The Ethiopian highland offers appropriate climatic conditions for a range of fruits and vegetables, including strawberries, pineapples, passion fruit, papayas, mango, guavas, avocados, green beans, cabbage, asparagus, baby corn, snow peas, and chili. Many of these crops can be produced all year round, and they thus offer opportunities to export at times when prices in Europe are high. [7]

With flat lands on altitudes between 1500 and 2500 meters, where days are warm and nights are cool, with fertile soils and sufficient water supply, Ethiopia offers very good agro-climatic conditions for the cultivation of flowers. Most farms produce roses, but some are diversifying into new products such as Hypericum, Gypsophilia, carnations, lilies, and freesias. In the case of roses, high altitude allows buds to grow larger, which is important to fetch premium prices. [7]

1.2. 5.2 Governmental support

Government also provided long-term credit on very generous terms through the Development Bank of Ethiopia. Investors can borrow up to 70:30 debt-equity ratios with no collateral requirement. Interest rates are low and do not vary much. Compared to other major horticultural exporter countries in Africa, government support in Ethiopia is clearly very favorable. For example, the fixed interest rate (around 7.5%) is very low compared to many other African countries' interest rates which are generally around 15%. The real interest rate that Ethiopian exporters have been required to pay since 2005 is zero when calculated against the growing rate of inflation in Ethiopia. This translates into a pure resource transfer (subsidy) to exporters. [1]

The Prime Minister took personal interest in the growth of the industry. He meets growers regularly to discuss and take care of their problems, and in urgent cases the head of EHPEA is able to access him directly. [7]

As well as mobilizing resources, government is involved in advocacy to attract domestic and foreign investors. Its strong commitment to this start is demonstrated by the involvement of the top officials, including the Prime Minister through his position as the chair of the National Export Promotion Committee and frequent interaction with the sector entrepreneurs directly and through their association. [1]

1.2. 5.3 Shift of production sites from Kenya

Another factor is the international shift of production sites from Kenya caused by the water pollution in Naivasha Lake in Kenya and the expiration of the ACP/EU Cotonou Partnership Agreement for Kenya in 2008 (Bolo, 2007). The growers in Kenya had to bear additional costs to avoid further environmental deterioration, resulting in a decline in the competitiveness of the Kenyan cut flower industry, whereas Ethiopia adopted a code of conduct for the sector in 2007 before its environmental effect becomes a serious issue [2 8.] Furthermore, the exemption of EU tariffs on flower exports from Kenya expired in January 2008, whereas Ethiopia is still exempt from the tariffs. In addition, after the presidential election in December 2007, Kenya experienced political violence in many areas including Naivasha, where many flower farms operate *(Yamano and Tanaka, 2010).* Experts believe that the violence has caused some flower farms in Kenya to relocate their production sites to Ethiopia. [2]

1.2. 5.4 Associations related to the sector

The Ethiopia Horticulture Producers and Exporters Association (EHPEA, the association, hereafter) established in September 2002 with five members. The association currently has more than 86 members of which about 81 are flower producers/exporters. [1]

An 'Ethiopian Horticulture Development and Marketing Strategy' (hereinafter referred to as "the Strategy"), was prepared by the Association with support from the Dutch government and a Dutch consultant. The Strategic Paper emphasizes the importance of diversification of the market and the products, i.e. not only flowers but also vegetables and fruits should be exploited as export goods. [8]

The association has been involved in developing informal networks with donors and organizing various forums such as international trade fairs. As a result, it has created strong connections with the donor community and secured wide support for the sector. Donors include the UK DFID, the French Development Cooperation, USAID, and the Dutch government. The relationship with the Netherlands is particularly visible. The association received wide support from the Dutch government within the project 'Ethiopian-Netherlands Horticulture Partnership'. Different Dutch institutions such as the Dutch Center for the Promotion of Imports from Developing Countries (CBI) and Wagningen University are helping with capacity building. The association, therefore, has been crucial for building a shared vision among the various stakeholders through its interactions. [1]

1.2.6. Industries/companies supplying the floriculture sector

As the sector expands, the supply of industry specialists becomes more critical. Government with the support of the Dutch government has started to consolidate higher education in horticulture. One of the state universities, Jimma University, has begun to offer diplomas (BSc and MSc) in floriculture. Efforts are also underway to establish a Horticulture Practical Training Center (HPTC) within the Ethiopian-Netherlands Partnership on Horticulture. [1]

With the expansion of the sector, complementary activities, such as propagation of planting materials, packaging, fertilizers and chemicals supplies, and forwarding companies, started to emerge. By early 2008, there were six cuttings companies, all European in origin, producing pot plants and cut flower cuttings for export. The cuttings farms also propagate new varieties for the domestic market. A number of rose farms have begun to propagate for their own use and for the domestic market. Thus, the source of plant materials is slowing shifting from imports to local supply. There is an increasing trend for imported fertilizers and chemicals to be substituted by local production, and the majority of farms (96%) use locally produced packaging materials. [1]

Many enterprises ran booths at the Fair, including associated industries, e.g. flower breeders who create new varieties, fertilizer traders, distributors of greenhouses, constructors of irrigation systems, a corrugated box company and refrigeration installation companies (Table 1). Most of them already have a branch office in Ethiopia, while some others were trying to find a new business chance in Ethiopia through the Fair. [8]

Table 3 Number of Companies which ran Booths at the Fair (by Business Type)

Breeding	Fertilizer	Greenhouse	Irrigation System	Corrugated Box	Refrigeration System	Flori-Farm	Others
14	11	33	23	7	1	25	35

Source: Hortiflora Ethiopia 2007 Participant List

Table 4 Number of Companies which ran Booths at the Fair (by Nationality)

Ethiopia	Netherlands	Israel	Kenya	Spain	Saudi Arabia	South Africa	India	Other Europe
43	29	16	6	4	1	1	1	5

Source: Hortiflora Ethiopia 2007 Participant List

The industry surrounding horticulture is still in its infancy and improvement is needed in several areas, e.g. refrigeration systems at the airport, the transportation system, and capacity building for the workers. [8]

1.2.7. Market to the sector

The easy way is to sell at Dutch auctions, but higher prices can be achieved through direct sales to final customers, although this places higher demands on producers in terms of production programming and logistics. [7]

For Ethiopia – and for all of Africa - the major flower export destination is the EU. Cut flowers are sold via the auction markets (mainly Dutch auctions) and/or directly to supermarkets and other retailers. Relative ease of access to the auction market means new entrants tend to begin by using this channel. [1]

Over time, the sector has become more diversified in terms of market channels and destinations. In 2007, 41 farms reported involvement in direct sales. Table 5 shows the top market destinations for Ethiopian flowers. The number of destinations has increased from 2-3 countries (all in Europe) in the early 2000s, to some 56 worldwide in 2008. There are 14 destination countries with USD 100,000 and over export value. The EU is still the major destination accounting for around 94.5% of total export value with the Netherlands (88%) in the lead. The association members visit or received visitors from potential buyer countries in Europe, the Middle East and Japan. Currently, they are keen to expand business links with the Dubai Flower Centre (DFC) because of its geographical and logistical advantages which would boost their supplies to the Middle East and the Far East. [1]

Table 5 Top market destination countries for Ethiopian flower export 2008

Top market destination countries 2008	Region	exports millions USD	% of total exports
Netherlands	EU	92.37	88.19
Germany	EU	3.95	3.77
United Kingdom	EU	1.54	1.47
Japan	Japan	1.32	1.26
United Arab Emirates	Middle East	1.28	1.23
Saudi Arabia	Middle East	0.83	0.79
Russian Federation	East Europe	0.68	0.65
Israel	Middle East	0.61	0.58
Ireland	EU	0.46	0.43
Norway	EU	0.41	0.39
South Africa	Africa	0.27	0.26
France	EU	0.16	0.15
Cyprus	EU	0.12	0.12
Australia	Australia	0.11	0.10
EU total		99.02	94.53
All countries with 100,000 USD and above export		104.09	99.38
World		104.74	100.00

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1.2.8. Working environment

Many products used are highly toxic or associated with chronic effects. A Tanzanian study found that flower workers were unaware of inherent dangers, ignorant of the identity and hazards of the chemicals used, and had no access to the standard material safety data sheets. Workers did not have first aid information on dealing with splashes and spillages and with a few exceptions the health services available to workers did not differ from those of the general population. A report in Colombia confirmed a similar situation where workers are often not given appropriate personal protective equipment (PPE) or training on how to use protective gear that is provided; nor are they educated about the types of pesticides being used, how to handle the pesticides properly and potential risks.[11]

The beauty of cut flowers masks a system of growth and production marked by environmental degradation, labor abuses, and the exposure of almost 200,000 people inthe developing world to a variety of toxic chemicals. Compensation is poor,relative to the risks involved. For instance, on an average day, one womanworking in a Colombian carnation field will pick over 400 top-grade

flowers. Four such flowers will cost just under $4.00 at a US florist, more than the worker earns in a day. [7]

Table 6: Employment Statistics for Ethiopian Cut Flower Sector

Year	Flower Productive Area (Hectare)	Total number of workers	Remark
2010/2011	1,240	35,000	Productive area and number of workers are until January, 2011
2009/2010	1,306	33,000	
2008/2009	1,376	31,000	

Compiled by Global Development Solutions, LLC based on data from the Ethiopian Horticulture Development Agency, 2010

Workforce Characteristics*:* - The labour force in the visited farms was mainly local, while most of foreign owned farms employ foreign workers as technicians and production specialists. The majority of workers in farms were employed in fixed terms and as daily laborers. The labour force in the farms was aged 18 years and above; an indication that the farms had complied with child labour regulations. [10]

Wage & Benefits: - The majority of workers earned a monthly salary of between 10 – 15 ETB (approx 50p – 70p) for the formal 8 hour working day and 300 – 450 ETB (approx £15 - £22) for a 192 formal working hours of a month. There was no variation in wages earned by male and female workers. Two farms offer a provident fund of 11 & 10 % for their permanent workers and one of these farms also cover 75% of educational expense for workers attending their education. [10]

Leave: - Most (12) farms give paid annual leave for most of their workers (permanent & fixed term workers) compared to the remaining farms who give paid annual leave for only permanent workers. While 10 farms offer paid weekly leave for permanent & fixed term workers and non-paid weekly rest for daily laborers, 5 farms offer no week leave for daily laborers at all. The length of maternity leave ranges from 2 to 3 months .Workers are not assured of their employment throughout the year. Employment insecurity is much higher with female workers as compared to male workers. [10]

Health and Safety: - Health and safety issues seem to be generally taken seriously in most of the visited farms. 11 farms (73.33 %) had a health and safety officer on site as well as a workers and management joint health and safety committee. 26.66% of farms had neither a health and safety officer on site nor workers and management joint health and safety committee. Sprayers were provided with at least two personal protective equipments, the most common PPE being respirators and gloves. With regard to medical check-up - blood enzyme test - only spray workers are sent for the check-up. The frequency of the check – up is being from 3 months to 1 year. [10].

In November 2003 about 200 Colombian flower workers, mainly women, experienced symptoms such as strong headaches, nausea, swelling, rashes, diarrhoea and sores inside and around the mouth shortly after arriving at work at Flores

Aposentos, north of Bogotá. The Colombian National Institute of Health indicated that women flower workers suffer skin lesions, allergies, respiratory problems, fainting spells, headaches, eye problems and chronic asthma, as well as congenital malfor- mations. [11]

Codes of Conducts: By the time data was collected, eight of the fifteen farms had adopted codes of practice, with the MPS (Milieu Project Sierteelt) and EHPEA Code of Practice being the dominant. In one case a farm was found adopting FFP (Fair Flower Fair Plants) code. Concerning workers knowledge on codes of conducts, the picture is grim that 92 % of worker respondents didn't know which code their farm subscribe to or they have never heard of the existence of the so called codes of conducts or certification schemes at all. [10]

Maternity Protection;- Only 41% of the workers interviewed were entitled to paid maternity leave, while 23% were entitled to unpaid maternity leave, 15% reported that they are not entitled to maternity leave and another 21% disclosed that they don't know whether they are entitled to maternity leave or not. [10]

Exposure: - is not only an issue for those whose job involves pesticide application, as workers can be exposed when they transplant crops, prune, and cut or pack flowers. Greenhouse production is common in developing countries as well as in Europe (over 87% of Colombia's 8000 ha of flowers are grown in greenhouses) and workers will dust and spray pesticides in these enclosed spaces. [11]

1.2.9. Environmental impact

The environmental issue is the most worrying negative factor for the long term. It is encouraging that the effort to minimize the environmental impact has started but it should continue further. [8]

Lack of safe management of agrichemicals is one of the environmental issues. Previously, each farm had to import agrichemicals individually because the mass import and resale of agrichemicals was restricted by law, and each farm had the responsibility to treat and dispose of the agrichemicals safely. The Ministry of Agriculture was supposed to provide training on the safe management of agrichemicals for those farms but this was not implemented. [8]

A case study of the Lake Naivasha region in Kenya identified negative impacts from flower production due to worsening environmental conditions affecting fishing, local food security (declining fish stocks) and community health from water pollution and over-abstraction.

The ozone-depleting chemical methyl bromide is still widely used to sterilize soil. It is applied to soil before planting and then covered with plastic tarpaulins; once these are removed part of the gas will enter the atmosphere. A study in Nepal found use of methyl bromide even though it has been banned by the government. [11]

Although accurate scientific data is not available, it is often said that the proximity of farms and the lack of knowledge about how to treat agrichemicals causes contamination of water and overuse of groundwater. Depletion of water resources is also pointed out as an issue caused by the lack of a master plan for an irrigation system. Although the code of conduct COC is going to be signed quite soon, careful attention should be paid to environmental issues, given that the serious deterioration of the environment has been observed in Kenya where floriculture has prospered and is more advanced than Ethiopia. [8]

There are around 120 chemicals that enter the country for the floriculture industry which are found on the world health organization negative pesticide list, while environmentalists have characterized some of these chemicals as having carcinogenic potential, Such hazardous chemicals are used in the flower farming sector in Ethiopia. Industries located near Ziway are using a broad range of fertilizers and pesticides; the farm effluent is directly discharged in to the nearby lake which led to deterioration of the water quality and aquatic life. [12]

EHPEA took the lead in establishing a Code of Practices for the flower industry. The Code documents compliance with Ethiopian laws on labour and environmental issues, as well as compliance with good agricultural practice. It is supported by many stakeholders, including the competent ministries and several non-governmental organizations, and it is audited internationally. Such standards are increasingly demanded by international buyers and help to preserve the image of Ethiopian producers. [7]

The entrepreneurs in the floriculture industry in Ethiopia are relatively aware of the environmental issues responding to the strict requirements of environmental measures and the bans against products that fail to meet the standards for the protection of the environment.
A Code of Conduct (CoC) on environmental standards has been drawn up with support from the Netherlands Embassy in Ethiopia and the Wageningen University of the Netherlands, and is going to be signed by the stakeholders in the near future. Also, labor issues are another pillar of the CoC. [8]

1.2.10. Logistics and supply chain

The main inputs used in rose farming and post-harvest handling operations are fertilizers, chemicals, and packaging materials. Rose exporters generally use the services of two and up to five local suppliers of these inputs. Sometimes they also import portions of these inputs directly. Even though the inbound/import logistics for fertilizers and other inputs is just as time consuming and burdensome, rose exporters do not report any major concerns in relation to the flow of inputs to their farms. This is mainly because the required imported inputs are a fixed set of commodity-type inputs which can be stocked in a warehouse if necessary as a way to overcome the slow movement of inputs across borders in Ethiopia. Since most inputs can be readily purchased from local traders, rose exporter can generally minimize carrying-costs associated with buffer stock. [9]

Once inputs reach a rose farm, the rose/cut flower production value chain goes through three major stages: rose farming, post-harvest handling, and marketing and delivery to market. Rose farms, depending on variety, type of farming, and altitude, generally have 8-12 harvest cycles per year. Post-harvest handling and transport to export markets are therefore a function of matching harvest cycles with optimal timing of the demand for roses in international markets. [9]

1.2.10.1 Logistics costs (in relation to production and marketing costs)

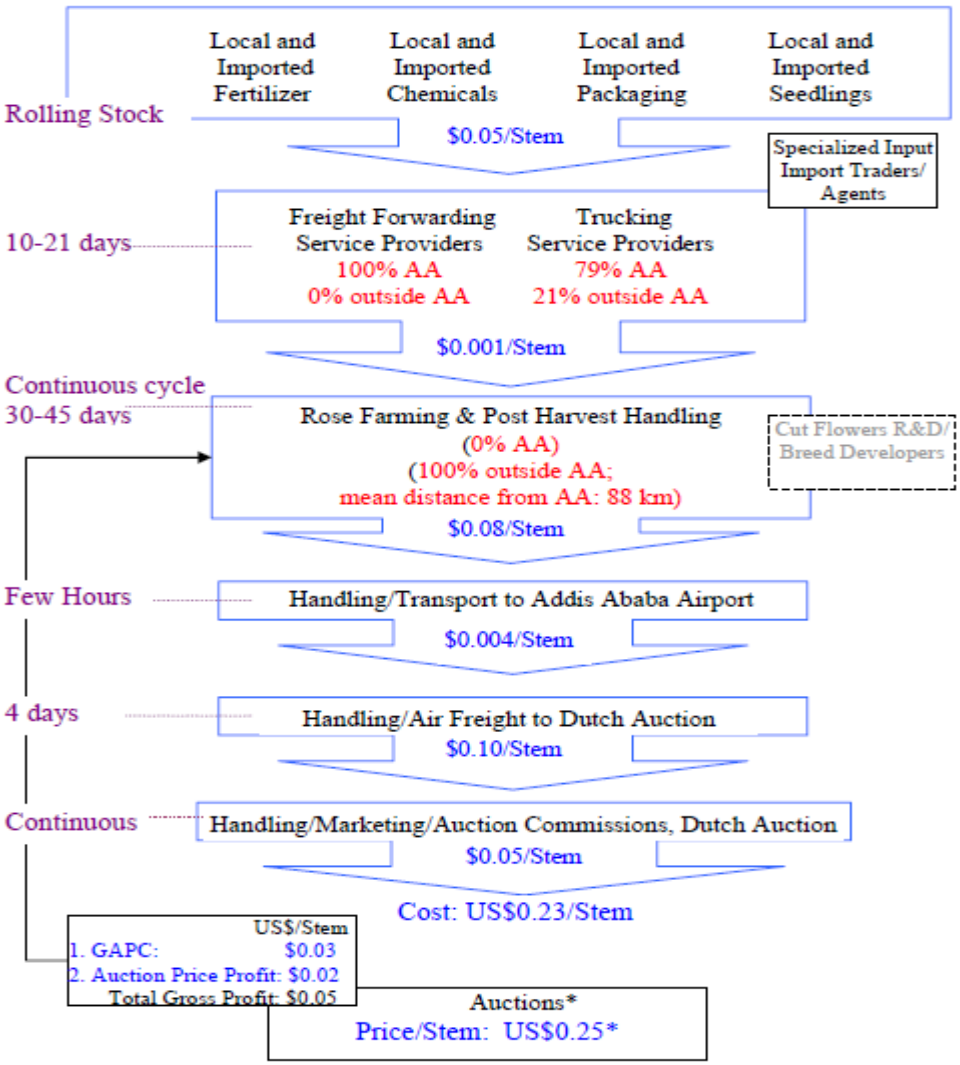
The average expenses on marketing and transportation are estimated to account for over 70 per cent of the total variable cost *(Joosten, 2007, cited in Yukichi Mano and Aya Suzuki).* [2]

As the industry grows, the unit cost of a rose has been decreasing. The unit cost of the Ethiopian rose was more expensive than the Kenyan rose by more than 35 % in 2002, while it dropped by 15% in 2004, which is almost the same price as the Indian rose and even cheaper than the South African, the Ugandan and the Zambian rose. [8]

with an average sales price of US$0.25/rose stem, the transport, handling and other logistics cost are estimated to be less than 1% of the sales price of an exported rose stem (or US$0.01 per stem) – see table below. In terms of contrasting the cost of transporting and handling of inputs against the cost of inputs (see table7), interviews suggest that the cost of all imported inputs (excluding royalty fees) for a delivered rose stem is roughly US$0.05 per stem, and freight and handling charges associated with input imports constitute 2.3% of input costs. [9]

The cost of inputs needed for producing a rose stem are very low compared to the costs associated with rose exporting stages of the value chain and the cost of rose export related services (ex: rose export related services (US$0.15/stem) are roughly three times higher than the cost of inputs needed to produce a rose stem (US$0.05/stem)). [9]

Figure 1: Cut Flowers (Rose) Supply Chain, from Ethiopia to Dutch Auctions



Boxes with dashed - - - lines illustrate the missing and/or weak supply chain service providers
GAPC - Guaranteed auction participation commission paid to raise exporter/auction participant
* Only for illustration – prices in auctions are extremely volatile)

Table 7 Cost of Services in the Ethiopian Export Roses, 2010

Sales Price Per Rose Stem*	**$**	**0.252**	**% Share**
Total Cost of Services	**$**	**0.168**	**66.7%**
Input Transport and Handling Charges**	**$**	**0.001**	**0.4%**
Production Related Services	**$**	**0.017**	**6.8%**
Rose Export Related Services	**$**	**0.150**	**59.6%**
Gross Profits	**$**	**0.022**	**8.8%**

* C&F Dutch Auction
** Excludes sea freight from import source to Djibouti
Global Development Solutions, LLC

Table 8 Cost of Input Import Related Services, Share in Rose Production Input Costs, 2010

Cost of Inputs in a Rose Stem*	$	0.045	% Share
Total Cost of Services	$	0.168	373.0%
Input Transport and Handling Charges**	$	0.001	2.3%
Production Related Services	$	0.017	37.8%
Rose Export Related Services	$	0.150	332.9%

* C&F Dutch Auction
** Excludes sea freight from import source to Djibouti
Global Development Solutions, LLC

When all costs associated with farming and post-harvest handling stages of rose production are considered, the cost of royalty payments to international breeders (US$0.012/stem) constitutes 21% of the ex-farm rose production costs (US$0.08/stem); i.e. excluding all post-farm freight and marketing costs for delivering roses to the export market. [9]

Table 9 The Role of Services in the Ex-Farm Rose Production Cost, Ethiopia

Production Cost Per Rose Stem*	$	0.080	% Share
Input Import Related Services	$	0.001	1.5%
Production Related Services	$	0.017	21.3%
Royalties	$	0.012	14.7%
Utilties	$	0.003	3.3%
Finance	$	0.002	2.8%
Other Services	$	0.000	0.5%

* Ex-works, includes labor, inputs and all other farming/post-harvest handling costs
Global Development Solutions, LLC

For a sales price of US$0.25 per rose stem in a Dutch auction, services related to flower exports constitute almost 60% (US$0.15), of which:
• Airfreight and handling services to the auction accounts for the largest share (64%) of the cost (US$0.1/stem);
• Marketing and handling fees and commissions at the auction are the second most costly export related service (33%); and
• Inland handling and transport of flowers using refrigerated trucks from farms to Addis Ababa Airport is the third largest export service (2%). [9]

Over 95% of Ethiopian cut flower exports are destined for the European Union. Alongside home-grown varieties, the Dutch flower auctions handle over 60 per cent of total EU imports from abroad, including those from Ethiopia. The value chain analysis suggests that, at US$0.05/stem, the cost of marketing Ethiopian flowers through the Dutch auction constitutes 20% of the export price of a rose stem, or 33% of the export service costs. [9]

Table 10 The Role of Export Services in Cut Flower Export Price, Ethiopia

			% Share Of Export Price	
Sales Price Per Rose Stem*	$	0.252		
Total Cost of Services	$	0.168	66.8%	
Input Import Related Services	$	0.001		
Production Related Services	$	0.017		
Rose Export Related Services	$	0.150	59.6%	% Share of Exp. Services
Inland Transport and Handling, Addis Ababa Airport	$	0.004	1.5%	2%
Airfreight and Handling to Destination	$	0.097	38.3%	64%
Marketing/Handling Fees and Commissions, Export Market	$	0.050	19.8%	33%

* C&F Dutch Auction
Global Development Solutions, LLC

Table 11 Airfreight Cargo Fees. Addis Ababa - Europe

Type of Service	Vehicle Type	US$/Kg
Chartered Airplane	B-747	$ 1.78
Chartered Airplane	MD	$ 1.86
Chartered Airplane	Air Bus	$ 1.70
Inland Transport	Refrigerated Truck	$ 0.02

Global Development Solutions, LLC

1.2.10.2 Lead time

As far as import and processing time and related procedures are concerned, the process of importing inputs used in rose farming is characterized by poor across border trading, the most notable indicator being the long delays caused by official procedures. Rose/cut flower exporters can mitigate the lengthy input import process by either maintaining buffer stocks when importing directly or acquire these inputs readily in the market via local traders. [9]

Table 12 Average Time and Cost for Cut Flowers Export Supply Chain

Supply Stage	Days	Value $ per stem
Rolling import stock	0	0.05
Import freight, customs clearance etc	10-21	0.001
Farming / Production stage	30- 45	0.08
Handling/transport (output)	minimal	0.004
Export stage (air freight)	4	0.10
Total without forex delay	44-64	0.234

Global Development Solutions, LLC

1.2.10.3 Transportation system

One of the issues for the floriculture industry in Ethiopia is the weakness of the international and the domestic transportation system although it shows significant improvement. In addition, the refrigeration system at the airport is not sufficient enough, and so the flowers cannot remain long at the airport. Therefore, each farm has to adjust the time when they cut flowers to the departure time of flights as well as the amount to be exported to the available space. Most of the farms are, as a consequence, located within 50km from the airport. The proximity of farms to each other, however, causes shortage of water, drainage facilities, and labor. [8]

Lack of a comprehensive transportation system, i.e. absence of a transportation company from the farm to the destination, pushes up the transportation costs in Ethiopia as compared to other African countries. [8]

The empty space in the aircraft on the return trip should be utilized efficiently, filled with import goods from Japan to Ethiopia. The Embassy of Japan in Ethiopia would aspire to encourage such an attempt by providing information to the potential counterparts who may be interested in the trade with Ethiopia. [8]

The other important factor in the cut flower export business is inland transportation. This is to transport the cut flowers from the grower's premises/farm to the airport. Specially designed refrigerated trucks are used for this purpose. According to the VCA, inland transportation and handling of cut flowers (US$0.004/stem) constitute 2% of export related services. Many farms have their own refrigerated trucks, but there also are many local transporters with over 84 trucks in very good condition available to provide transport services (see table13). One hundred percent of freight forwarding service providers, and 78.5% of trucking services are controlled from A.A city. [9]

Table 13 Refer Trucks' Service Supply for Cut Flower Exports

Truck Category	Description	No. of Available Trucks
Green	In very good condition and with 100% performance	48
Yellow	Trucks with small defects such as on doors, hinges, etc.	34
Red	Trucks that need overall maintenance or that must be discarded.	2

Global Development Solutions, LLC

1.2.11.Main bottlenecks in the logistic system

Rodrik's (2004) view that: "The right model for industrial policy is not that of an autonomous government applying Pigovian taxes or subsidies, but of strategic collaboration between the private sector and the government with the aim of uncovering where the most significant obstacles to restructuring lie and what type of interventions are more likely to remove them is critical." [1]

1.2.11.1 Land lease

One key problem faced by the pioneers was access to large plots of suitable land at a reasonable distance from the airport. At the outset, producers had to lease small plots of land from individual farmers [26]. The government then started assisting investors in obtaining appropriate and accessible farmland at a lease price of only US$ 18 per hectare. The second major problem was uncompetitive airfreight rates. The government helped to arrange an agreement with Ethiopian Airlines and currently subsidizes the freight rates. [7]

1.2.11.2 Technological competence

Ethiopian nationals – both private investors and public research institutions – have not yet been able to adopt international best practice know-how and to adapt technologies to their local environments. Achieving technological competence in this regard may become a major competitive advantage for Ethiopia vis-à-vis its main competitors, Kenya and Ecuador. Greater investment in dedicated research and agricultural extension services is needed to achieve this. [7]

1.2.11.3 Breeders' right

Only flower breeders have the right to grow new varieties themselves and the right is protected by an international law known as "Breeders' Rights" and a patent royalty should be paid when others grow the variety. The International Union for the Protection of New Varieties of Plants (UPOV) has been established as a body to protect the breeders' rights. Ethiopia has launched a proclamation on Breeders' Right, which is very important for Ethiopia because repetitive violation of Breeders' Rights would lead to a situation that the country would be shut out of the international market. [8]

All of the rose and cut flower breeds come from abroad, mainly from Israel, Kenya, and the Netherlands. As the cut flower industry matures, the lure to circumvent costly royalty payments increases, something which could represent a considerable market risk for the Ethiopian cut-flower industry. The market risk is twofold. First, being blacklisted as an 'illegal' supplier in the international market leads to eventual exclusion from those markets and creates a negative international reputation for the entire industry. Secondly, illegal self propagation inhibits the emergence of independent and legal nursery/propagation service providers who, after incurring the costs of purchasing the legal rights to propagate, could be priced out of the market. [9]

1.2.11.4 Transport system

One of the issues for the floriculture industry in Ethiopia is the weakness of the international and the domestic transportation system although it shows significant improvement. Lack of a

comprehensive transportation system, i.e. absence of a transportation company from the farm to the destination, pushes up the transportation costs in Ethiopia as compared to other African countries. [8]

1.2.11.5 Refrigeration system

In addition, the refrigeration system at the airport is not sufficient enough, and so the flowers cannot remain long at the airport. Therefore, each farm has to adjust the time when they cut flowers to the departure time of flights as well as the amount to be exported to the available space. Most of the farms are, as a consequence, located within 50km from the airport. The proximity of farms to each other, however, causes shortage of water, drainage facilities, and labor. [8]

1.2.11.6 Management of agrichemicals

Lack of safe management of agrichemicals is one of the concerns. Improvement can be observed in the effort of AgriSher providing information on agrichemical treatment. However, this is not the responsibility only of private companies but also of the Government as well. There is a need to establish a thorough information-sharing system about agrichemical treatment between the Government and each private enterprise. [8]

1.2.11.7 Infrastructure

The unit cost of the Ethiopian roses is already quite competitive even though the industry has just started in Ethiopia and is still suffering from relatively low infrastructure and the weakness of institutional arrangements. It could be even cheaper if the business environment was improved. [8]

1.3 Statement of the problems

Ethiopia is now Africa's second largest flower exporter after Kenya, with its export earnings growing by 500% over the past year. Ethiopia's flower exports reached 100 million USD and the industry is one of the top four sources of foreign exchange for the country. In less than a decade of experience, Ethiopia ranks second in Africa for flower exports (after Kenya), and fifth in Extra-EU exporters to the EU market. Annual average growth in number of firms and exports in 2003 to 2008 is around 380% and 638% respectively. [1]. But this growth of the sector needs proper logistic system in order to facilitate the growth of the industry.

Ethiopian growers can produce a very high quality product, which has a big demand on the market in the advantage of higher altitude of the country but at this moment it is still quiet important to bring this product correctly and on time into that market. This can be achieved by designing a good logistic system. [23]

The majority of the farms are located in about 50 km radius of the capital city, Addis Ababa. The largest cluster Holeta accounts for 31.3% of the total number of farms. The second and third biggest clusters are Sebeta and Bishoftu accounting for 15.6% and 10.9% flower farms respectively. Even if these cluster areas will create an opportunity for collaboration among producers there is no collaboration between producers.

On average the cost of plant materials, and chemicals and fertilizers account for about 6%, and 7.6% of total sales respectively. Packaging cost, transport cost (sum of both road and air) account for about 2% and 21.6% of total sales respectively. Technical advice fee accounts for less than

one percent, while marketing cost measured by commissions and agents fee accounts for about 4.8%.[24] the transport took the highest cost and this will insight that great work has to be done in decreasing the transportation cost.

2. Objectives

The main objective of the current thesis work was to describing the supply chain of floriculture in Ethiopia, determine main bottlenecks and develop efficient methodology in line with coordination possibilities and route optimization to reduce logistics cost and environmental impact.

The Specific objectives were to:

- mapping out details logistics activities of floriculture supply chain (describe all logistics activities in relation to time)
- determine the lead time from cutting processing to point of export (until the planes take off to abroad)
- estimate logistic cost of floriculture industry in relation to production and marketing costs
- determine the inland transport roots of floriculture products
- estimate environmental impact
- study work-environment conditions in the production and supply chain
- optimize routes
- determine the main bottlenecks in logistics in the floriculture industry
- develop efficient and effective logistics system to solve the main logistic problems in floriculture supply chain to reduce logistics cost

Hypothesis

-Rout optimization helps to decrease transportation cost

-Coordination among producers has an advantage to cooperating producers and to the society

-Efficient logistic system will decrease the total cost and the environmental impact

-Efficient transportation will decrease the transportation cost as well as the environmental impact as a result of transportation.

Limitation of the study

According to the data obtained from Ethiopian horticulture Agency there are about 81 flower farms in Ethiopia and these farms are located in different parts of the country these made the data collection to be limited on the farms located near to the capital city Addis Ababa only even if

most of the farms are found around Addis Ababa in 50Km radius in which the data is collected, full data from all the farms found in the country cannot be collected for economic as well as time consumption reasons. Data from suppliers is not collected but information about suppliers was collected from interviews made with farm managers of the selected farms. GIS and Auto Cad digital maps are used for route optimization and the digital maps are older because it is difficult to obtain the recent ones.

3. Methods

3.1 Phases and steps

First data on the total number and locations of floriculture industries in the county was collected and the transport routes connecting each flower farms (production sites) to Addis Ababa city, which is the common place for transport mode change from tuck to cargo transport, was identified.

After identifying the production sites and the routes connecting production sites to Addis Ababa city the next step was selecting the main routes that connect concentrated follower farms (more number of production sites) to Addis Ababa. This helped me to focus on more concentrated production sites along the same route and make my sample more representative to most production sites.

The third step was collecting more detailed data from production sites along the selected main routes. The data collected includes production methods and raw material data (used in analyzing environmental impact), transport data, vehicle type, vehicle capacity, vehicle load data (used for describing transport efficiency, transportation cost, cooperation possibility and optimization) and location data including GPS coordinate data of the flower farms, which was used in the optimization task. For farms without GPS data the data was collected manually by using potable GPS.

The fourth step was describing the supply chain of floriculture in the country and existing transport roots from production sites to cargo transport as well as the cargo transport system in relation to distance and time and optimizing the transport routes and describing the logistic system in the floriculture industry.

Lastly describing the main bottlenecks of the floriculture industry in Ethiopia and develop efficient and effective logistic system in line with coordination possibilities and evaluating the developed logistic system with the existing one in relation to logistic cost, time, distance and environmental impact.

3.2 CONCEPTUAL FRAMEWORK

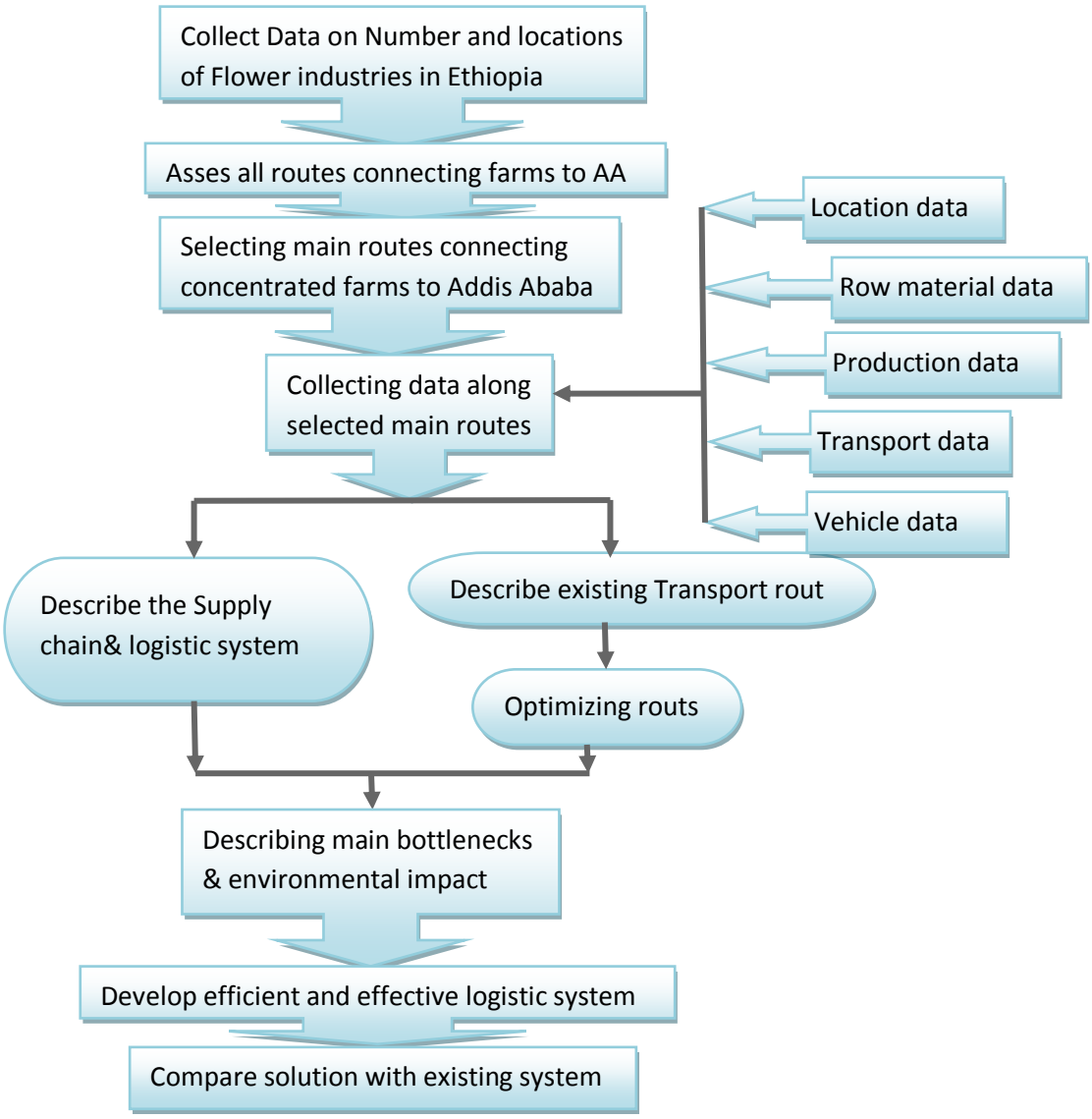


Figure 2 conceptual frame work

3.3 Data collection

Primarily secondary data were collected from Ethiopian horticulture agency. The data collected from this agency includes the number and locations of cut flower farms found in Ethiopia and type of products of each farm. This data helps to decide on where detail data directly from the farms should be collected.

There are totally 81 farms which are producing cut flowers in Ethiopia but out of them 14 flower farms were found in Bishoftu (formerly called Debrezit) town, 14 farms were found in Sebeta town, 25 of them fond in Holeta town, 6 farms in Koka town, and 5 farms in Ziway town the remaining farms are found in seven places i.e. Hawasa, Addis Ababa, Awash-Melka, Sululta, Weliso, Welkite, and Sendafa towns. More of the farms are concentrated around three places namely Holeta town taking 30.9% share from the total number of cut flower farms in Ethiopia, Bishoftu with 17% share and Sebeta also taking 17% share. Form this figure it good to concentrate on places where farms are more clustered their fore more detail data is collected from three places in which more clustered cut flower farms are found. These are Holeta town found in Oromia region West Shewa zone welmera wereda, Sebeta town which is also found in west Shewa zone and Bishoftu town.

The detail data collected by distributing questionnaire and by direct interviews with the farm managers of the selected farm sites. The data obtained from these survey mainly focuses on their Production method, Raw materials data, Transport data, transport Time from farm to airport, Time from cutting till transport, Vehicle type used for transport and load capacity, Amount of product transported and frequency of transport, Raw material transportation, Cargo transportation and cost, Inland Transport cost and time, Production cost and time, Market cost of products and GPS location data of each selected farms using Hand healed GPS were also collected.

3.4 Data analysis

3.5. 1 Analysis of floriculture supply chain

In order to describe the floriculture supply chain data were analyzed quantitatively as well as qualitatively. Parameters such as lead time, loading time, transport time, production time, production cost, transport cost etc are analyzed quantitatively and the quantitative parameters include market places, activities at the farm like cutting, sorting, bunching, cooling, packaging, loading etc.

The data collected from questionnaire, through informative interviews, personal observations and secondary document analysis were analyzed to meet the specific objectives. The analysis started from the description of supply chain of floriculture. Value chain mapping was done for the floriculture supply chain starting from the flower farms to the Bole air port cargo center.

Statistical Microsoft Excel 2007 software was employed to analyze the data. The analyzed data were presented using tables, graphs and charts. And statistical analysis measures were applied for the quantitative analysis.

3.5. 2 Route optimization analysis

The route optimization analysis was done from the location data collected by using hand held GPS and GIS digital road networks maps collected from different sources and utilizing Global mapper 2011 software. The initial point of travel was taken from the outlet of the loading place of the flower farms and the destination for all the farms is taken at the bole air port because it is the final destination for all of the floriculture producers for inland transportation. After bole air port the transportation was done by cargo for abroad market centers found in different parts of the world. Facility analysis is not performed because the destination for all the floriculture producers is a common place that is Bole air port.

4. Results

4. 1 Description of supply chain of floriculture in Ethiopia

Supply chain of floriculture in Ethiopia consists of different activities categorized as farm operations, inland transport, and cargo activities. In the farm activities the operation starts from cutting. Cutting is done by leaving two leaves at bottom of the rose tree. After cutting the stem of the cut is collected in water bucket and taken to pre-cooling room and kept for 8-10hrs at temperature of 4-6 ^{o}c. After pre-cooling the sorting and packaging process begins. The packed flowers kept in cold room for 1 and ½ days at temperature of 2^{o}c.Finally the bundles of flowers are placed in cartoon (23 bundles/cartoon) and placed back to the cold room. The inland transport operation starts from loading the packed flowers to the cold truck and followed by transporting it to the cargo station that is bole air port and concluded by unloading the packed flowers at the cargo station. The last activity is the cargo activity which stars by temporarily storing the flower in a cold room and then loading it to the cargo unit followed by transporting it to the Dutch auction market or other whole sellers

4.1. 1 Farm activities

Production

The farm activity starts from producing the flowers. Most of the flower farms found in Ethiopia use an artificial production method by using green house for a protection of any natural effects like air temperature, humidity and rain water. Ground water is used in most of the flower farms for drip irrigation and all of the farms collect rain water by using a water hole excavated for this purpose. They use the collected rain water for irrigation during the dry season. Even if stream water is not good for flower production due to its high PH value, some farms use stream water when there is shortage of ground water. All types of fertilizers are used for production except urea. The production is made artificially in a controlled situation inside a green house. The green house is equipped with automatic electro mechanical system, temperature and humidity sensors in order to control the optimum temperature, humidity, intensity of sun light and protection of

rain water. The production process takes 60 to 65 days between consecutive cut to cut activities and costs around 8 US cents per each steam of rose.

Figure 3 Flower production in a green house

Figure 4 Greenhouses

Cutting and sorting activities

The next farm activity stars by cutting the produced rose flowers. Cutting is done at the farm manually by using daily labourers. The daily labourers wear glove during the cutting process but they did not wear mask for chemical protection. Cutting is done by leaving two leaves at the bottom of the rose tree.

After the flowers are cut the rose trees are collected in a water bucket and taken to pre cooling room and kept for a period of 8 to 10 hours at a temperature of 4 to 6 degree centigrade. After pre cooling, the sorting process begins. Sorting is an activity of selecting standard quality rose stems from the collected group of rose trees and cleaning them from unwanted leaves.

Figure 5 Flowers in a bucket of water

Figure 6 Flower trees in a water bucket inside a pre cooling room

Figure 7 Sorting activity

Packaging

After the sorting process the next farm activity is packaging. The sorted quality rose stem are tied in bundles for packaging and the bundles are placed in cartoon which can hold 23 bundles of flowers. Then the bundles are placed back to the cold room and kept at a temperature of 2 degree centigrade till the cartoons are going to be loaded on a cold truck for transportation purpose.

Figure 8 Bundling material

Figure 9 Packaging

4.1. 2 Inland and cargo transport activities

Products are mainly transported to market places to Middle East and mostly to the Dutch auction market. The inland transport is directly to the Bole air port cargo transport center for this purpose cold trucks are used. The cold truck inland transport is totally managed by each company itself. Loading activity at the flower farms to the inland cold transport is done manually in all the flower farms but loading machines are utilized for vegetable and fruit farms. After the loading is accomplished the next step is transporting the goods to Addis Ababa Bole air port. During this activity each farm uses their own transport routes to reach air port. The inland transport ends at the cargo center then the next transport activity is done by using mostly Ethiopian cargo to abroad market places. In order to make the cargo transport each producer should inform the volume of their product to be transported and pay for the planned volume even if they did not transported their planned volume.

The inland transport costs on average of1.7 US cents for the flower farms located around Holeta Town, 1.8 US cents for farms found around Menagesha town and Sebeta towns and 1.9 US cents for farms located around Bishoftu town per each stem of rose flower. The cargo transport costs on average base of 9.2 US cents per stem of flower even if it depends on the destination of market places. All rose producers transport their products directly to destination market places found in foreign countries because none of them have distribution centers or retailing centers in Ethiopia.

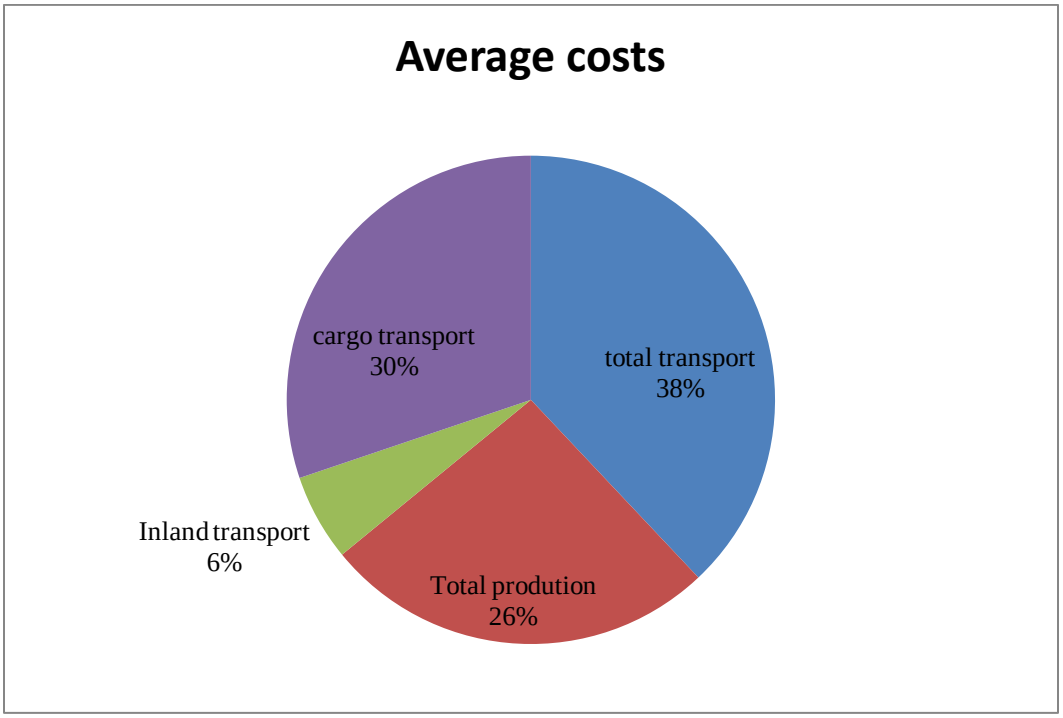


Figure 10 Percent share of transport cost in relation to production cost

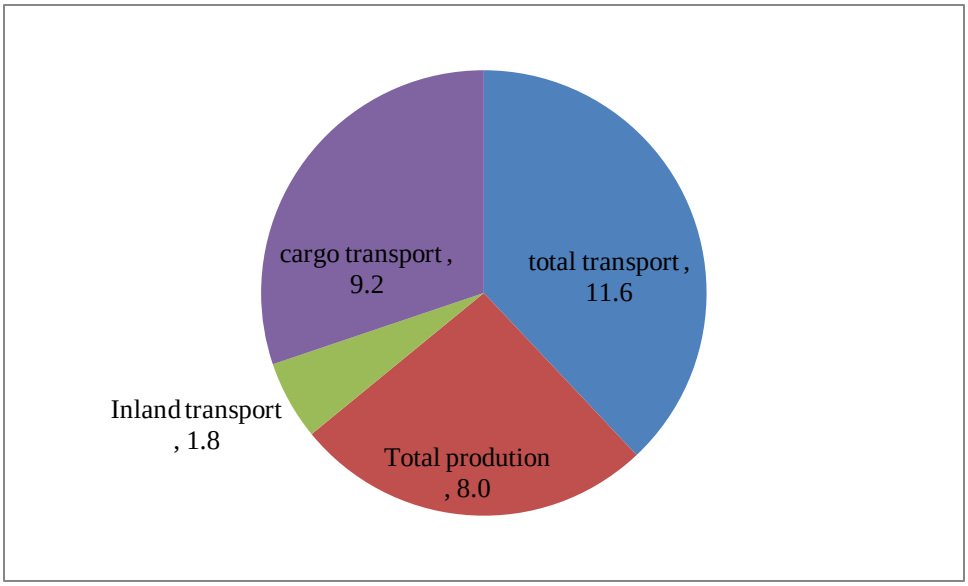


Figure 11 Average transport costs in relation to production costs

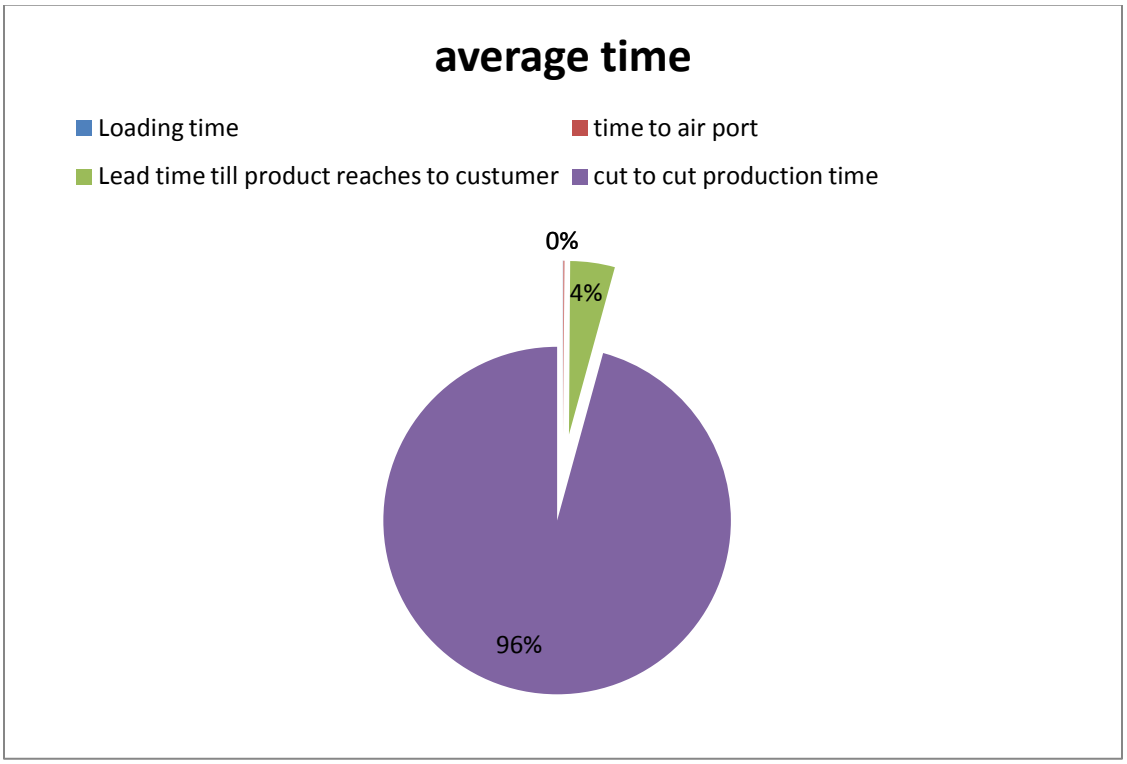


Figure 12 Percent of Average time of transport in relation to other activities

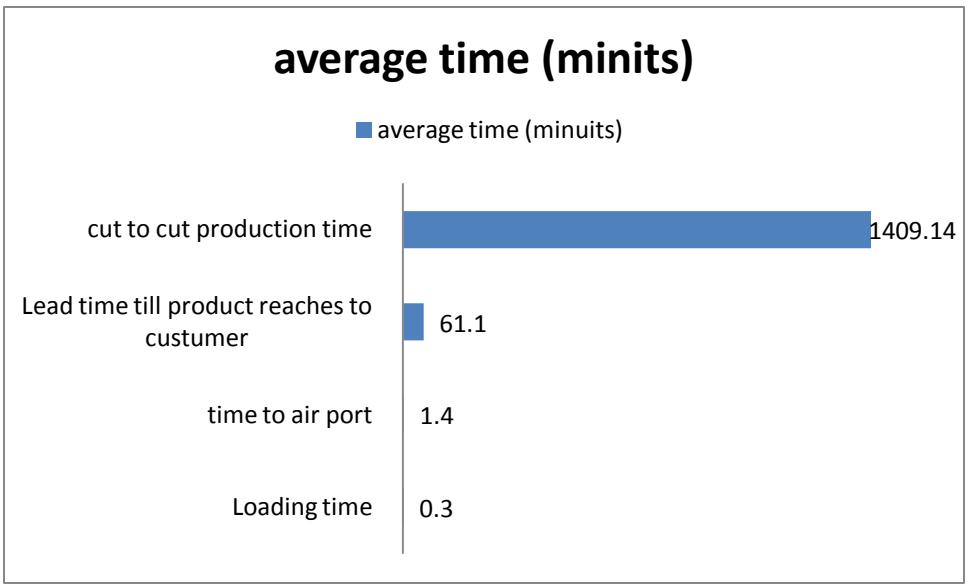


Figure 13 Average time in minutes for transport in relation to production time

4. 2 Facility location

All the rose farms found in Ethiopia have their own green houses for the production purpose. The produced flowers have a location for cutting activity inside a house built for value adding activities this place contains wider space for cutting activity, one to two places for pre cooling activity at a regulated room temperature of 4 to 6 degree centigrade, a cold room at a room temperature of 2 degree centigrade for cooling activity, a packaging material stock room used for packaging purpose and an office of marketing and management staffs. All this places are arranged under one roof partitioned for each special farm activities.

There are totally 81 farms which are producing cut flowers in Ethiopia but out of them 14 flower farms were found in Bishoftu (formerly called Debrezit) town, 14 farms were found in Sebeta town, 25 of them fond in Holeta town, 6 farms in Koka town, and 5 farms in Ziway town the remaining farms are found in seven places i.eHawasa, Addis Ababa, Awash-Melka, Sululta, Weliso, Welkite, and Sendafa towns. More of the farms are concentrated round three places namely Holeta town taking 30.9% share from the total number of cut flower farms in Ethiopia, Bishoftu with 17.3% share and Sebeta also taking 17.3% share. Form this figure it good to concentrate on places where farms are more clustered their fore more detail data is collected from three places in which more clustered cut flower farms are found. These are Holeta town found in Oromia region West Shewa zone welmerawereda, Sebeta town which is also found in west Shewa zone and Bishoftu town.

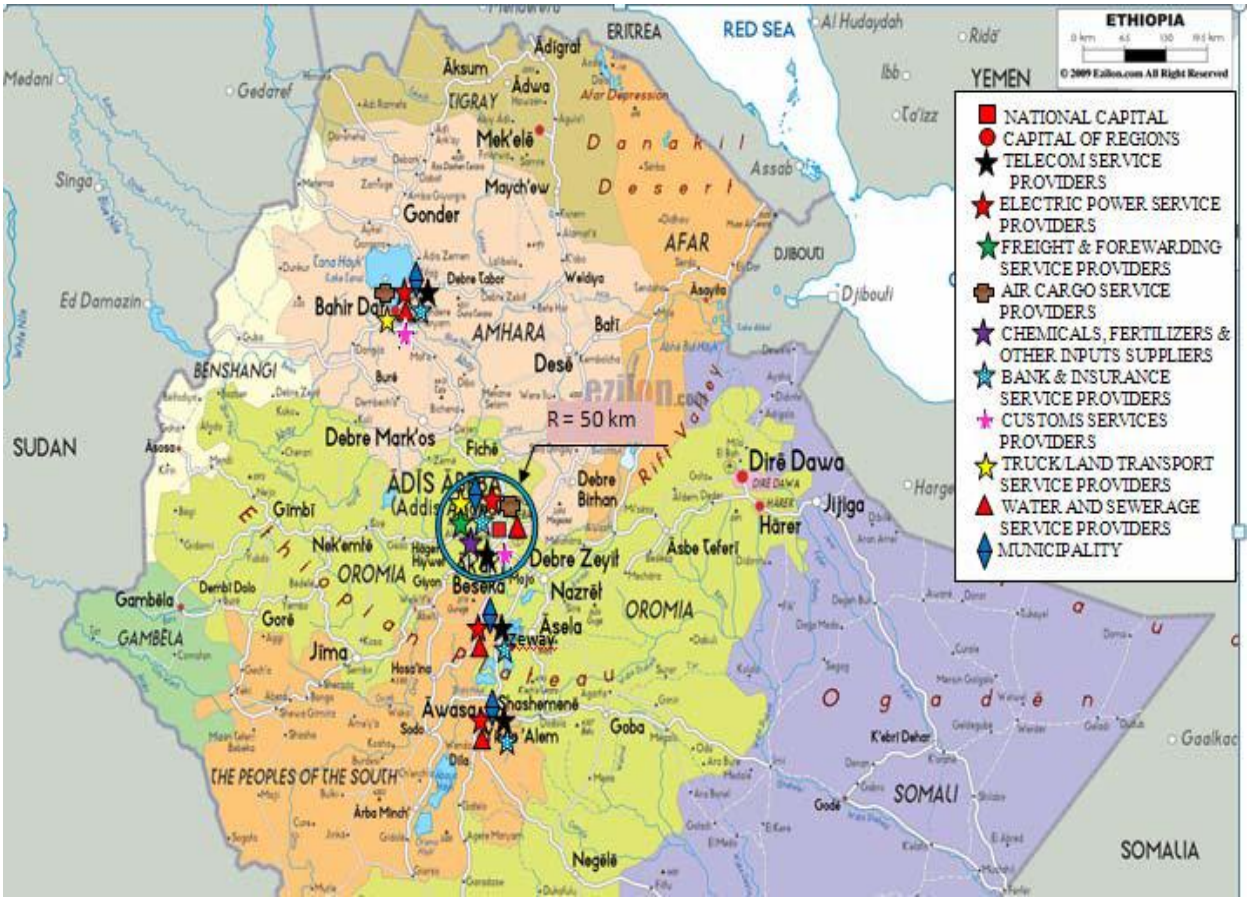


Figure 14 Flower farm locations in Ethiopia

Source *Global Development Solutions, LLC*

Table 14 Geographic Distribution of Service Providers for the Cut Flower Industry

Service Provider Type	Service Provider	Location	Distance from Addis Ababa (km)	Remark
Inputs				
Chemical & Fertilizer Suppliers	Agrisher	Addis Ababa	–	Inputs imported mostly from: South Africa, Holland, Norway, Israel, France, Germany, India and China.
	Golden Rose			
	BASF			
	AZRUM			
	Hortishare			
	BABA Trading (only generic products)			
	OMNI			
Rubber Band Suppliers	Agrisher	Addis Ababa	–	
	Private shops in Merkato	Addis Ababa	–	Merkato is the largest market place in Ethiopia.
Plastic Sleeves and Film	Imported directly by the respective companies			
Packaging	Minaye Packaging	Alemgena	20	
	Golden Rose	Addis Ababa	–	
	Shiv (Ethiopia Meadows)			
	Seventh Hill	Debre Zeit	50	
Freight and Handling				
Truck and Land Transport	Sher Ethiopia	Addis Ababa	–	These companies provide cold-chain transport services
	Herberg			
	Minaye	Alemgena	20	
	Ziway	Ziway	163	
	AQ			
	Lafto	Addis Ababa	–	
	Tans Transport	Addis Ababa	–	+/- 200 trucking companies (most prominent ones listed)
	East-West Transport			
	Get-Us Transport			

Global Development Solutions, LLC 2/18/2011

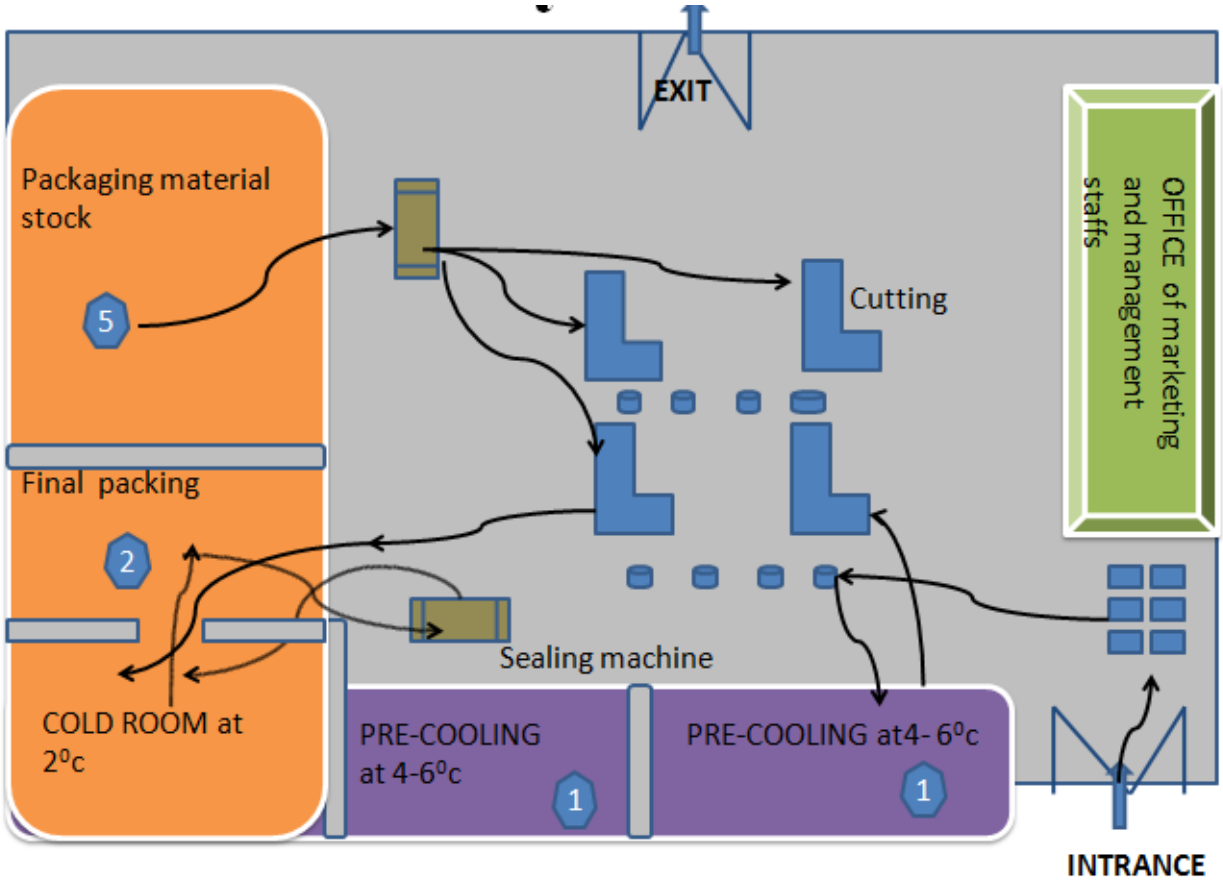


Figure 15 Facility location at the farm.

Table 15 Geographic distribution of flower farms in Ethiopia

cluster name	*number of farms*	*% of farms*
Sebeta	14	17%
Holeta	25	31%
Bishoftu	14	17%
Ziway	8	10%
Koka	6	7%
Sendafa	3	4%
Sululta	3	4%
Awash	3	4%
Addis Ababa	1	1%
Awasa	2	2%
Weliso	1	1%
Welkite	1	1%
Total	**81**	**100%**

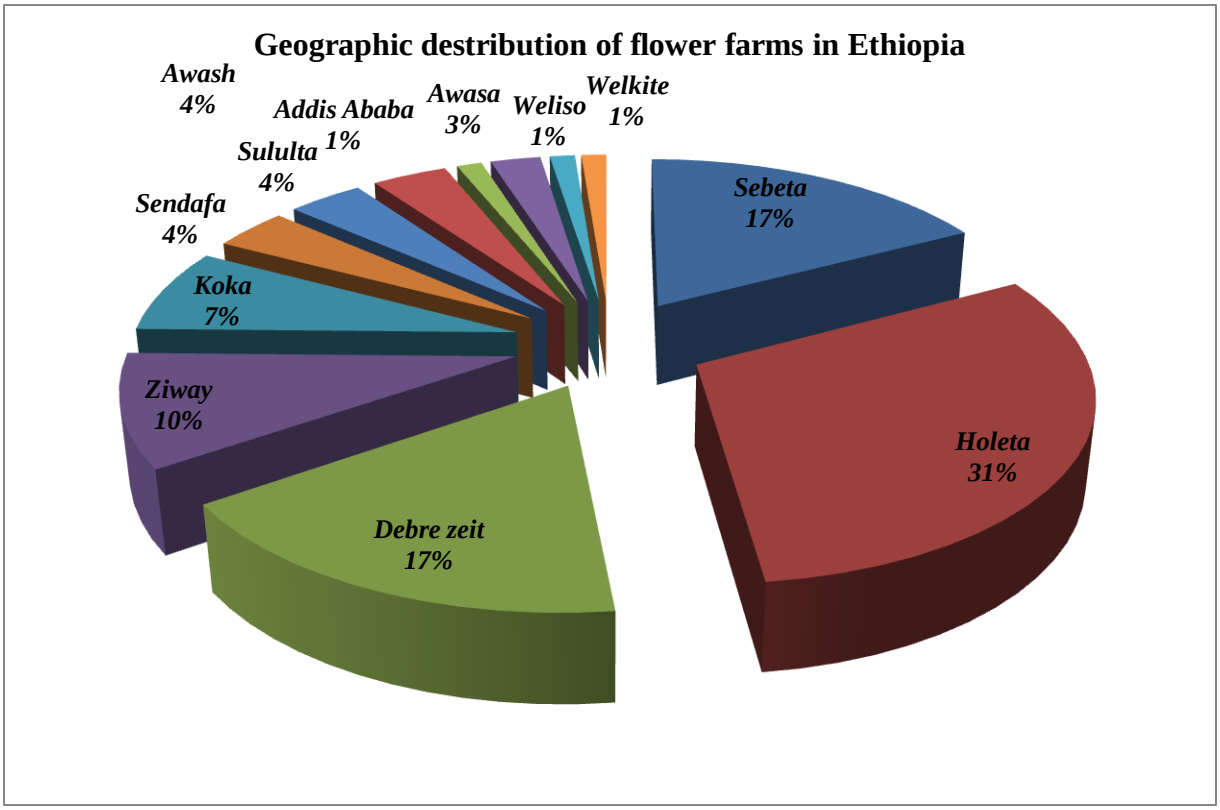


Figure 16 Geographic distribution of flower farms in Ethiopia

4. 3 Floriculture supply chain in Ethiopia

Ethiopian flower producers do not sell their products in the local market. Most of the flower products inter to the Dutch auction market and there are also market places in other countries. The major international markets include Europe, the U.S., the Middle East, and Japan.

Ethiopian flower producers get their inputs for production from different suppliers. There are fertilizer suppliers, chemical suppliers and material suppliers. After production, each farm uses their own cold truck for inland transport to the cargo center and use cargo transport to reach their market destination places.

Table 16 Average time in the supply chain

Farm	cut to cut production time (days)	Loading time (minuets)	time to air port (hours)	Lead time till product reaches to customer (days)
1	55	25	1	2.5
2	60	15	1	2.5
3	63	15	1.5	2
4	65	15	1	2
5	55	25	1	2.5
6	60	15	1.5	2
7	60	15	1	2.5
8	60	25	1	2.5
9	65	15	1	2
10	60	15	1	2.5
11	55	15	0.6	4
12	55	15	0.6	4
13	60	15	2	2.5
14	60	15	2	2
15	55	20	2	2.5
16	60	15	2	2.5
17	60	15	2	2.5
18	55	15	1.5	3
19	60	15	2	2.5
20	55	20	2	2.5
21	55	15	1.5	2.5

Table 17 Average costs of activities in flower supply chain

Farm	total transport cost (US cent/stem)	Total production cost (US cent/stem)	Inland transport cost (US cent/stem)	cargo transport cost (US cent/stem)	Labour cost (Et. birr/day)
1				9	18
2	11	8.4	2	9	14
3	10	1.2	1.5	9	18
4	11	8	1	10	18
5	10	8	2	9	18
6	10	1.2	1.5	9	18
7	11	8.4	2	9	14
8	11	8.4	2	9	18
9	11	8	1	10	18
10	11	8.4	2	9	14
11	18	8	1.8		18
12	18	8	1.8		18
13	12	9	2	9	20
14	11	8	1.9	9	20
15	10	10	2	9	18
16	11	9	1.5	10	20
17	11	8.5	1.5	9	18
18	12	10	2	9	25
19	11	9	1.8	9	25
20	11	10	1.8	10	25
21	11	10	2	9	25

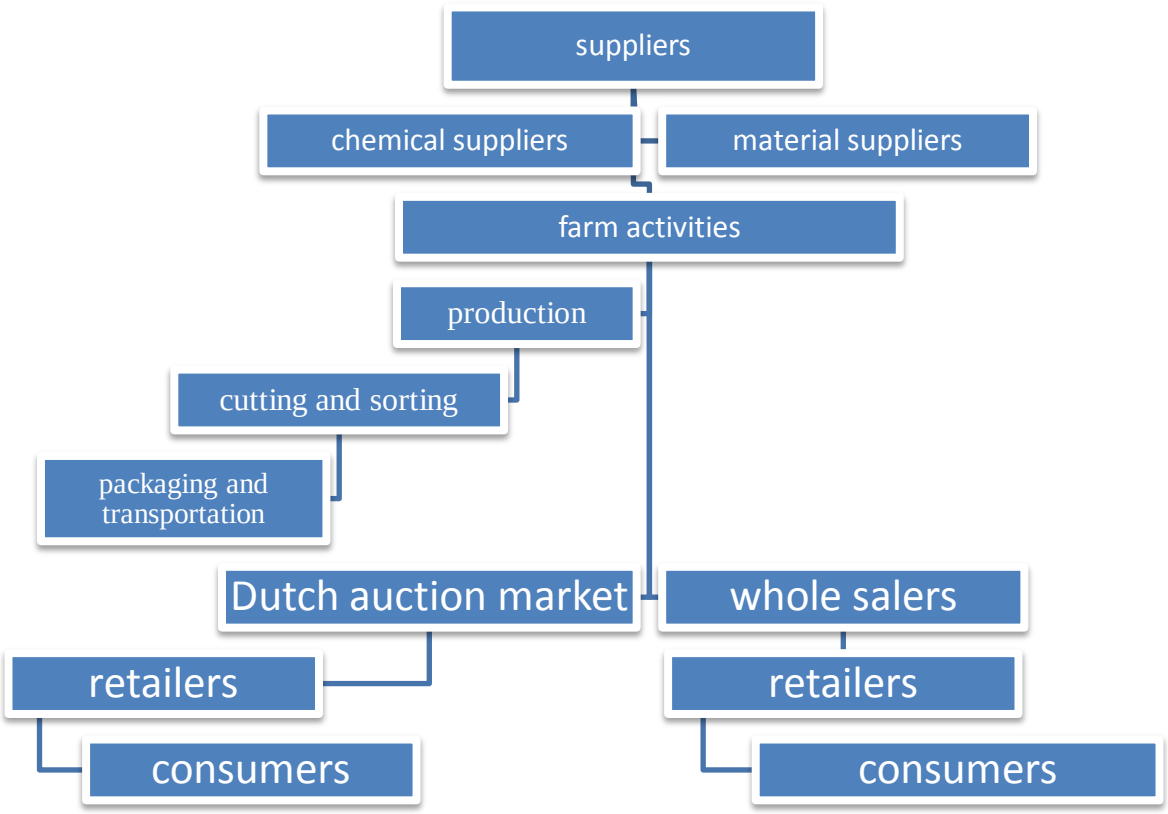


Figure 17 Flower supply chain in Ethiopia of Ethiopian floriculture products

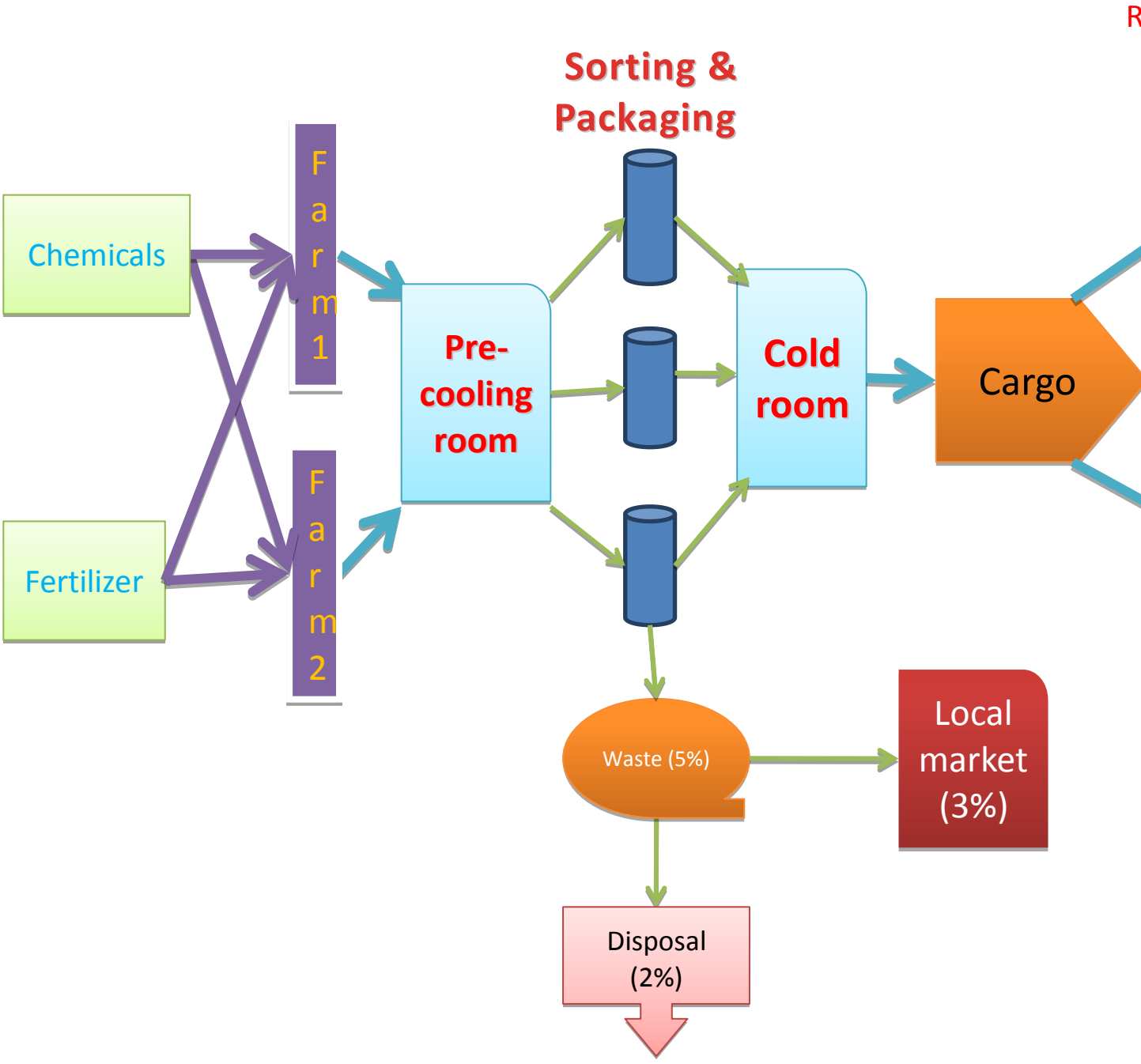


Figure 18 Flower supply chain in Ethiopia

4. 4 Environmental and social impact

The environmental issue is the most worrying negative factor for the long term. It is encouraging that the effort to minimize the environmental impact has started but it should continue further.

Ethiopian flower producers utilize lots of chemicals and fertilizers for production. Most farms in Ethiopia use ground water for irrigation purpose this will create continues depletion of ground water. The use of chemicals will also create contamination of ground water and streams near to the farm locations are also getting contaminated by the chemicals used even if the effect is not significant the proper use of chemicals and safe disposal of waste should be made by trained professionals for chemical protection. The chemical sprayers wear mask during chemical spraying but most of the workers are not trained for this special purpose. This will put the health of the workers in danger. Workers are taken to hospitals every three months in order to check them for chemical effect. If the chemical effect is significant the employee will be discarded. This will create significant effect on the life of the employee.

I have found no farm with recycling plant for waste treatment but it is good to have a recycling plant or waste treatment plant in order to protect the environment from chemical contamination.

Table 18 Chemicals used for flower production

Fertilizers

☐ Calcium nitrate	☐ Ammonium nitrate
☐ Potassium nitrate	☐ Ammonium sulphate
☐ Magnesium nitrate	☐ Iron
☐ Potassium sulphate	☐ Borax
☐ Magnesium sulphate	☐ Sodium molybdate
☐ MKP (mono potassium sulphate)	☐ Copper sulphate
☐ MAP (mono ammonium phosphate)	☐ Zink sulphate
	☐ Manganese sulphate
	☐ Nitric acid

Pesticides

☐ Pride	☐ Ridomill	☐ Lanet
☐ Magister	☐ Previcul	☐ Ace
		☐ Acifate
		☐ Nustal
		☐ Thiovit

☐ Sulphur	☐ Acitte	☐ Sprokill ☐ Acrobat ☐ Milzar ☐ Aliet ☐ Proplant ☐ Previcure ☐ Privicure energy ☐ Daconil ☐ Torque ☐ Oxamatrin ☐ Abmite ☐ Defencolazole
☐ Melbechok	☐ Shavir	
☐ Rufast	☐ Oscal	
☐ Bay cog	☐ Oberon	
☐ Teldor	☐ Knock out	
☐ Scalala	☐ Dynamic	
☐ Kocide	☐ Selecson	
☐ Ode or	☐ Polityin	☐ Rovcal
☐ Mancozeb	☐ Amitroz	☐ Floromite
☐ Flogamite	☐ Strikel	☐ Meltatox
☐ Meltatox	☐ Impious	☐ Confidor
☐ Nimrod	☐ Couis	☐ Amonogold
☐ Stroby	☐ Sencozeb	☐ **Helcozeb**

The Ethiopia Horticulture Producers and Exporters Association (EHPEA) play a significant role in organizing external training courses for workers and managers from member farms. The training programs include post-harvest handling and cold chain; safe use and storage of pesticides; and strategies to secure competitive advantage in flower industry. [1] EHPEA took the lead in establishing a Code of Practices for the flower industry. The Code documents compliance with Ethiopian laws on labour and environmental issues, as well as compliance with good agricultural practice. It is supported by many stakeholders, including the competent ministries and several non-governmental organizations, and it is audited internationally. Such standards are increasingly demanded by international buyers and help to preserve the image of Ethiopian producers. [7]

Lack of safe management of agrichemicals is one of the environmental issues. Previously, each farm had to import agrichemicals individually because the mass import and resale of agrichemicals was restricted by law, and each farm had the responsibility to treat and dispose of the agrichemicals safely. The Ministry of Agriculture was supposed to provide training on the safe management of agrichemicals for those farms but this was not implemented. [8]

4. 5 Main bottle necks

The main problem mentioned during the data collection includes;

- Higher transportation cost which took about 38% of the total cost of production and logistic costs. The total production cost took 26% of all costs, the cargo transport 30%, and the inland transport cost took 6% of the all costs.
- Cold climate and high humidity decreases production quantity even if it produces higher quality products.
- Rejection of products not fitting the quality standard which took 7 to 10% of the produced quantity of products
- Availability of labour is also mentioned as a problem in some of the farms found around Holeta town
- Water resource
- Material supply and
- Cargo transport process

4. 6 Route optimization

The route optimization is made manually by the help of Excel for mathematical manipulation of quantitative data mainly the travel distance along the transport route to Bole cargo transport center. Locations of the farms are taken by using hand held GPS and overlapped on a digital road network and different route options are analyzed in order to choose the shorter one from this analysis the result of the optimization decreases 25.71% distance for the flower farms found around Holeta town, 14.39% distance saved for the farms found around Sebeta town and 1.08% distance saved for the farms found around Bishoftu town. All distance saved is after the route inters Addis Ababa town because there is no alternative route till the route reaches in Addis Ababa.

Table 19route optimization result

	Welegaber (holeta farms)	GimaBer (Sebetafarms)	Harerber (Bishoftu farms)
Current route length (Km)	61.396	54.896	67.923
Optimized route length (Km)	45.614	46.998	67.189
distance saved	15.782	7.898	0.734
% distance saved	25.71	14.39	1.08

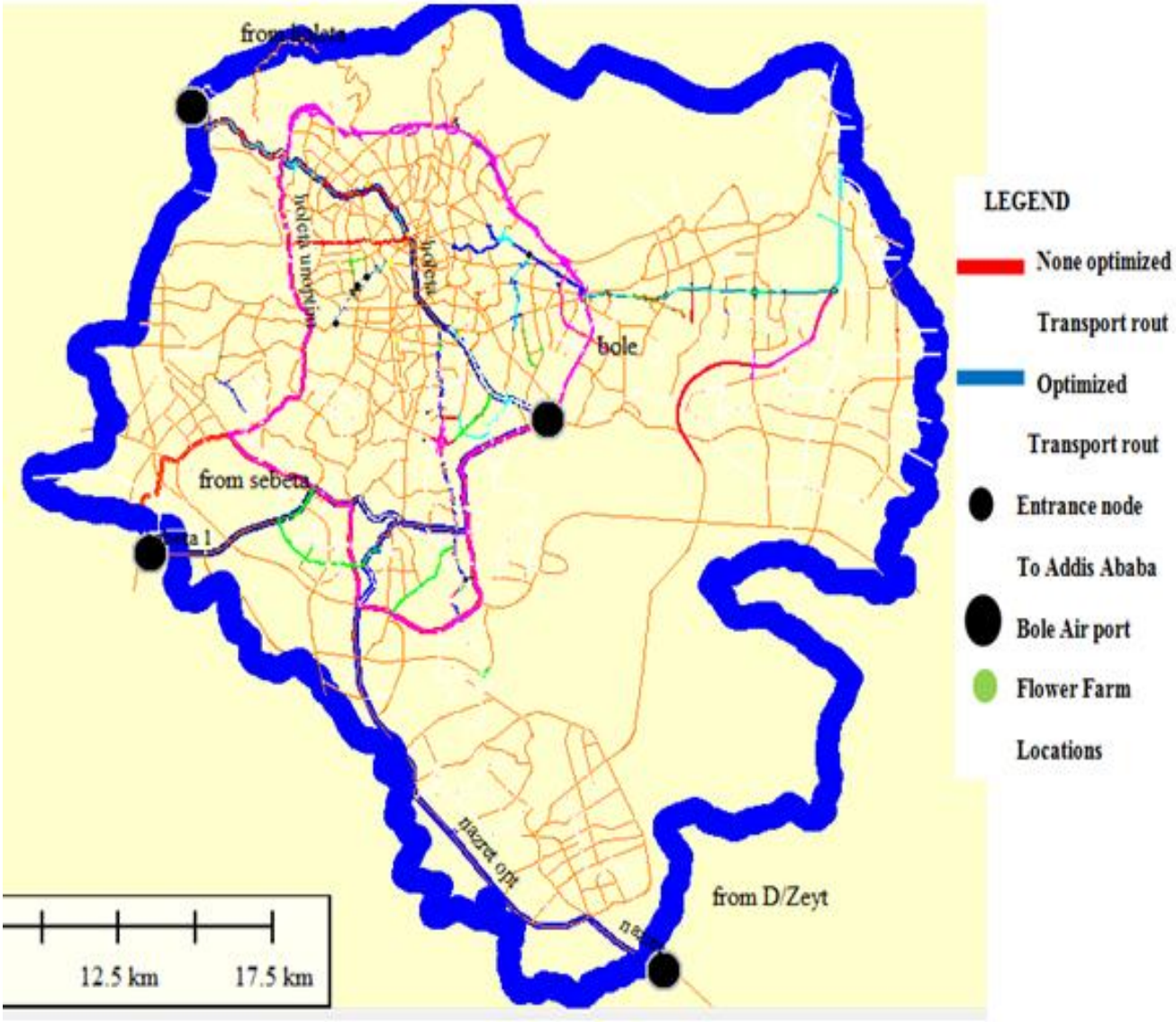


Figure 19 Transport routes from three entrances to Addis Ababa and optimized routes

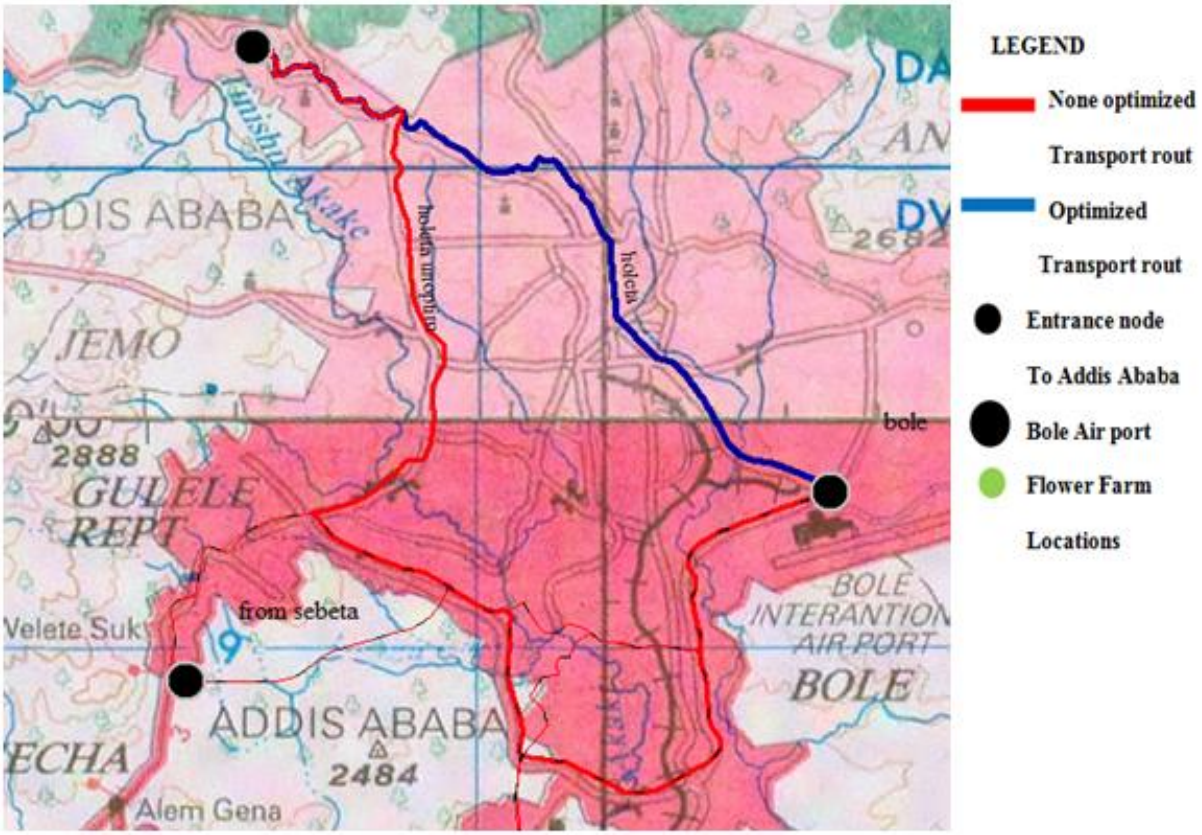


Figure 20 Transport routes from farms found in Holeta town to Addis Ababa and optimized routes

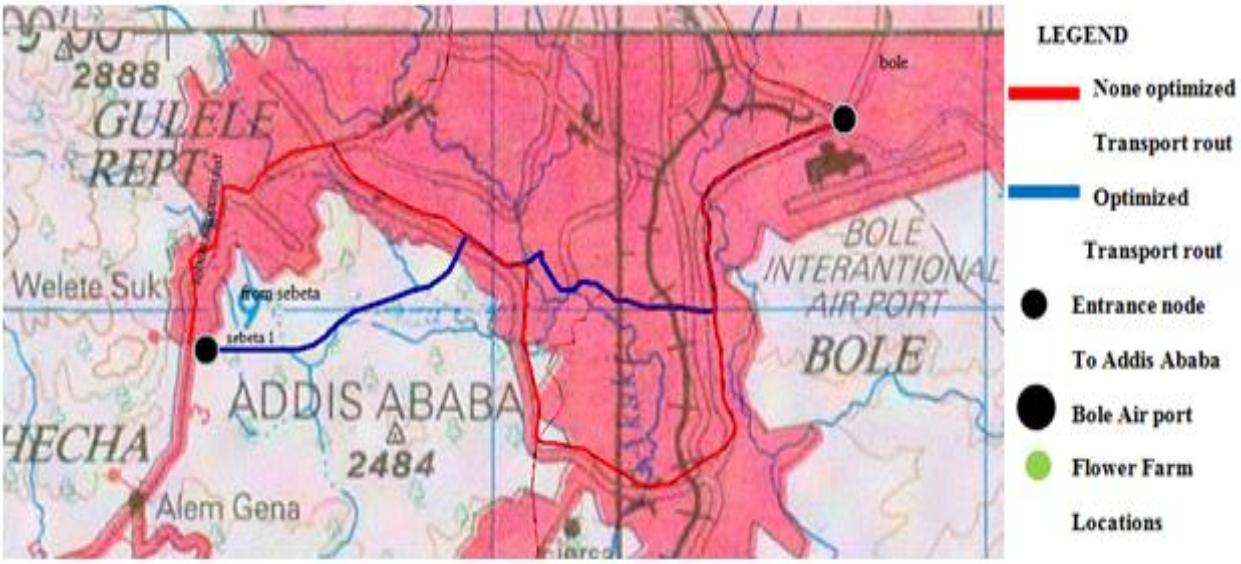


Figure 21 Transport routes from farms found in Sebeta town to Addis Ababa and optimized routes

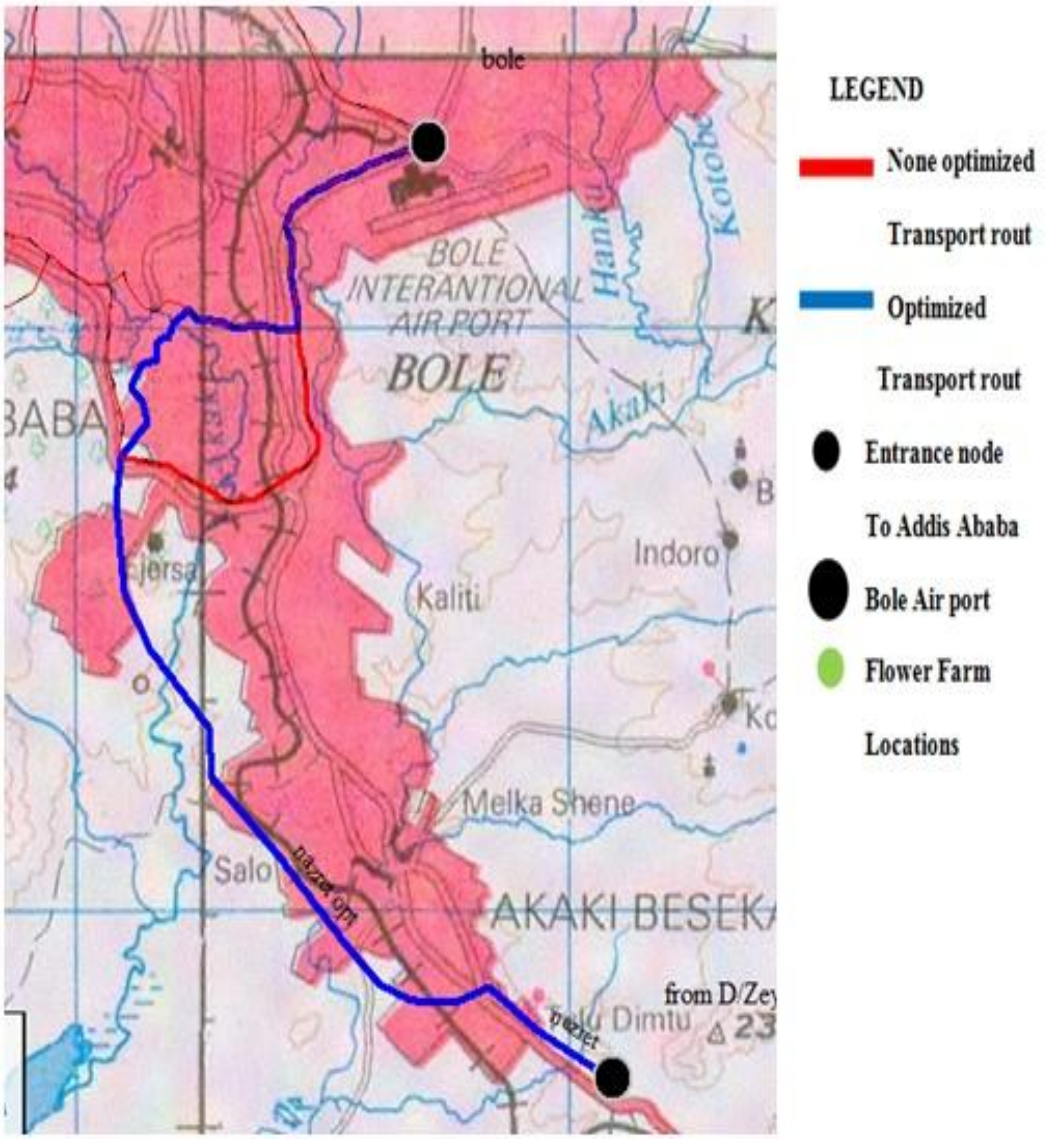


Figure 22 Transport routes from farms found in Bishoftu town to Addis Ababa and optimized routes

4. 7 Probability of collaboration

Flower farms in Ethiopia are located in cluster around three places namely Holeta town containing 31% of all the flower farms found in the country, Bishoftu town with 17% share of the flower farms and Sebeta town with 17% share of the total flower farms this cluster of farms indicate the probability of collaboration between farms found in a cluster. Collaboration probability analysis inside a cluster was made on an inland transport of products to the cargo center found in Addis Ababa Bole air port.

From the data collected on the type of vehicles used for inland transport there are two main cold truck vehicles with a loading capacity of 135boxes and 220 boxes but all farms did not use the capacity of their vehicles on each trip. Analysis was made for the three clusters of farms separately because the probability of collaboration is found between farms found in the same cluster. For the first cluster i.e. found in Holeta town the analysis was made based on the data collected from 10 farms and the average loading of vehicle per each trip is 70.5% from this it is clear that 29.5% of the vehicles capacity is an empty load trip. For the second cluster found in Sebeta town analysis was made for the data collected from 5 farms with an average load of vehicle 73% and for the third cluster in Bishoftu town 4 farms are taken for analysis having an average vehicle load of 73.75%.

For the first cluster found around Holeta town If the 10 farms collaborate in transporting their goods inland they will save 4 vehicle trips each day if the vehicle used is 135 boxes capacity or they can transport 543 boxes of flowers (374670 stem of flowers) each day by saving the inland transport cost of 6744.06 USD each day still one vehicle trip with an empty haulage of 3 boxes each day. If they use the 220 boxes capacity vehicle they can save 3 vehicle trips or 628 boxes of flowers will be transported without any transportation cost and they can save 7799.76 USD each day but still one vehicle will make a trip with an empty haulage of 188 boxes each day.

For the second cluster found in Sebeta town collaboration between the analyzed 5 farms in transporting their products inland will save on average 1.510 vehicle trips with a capacity of 135 boxes or 203boxes of flowers (140415 stems of flowers) will be transported without any cost of transportation in other words they can save a transport cost of 2527.47 USD each day one vehicle still with an empty haulage of 68 boxes. But if they use the 220 boxes vehicle capacity for the collaborated transportation they cannot reduce any trip or cost but one vehicle will make a trip with an empty haulage of 203 boxes.

For the third cluster found in Bishoftu town the result from analysis of data collected from four farms shows there is a probability of reducing 1.55 vehicle trip if the inland transport collaboration is made by using 135 boxes vehicle capacity or the coordination can save transportation cost for 209 boxes of flowers (144728 flower stems) one vehicle still with an empty haulage of 74.75 boxes. Totally 2605.09 USD will be saved each day. If the coordinated

transport was made by 220 boxes vehicle capacity noting can be saved but the last vehicle will make a trip with an empty haulage of 209.75 boxes.

Table 20 Coordinated transport using 135boxes vehicle capacity

farm location	trips saved daily	no boxes saved	no of stem	empty haulage (Boxes/trip)	cost saved (USD/trip)
Holeta	4.02	543	374670	3	6744.06
Sebeta	1.51	203.5	140415	68.5	2527.47
Bishoftu	1.55	209.75	144727.5	74.75	2605.09

Table 21 Coordinated transport using 220 boxes vehicle capacity

farm location	trips saved daily	no boxes saved	no of stem	empty haulage (Boxes/trip)	cost saved (USD/trip)
Holeta	2.85	628	433320	188	7799.76
Sebeta	0.93	0	0	203.5	0
Bishoftu	0.95	0	0	209.75	0

Table 22 Probability of Collaboration for inland transport

Farm	production quantity (stem/m2/year)	vehicle capacity (boxes)	percent volume of vehicle loaded per trip	Trip frequency (days/week)	empty volume	empty volume box capacity (min)	empty volume box capacity (max)
1	120	135&220	70	7	30	40.5	66
2	120	220	75	4	25	55	55
3	110	270	75	7	25	67.5	67.5
4	120	135	60	7	40	54	54
5	120	135&220	70	7	30	40.5	66
6	110	270	75	7	25	67.5	67.5
7	120	220	75	4	25	55	55
8	120	135&220	70	7	30	40.5	66
9	120	135	60	7	40	54	54
10	120	220	75	4	25	55	55
		average	70.5		total	529.5	606
11	100	135	95	7	5	6.75	6.75
12	100	135	95	7	5	6.75	6.75
					total	13.5	13.5
13	140	135	75	7	25	33.75	33.75
14	140	135	60	7	40	54	54
15	140	220	75	7	25	55	55
16	140	135	80	7	20	27	27
17	140	135	75	7	25	33.75	33.75
		average	73		total	203.5	203.5
18	140	135	75	7	25	33.75	33.75
19	130	220	75	7	25	55	55
20	140	220	70	7	30	66	66
21	140	220	75	7	25	55	55
		average	73.75		total	209.75	209.75

5. Conclusion and recommendations

5. 1 Conclusion

From this study it can be concluded that the floriculture supply chain in Ethiopia is structured randomly by different companies and there is well studied and collaborated supply chain in the country. Even if I cannot get a study conducted directly on the floriculture supply chain and environmental impact, former researches made in relation to the floriculture industry also agree that the floriculture supply chain is not organized in a collaborated and structured manner. Generally the supply chain has different drawbacks that can reduce the competitiveness of the sector in the world market, therefore it is better to have efficient floriculture supply chain from farm to the cargo transport center and even to the end consumer stage. The findings of the study are summarized as follows;

- ✓ All flower industries in Ethiopia sale their products outside the country and none of them has retailing centers in Ethiopia. The main destination market is the Dutch auction market for around 88% of the total product.
- ✓ All of the farms use their own cold trucks for inland transport of their goods and cargo transport for transporting products outside the country.
- ✓ There is no coordination between companies in transporting their goods and in other activities also.
- ✓ 75% of the farms in Ethiopia are clustered in four places in which 31% of them clustered in Holeta town, 17% of them in Sebeta town, 17% in Bishoftu town and 10% of them in Ziway town. This form of clustering creates a probability of collaboration between farms.
- ✓ Coordination in transporting goods inland saves significant transport cost.
- ✓ None of the farms have west treatment plants and safe chemical disposal system
- ✓ Due to production quantity above 90% of cold trucks are traveled with an average loading factor of 73%. And the empty haulage is not utilized by collaboration.
- ✓ The average lead time till the product reaches the customer took two to three days depending on the destination market.
- ✓ From the route optimization made for the top three cluster the cluster in Holeta town results in 25.71% distance save, the cluster in Sebeta resulted in 14.39% distance save and cluster in Bishoftu town resulted in 1.08% distance save therefore I can conclude that route optimization can save the highest percentage of distance for the routes from Holeta and Sebeta towns but not significant on the routes from Bishoftu town.
- ✓ Total transport cost took 38% of the total cost in relation to production cost which took 26% of the total cost.
- ✓ Cargo transport cost and process is one of the bottlenecks in the sector.

- ✓ Low air temperature decreases the production quantity even if it produces quality product.
- ✓ Even if the effect is not significant currently, depletion of ground water and chemical contamination can be seen as future risks regarding environmental impact.
- ✓ Workers involved in chemical sparing have a check for chemical effects every three months and provided gloves, masks and sweet for chemical protection but are not guaranteed for Sevier chemical effects.
- ✓ The minimum labour wedge is 14 Ethiopian Birr per day and the maximum is 25 Ethiopian Birr per day.

5. 2 Recommendations

In order to achieve an efficient and effective floriculture supply chain in Ethiopia and reduce environmental impact the following measures shall be taken;

- Proper routine and periodic maintenances of roads and construction of new roads is important to create good transportation service and reduce the inland transport cost.
- Create collaboration between producers in order to utilize the empty haulage in transporting goods inland. We can reduce not only transport cost by collaboration but also we can also reduce the environmental pollution because of vehicle emission when we reduce the number of trips.
- Optimized routs shall be used to decrease logistic cost and environmental Impact.
- Treatment plants shall be built to protect the environment from contamination.
- Workers should be trained for use of fertilizers or chemicals.
- There should be serious control of dangerous chemicals not to be used in floriculture industry

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ANNEX

Addis Ababa Institute of Technology

Questioner for M.sc Research work

Name of the company _____

Location: - region _____ wereda _____

<table>
<tr><td>1. Types of product</td><td colspan="8">☐ Highland magic
☐ Marie Claire
☐ Label
☐ Upper class
☐ Sweet candy</td><td>☐ Duet
☐ Strawberry
☐ Vegetables
☐ Others _____</td></tr>
<tr><td>2. Production method</td><td colspan="9">☐ Natural
☐ Artificial</td></tr>
<tr><td rowspan="12">3. Production time
(Tick below the production time indicated),

If the production time is not indicated write it in the last column provided for other production times.</td><td>Production time(days)</td><td>50</td><td>55</td><td>60</td><td>65</td><td>70</td><td>75</td><td>other</td></tr>
<tr><td>Product Type</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Highland magic</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Marie Claire</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Label</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Upper class</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Sweet candy</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Duet</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Strawberry</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Vegetables</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Others</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

4. Production quantity
(Tick below the production time indicated),

If the production quantity is not indicated write it in the last column provided for other production times.

Production quantity (stem/m^2)	100	110	120	130	140	160	170	other
Product Type								
Highland magic								
Marie Claire								
Label								
Upper class								
Sweet candy								
Duet								
Strawberry								
Vegetables								
Others								

5. Total Transport cost/stem (in US cents)

- ☐ 9 US cents/stem
- ☐ 10 US cents/stem
- ☐ 11 US cents/stem
- ☐ 12 US cents/stem
- ☐ 13 US cents/stem
- ☐ 14 US cents/stem
- ☐ 15 US cents/stem
- ☐ 16 US cents/stem
- ☐ Other _____

6. Total production cost/stem

- ☐ 0.5 US cents/stem
- ☐ 1.5 US cents/stem
- ☐ 2.0 US cents/stem
- ☐ 2.5 US cents/stem
- ☐ 3.0 US cents/stem
- ☐ Other _____

7. Logistics cost/stem

- ☐ 1 US cents/stem
- ☐ 2 US cents/stem
- ☐ 3 US cents/stem
- ☐ 4 US cents/stem
- ☐ Other_____

8. Inland Transport cost/stem

- ☐ 7 US cents/stem
- ☐ 8 US cents/stem
- ☐ 9 US cents/stem
- ☐ 10 US cents/stem
- ☐ Other _____

9. Inland transport method

- ☐ Cold chain
- ☐ Other _____

10. Type of vehicle for inland transport	☐ Cold tuck ☐ Other _____	
11. Vehicle capacity	☐ 135 boxes ☐ 180 boxes ☐ 225 boxes	☐ 270 boxes ☐ Other _____
12. Average Volume of vehicle loaded per trip	☐ 60% ☐ 65% ☐ 70% ☐ 75% ☐ 80%	☐ 85% ☐ 90% ☐ 95% ☐ Full capacity (100%) ☐ Other_____
13. Time to reach airport	**Tick the hour hear and**	**The minute part in this column**
	☐ Less than 1 hour ☐ 1 hour and ☐ 2 hours and ☐ 3 hours and ☐ 4 hours and ☐ 5 hours and ☐ 6 hours and ☐ Other_____	☐ 10 minutes ☐ 20 minutes ☐ 30 minutes ☐ 40 minutes ☐ 50 minutes ☐ Other _____
14. Loading time	☐ 10 minutes ☐ 15 minutes ☐ 20 minutes	☐ 25 minutes ☐ 20 minutes ☐ Other _____

15. Trip frequency (circle on the numbers)	☐ Each day ☐ Each 2days ☐ Each3days ☐ Each 4days	☐ Each 5 days ☐ Each 6days ☐ Each 7days ☐ Other _____
16. Cargo transport cost per stem	☐ 1 US cent ☐ 2 US cents ☐ 3 US cents	☐ 4 US cents ☐ Other _____
17. Average Cargo load per trip (better to ask for the airport)	☐ 60% ☐ 65% ☐ 70% ☐ 75% ☐ 80%	☐ 85% ☐ 90% ☐ 95% ☐ Full capacity (100%) ☐ Other_____
18. Cargo trip frequency	☐ Each day ☐ Each 2days ☐ Each3days ☐ Each 4days	☐ Each 5 days ☐ Each 6days ☐ Each 7days ☐ Other _____
19. Chemicals used for production	**Fertilizers** ☐ Calcium nitrate ☐ Potassium nitrate ☐ Magnesium nitrate ☐ Potassium sulphate ☐ Magnesium sulphate ☐ MKP (mono potassium	☐ Ammonium nitrate ☐ Ammonium sulphate ☐ Iron ☐ Borax ☐ Sodium molybdate ☐ Copper sulphate

	sulphate) ☐ MAP (mono ammonium phosphate) ☐ Zink sulphate ☐ Manganese sulphate ☐ Nitric acid **Pesticides** ☐ Pride ☐ Magister ☐ Sulphur ☐ Melbechok ☐ Rufast ☐ Bay cog ☐ Telder ☐ Scalala ☐ Kocide ☐ Ode or ☐ Mancozeb ☐ Flogamite ☐ Meltatox ☐ Nimrod ☐ Stroby ☐ Ridomin ☐ Previcul ☐ Acitte ☐ Shavir ☐ Oscal ☐ Obelo ☐ Knock out ☐ Dynamee ☐ Selecson ☐ Politgin ☐ Amitroz ☐ Strikel ☐ Impious ☐ Couis ☐ Rokural

	Other chemicals used for production 1_____ 2 _____ 3_____ 4_____ 5 _____ 6_____ 7_____ 8 _____ 9_____ 10_____ 11 _____ 12_____ 13_____ 14 _____ 15_____ 16_____ 17 _____ 18_____ 19_____ 20 _____ 21_____
20. Do labours wear mask during spraying chemicals	☐ Yes ☐ No
21. Do labours wear mask during the cutting process	☐ Yes ☐ No
22. Is there any collaboration with other companies	☐ Yes ☐ No
23. If yes	☐ In transporting products inland ☐ In transporting chemicals inland ☐ In transporting products by cargo ☐ In importing chemicals ☐ Other _____
24. Do the company have retailing centers in Ethiopia	☐ Yes ☐ No
25. Do the company have retailing centers in other counties	☐ Yes ☐ No
26. What are the main bottlenecks that you face /constraints encountered?	☐ Inland transport cost ☐ Cargo transport cost ☐ Material supply ☐ Material transport ☐ Cargo transport frequency ☐ Cargo transport process ☐ Labour availability ☐ Environmental protection rules ☐ Road infrastructure ☐ Government taxation ☐ Power supply ☐ Low air temperature ☐ High air temperature ☐ High humidity

	☐ Water resource ☐ Other _____
27. Who is responsible for the transport	☐ The company ☐ Other company (third party)
28. How the transport is organized	☐ Self transport using own vehicles ☐ Self transport using rental vehicles ☐ Coordinated transport ☐ Other _____
29. Activities at farm after cutting	☐ Sorting ☐ Storage ☐ Pre cooling ☐ Loading ☐ Cooling ☐ Transporting ☐ Bunching ☐ Other _____ ☐ Packaging
30. Loading	☐ Manual ☐ Loading machine ☐ Other _____
31. Lead time (until the product reaches the consumer)	☐ 1 day ☐ 4-5 days ☐ 1-2 days ☐ 5-6 days ☐ 2-3 days ☐ 6-7 days ☐ 3-4 days ☐ Other _____
32. Number of employees	☐ < 100 ☐ < 400 ☐ < 150 ☐ < 450 ☐ < 200 ☐ < 500 ☐ < 250 ☐ < 550 ☐ < 300 ☐ < 600

	☐ < 350 ☐ > 600
33. Destination in Addis Ababa	☐ Airport ☐ Warehouse ☐ Retailing shops ☐ Other _____
34. Any Value adding activities in Addis Ababa	☐ Packaging ☐ Storage ☐ Packing ☐ Palletizing ☐ Loading ☐ Cooling ☐ Transport to the airport ☐ Other _____

35. GPS location of the farm Northing_____

Easting _____

Elevation_____