

UNIVERSITY OF NAIROBI

SCHOOL OF BUSINESS

African International Business and Management Conference

AIBUMA 2011 CONFERENCE

DATE: August 25th – 26th, 2011

VENUE: Nairobi

THEME: “BUILDING SYNERGIES FOR BETTER PERFORMANCE”

SUB-THEME: PERFORMANCE MANAGEMENT

Article title:

A CONCEPTUAL MODEL FOR MANAGING SUPPLY NETWORKS FOR SIMULTANEOUS OPTIMISATION IN A COMPLEX ADAPTIVE ENVIRONMENT: A CASE OF THE FLORICULTURE INDUSTRY IN KENYA.

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Abstract

This paper is based on research findings and results to develop a conceptual model for managing supply networks for simultaneous optimisation. The study was a blend of both quantitative and qualitative research techniques. The qualitative research process made use of content analysis and was instrumental in answering the following research questions: what are the key success factors that influence performance of the floriculture industry in Kenya?, what are the relationships between the key success factors that influence the performance of the floriculture industry in Kenya? what are the factors that will indicate performance of the floriculture industry from a traditional perspective (supplier – customer)?, are there differences in factors to be considered for the embedded and free agents performance in the floriculture industry, end to end and within country?, what needs to be considered in developing a conceptual model for simultaneous optimisation of supply networks, end to end and within country? The quantitative phase of the research process resulted in the development of a revised conceptual model for managing supply networks for simultaneous optimisation, end to end and within country.

The flower industry in Kenya is composed of a diverse group, ranging from large scale international firms to SME's and free agents. Existing data from Horticultural Crops Development Authority reveals that there are 412 active flower exporters of which the majority are SME's at 358, the large firms are composed of 5 international, 42 National firms and 7 free agents. The industry is largely affected by changes in customer preferences and demand from the downstream end of the supply chain. This diversity makes it very difficult to achieve simultaneous optimization of supply networks with a view to having both individual firm's benefits as well as country specific benefits with regard to the triple bottom line. The specific challenges exhibited by the flower industry which further compounds its complex dimension includes: extremely short shelf life; Very specific demand cycles with extreme peaks; changes in consumer trends; mixing characteristics of service and product dimensions; operating part of 'first world' supply network in developing country; a composition of large , small international and free agents operating in the industry and; simultaneous optimization of supply networks in an effort to realize both individual firm's benefits as well as country specific benefits.

The paper concludes by identifying a set of issues that needs to be addressed by both the Kenyan government and flower firms. These issues includes but are not limited to: developing consensus over a complex adaptive system and a complex adaptive environment with regard to the flower industry in Kenya; identifying the characteristics of a complex adaptive systems; and establishing methods of managing complex adaptive systems with reference to the flower industry. The findings and results of the study points at: financing; key success factors (supply value chain); country specific benefits; transport; research and development as positively influencing the performance of the floriculture industry in Kenya.

Key words: Complex adaptive systems; complex adaptive environment; simultaneous optimisation

INTRODUCTION

There is need to examine the whole value chain for optimisation by the application of efficient and effective state-of-the-art practices in the financing, growth, harvesting, transporting, marketing and selling of the products. To be considered also is reforming institutions by transforming key organizations such as cooperatives into contemporary and high-performing entities that facilitate growth in the sector. Of importance likewise is increased productivity through provision of widely-accessible inputs and services to farmers. Optimisation is also attainable through transforming land use to ensure better utilisation of high and medium potential lands. There is need for developing arid and semi-arid areas (which accounts for 80% of Kenya's land mass) for crops. In addressing the cost of operations, it is important that the floriculture industry takes good cognizance of emerging developments and issues relating to climate change. In this regard, the industry would stand to benefit greatly by adopting smart practices that can enable producers to participate in the carbon markets by earning and trading carbon credits

This paper discusses the integration of the findings and results of research in relation to the theory investigated. Herein discussed is the proposed conceptual model developed as a result of integrating the qualitative and quantitative aspects of the research findings. The research findings from the study reveal that: Key success factors (supply value chain); financing; information integration; country specific benefits; transport; research and development as being critical in enhanced performance of the floriculture industry achievable by simultaneous optimisation of the supply networks end to end and within country.

RESEARCH METHODOLOGY

The study makes use of both the phenomenological approach (qualitative) and the positivist (quantitative) and the research design. The phenomenological paradigm is concerned with understanding human behavior from the researchers own frame of reference, the focus is on the meaning rather than the measurement of social phenomena. Such an approach allows for theory

to be developed from empirical reality, which indeed is an aspect of inductive research. The use of a focused interview schedule takes a phenomenological context of the research whereas the analysis of the survey data is a complete positivist approach to the research.

The positivist approach seeks the facts or causes of social phenomena, with little regard to the subjective state of the individual (Collis et. al. 2003). Therefore, logical reasoning is applied to the research so that precision, objectivity and rigour replace haunches, experience and intuition as the means of investigating research problems. This allows for conceptual and theoretical explanations to be developed and then tested by empirical observation, which is an aspect of deductive research.

The study thus makes use of a two-phased design. This according to Lee (1999), is a study in which a quantitative approach is followed by a qualitative approach (or the reverse), and this sequencing implies comparable standards for methodological rigor. First, there was need to identify the key success factors in the floriculture industry. This necessitated the qualitative approach. Secondly, there was need to understand the level of significance of the key success factors and the ultimate contribution to performance of the floriculture industry.

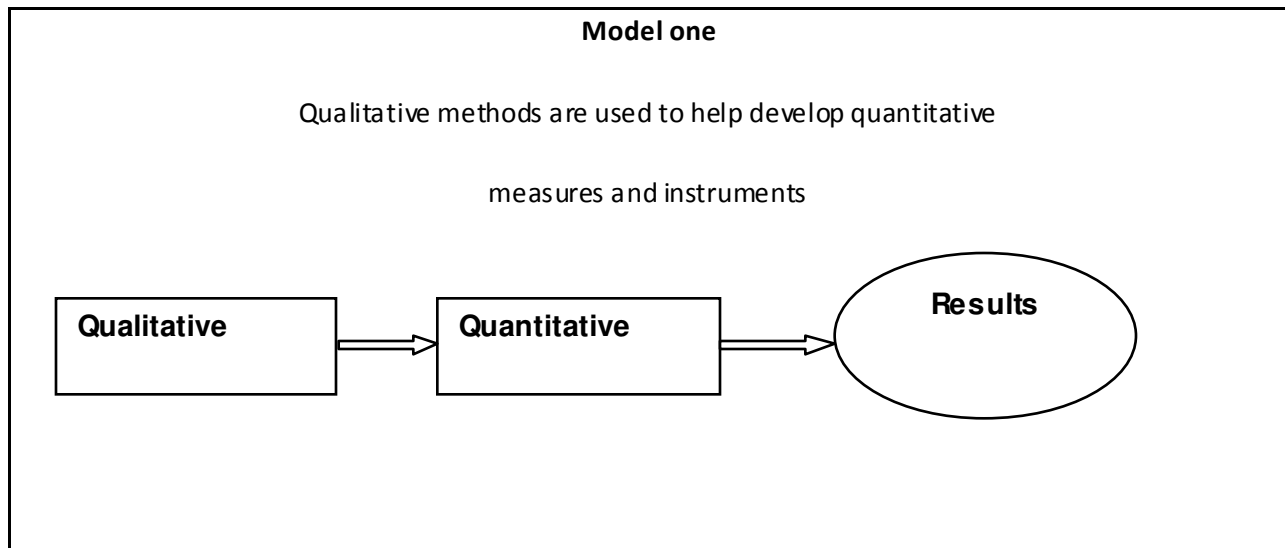


Fig. 1.1: Integrating qualitative and quantitative research

(Source: Steckler et. al. 1992)

The first phase of the study makes use of the phenomenological approach. Focused interviews were done targeting members of the civil society, regulatory bodies, and farm and industry players. This initial qualitative study was beneficial in identifying the emerging issues in developing a conceptual model for simultaneous optimisation of the supply networks in the floriculture industry in Kenya. The instrument for data collection in the phase two of the research process is a questionnaire. The questionnaire has mainly closed ended questions to facilitate the processes of quantitative analysis. Kothari (2005), argues that before administering questionnaires, it is always advisable to conduct ‘pilot study’ (pilot survey) for testing the questionnaire. This indeed serves as the replica of the main study and it brings into light the weaknesses (if any) of the questionnaire and also of the survey technique. Questionnaire piloting thus assisted in making the necessary improvements in the research instrument.

Figure 1.2 gives a summary of the research design showing how the findings of phase one of the study is fed into the phase two of the study.

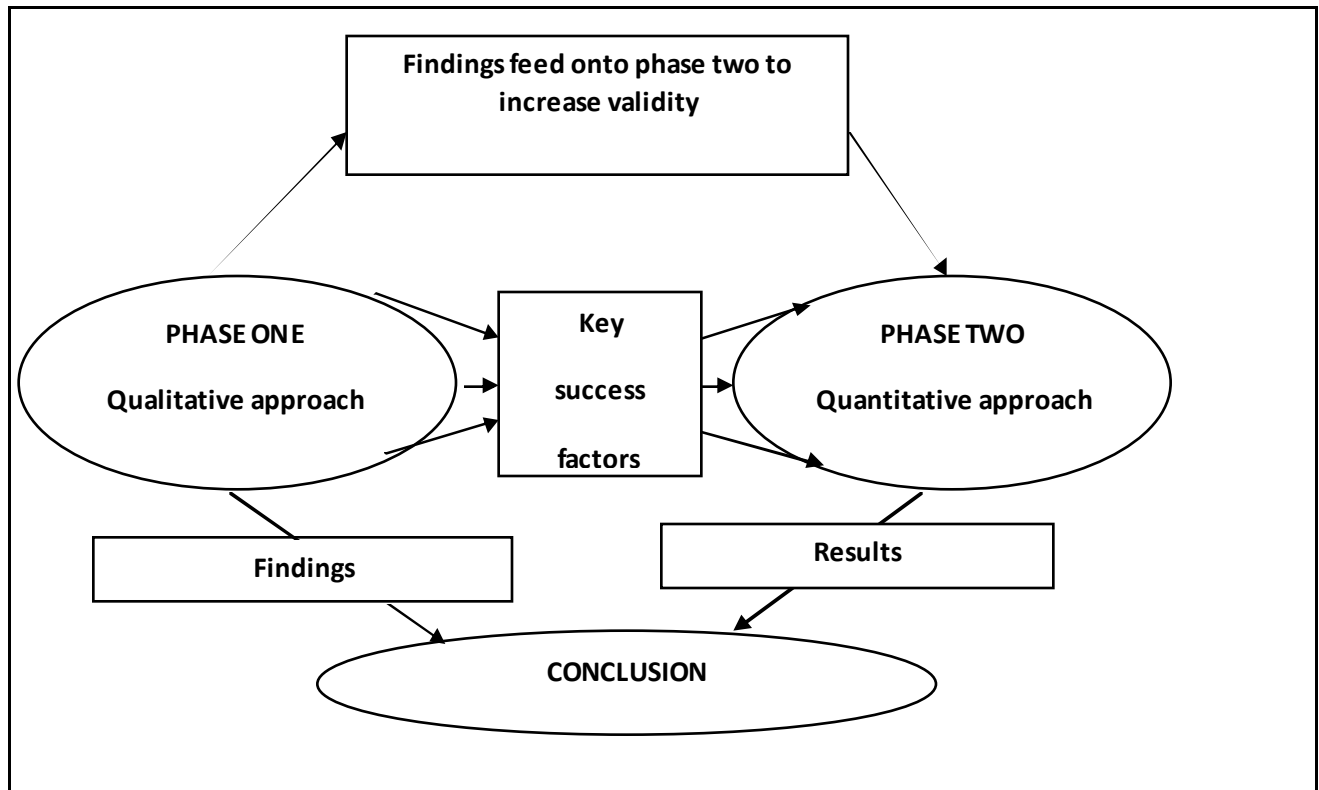


Fig. 1.2: Framework for this research process

The findings of the qualitative phase of the study feed onto the quantitative phase in order to increase the validity of the results. The findings and results of the two phases of the study was used in making the conclusions and recommendations of the study. The recommendations were addressed to both the flower growers and the government.

DISCUSSION OF FINDINGS AND RESULTS

The results of principal component analysis with five extractions resulted in a revision of the conceptual model to include: financing; key success factor; country specific benefits, transport, research and development as positively influencing the performance of the floriculture industry in Kenya. The revised conceptual model is illustrated in fig 1.3.

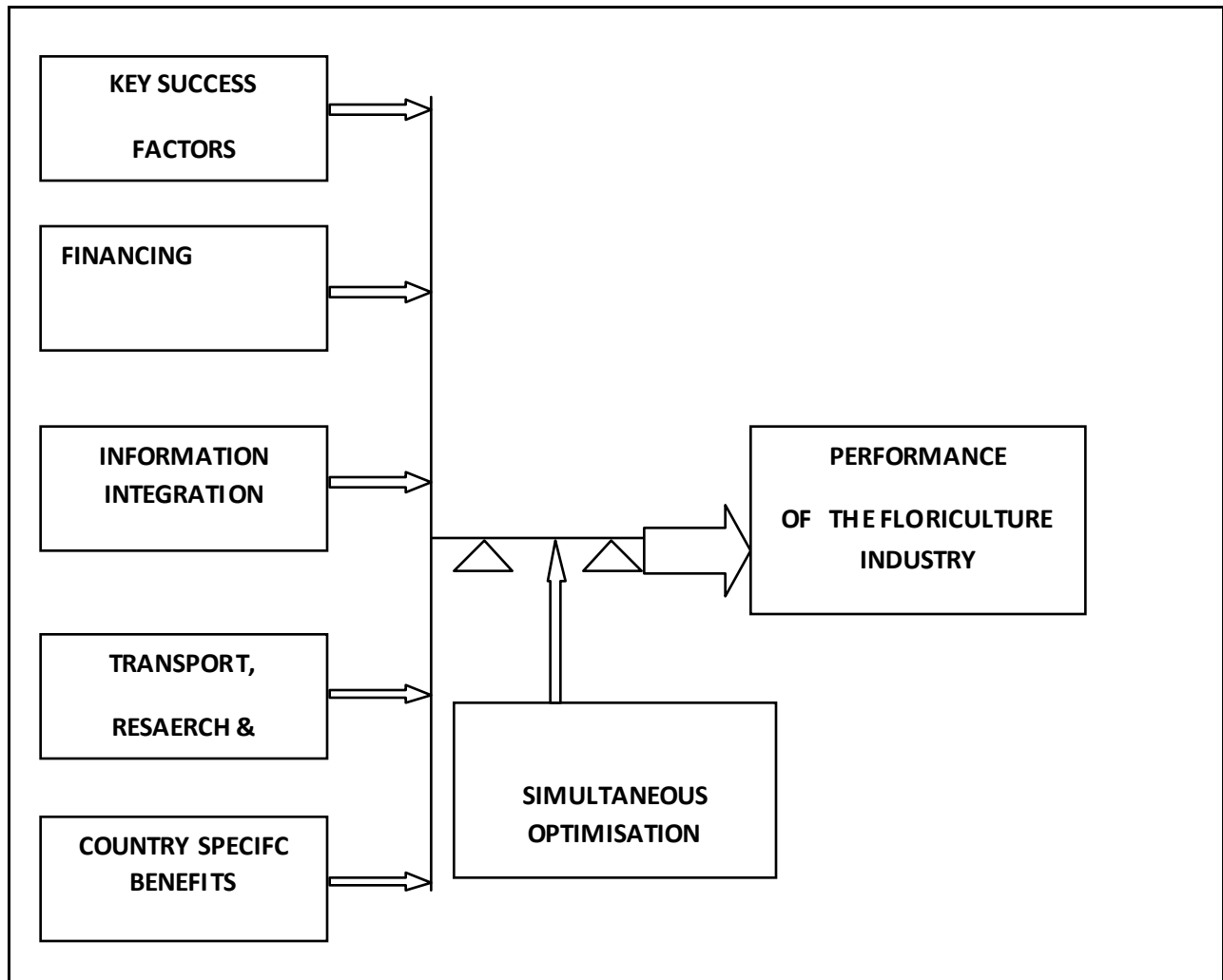


Fig 1.3: Revised conceptual model

Key success factors

The study reveals operational costs as being key success factor in influencing performance of the sector. According to Patel (2010), there is need for the industry to institute measures that can reduce economic impacts of climate change such as; accelerating development to cope with the existing impacts, e.g. integrated water management, electricity sector diversity, natural resources and environmental management.

There is also need to develop plans for water by all businesses that use significant amounts of water. Plans should have key features such as (Patel, 2010); social and environmental responsibility; interaction with stakeholders on water issues – government and civil society; a water policy; set target for water use efficiency and ; minimizing pollution.

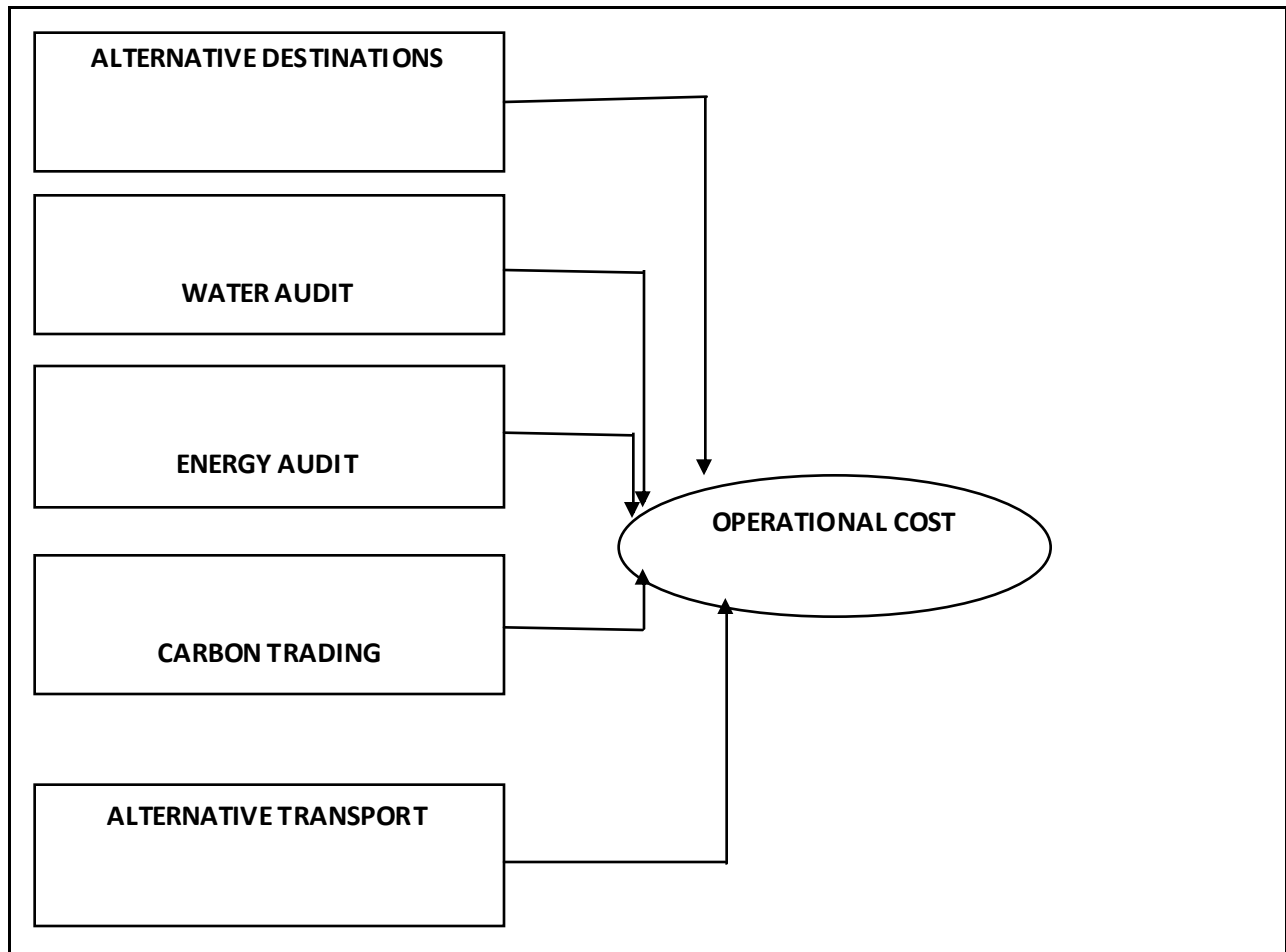


Fig. 1.4: Key operational costs

To effectively manage operational costs it is also important to also address the following issues across the supply networks. These includes: planting, growing; harvesting; transporting; marketing; and selling. According to Bolo et. al. (2006), major strategies in reducing operational costs in the flower industry is to identify ways to integrate small– medium scale growers into large scale producer’s supply chains and continuing to integrate technology and tough environmental standards into production practices. It is also emphasized that cut–flower producers should attempt to gain direct access cut-flower consumers outside the traditional auction systems into new markets such as Eastern Europe, where cut flower consumption has increased by 30 percent over the last two years (TechnoServe, 2006).

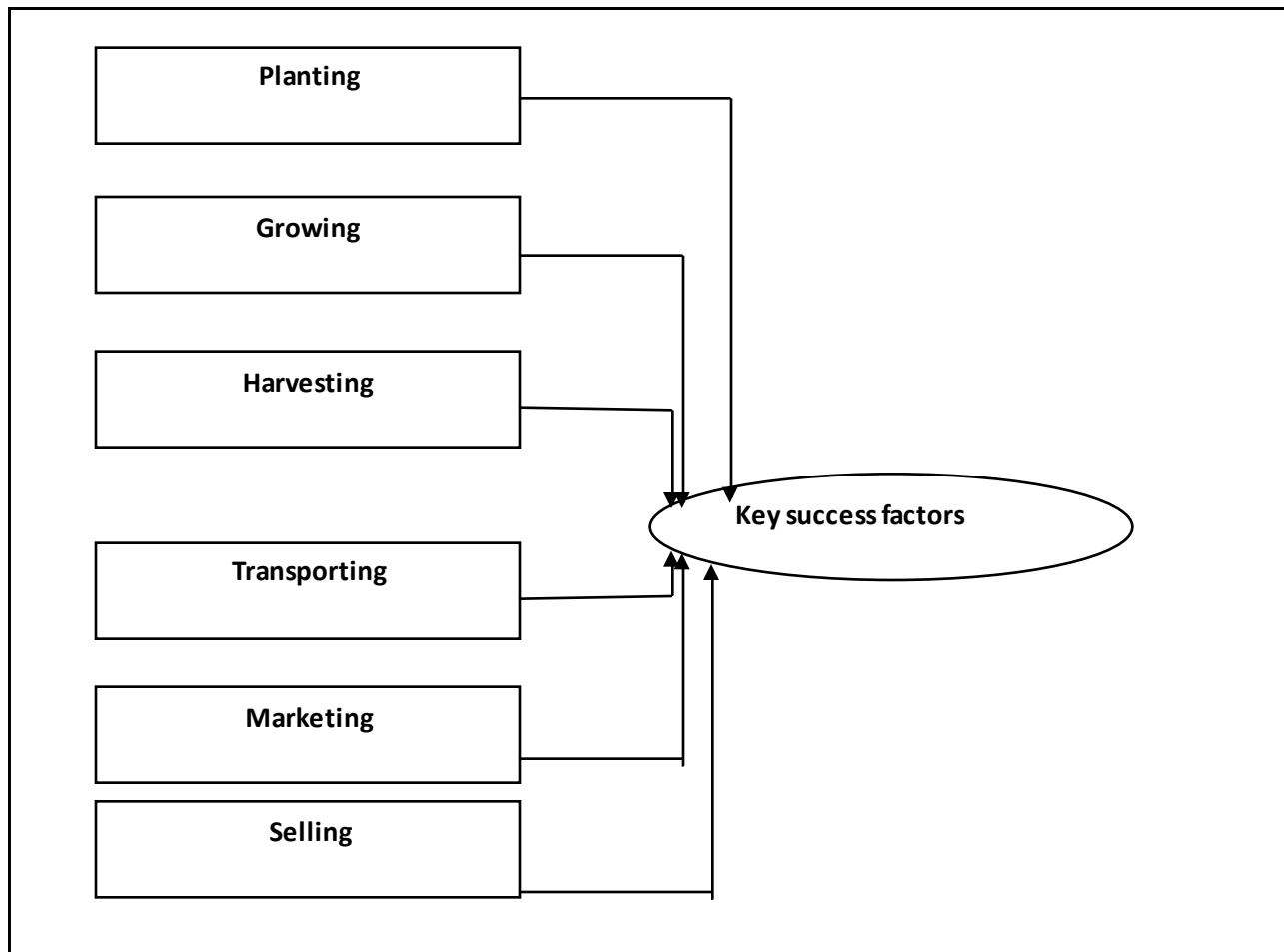


Fig 1.5: Value chain factors contributing to key success factors

The value chain shown in figure 1.6 can be viewed from two perspectives: large scale flower producers and small scale growers. The large scale producers are vertically integrated across the entire value chain with some large growers that breed their own plant stock. (Hornberger et. al., 2007). Large scale estates also leverage their size and economies of scale to invest in sophisticated post-harvest cold-supply chain infrastructure including refrigerated trucks for transportation to the airport.

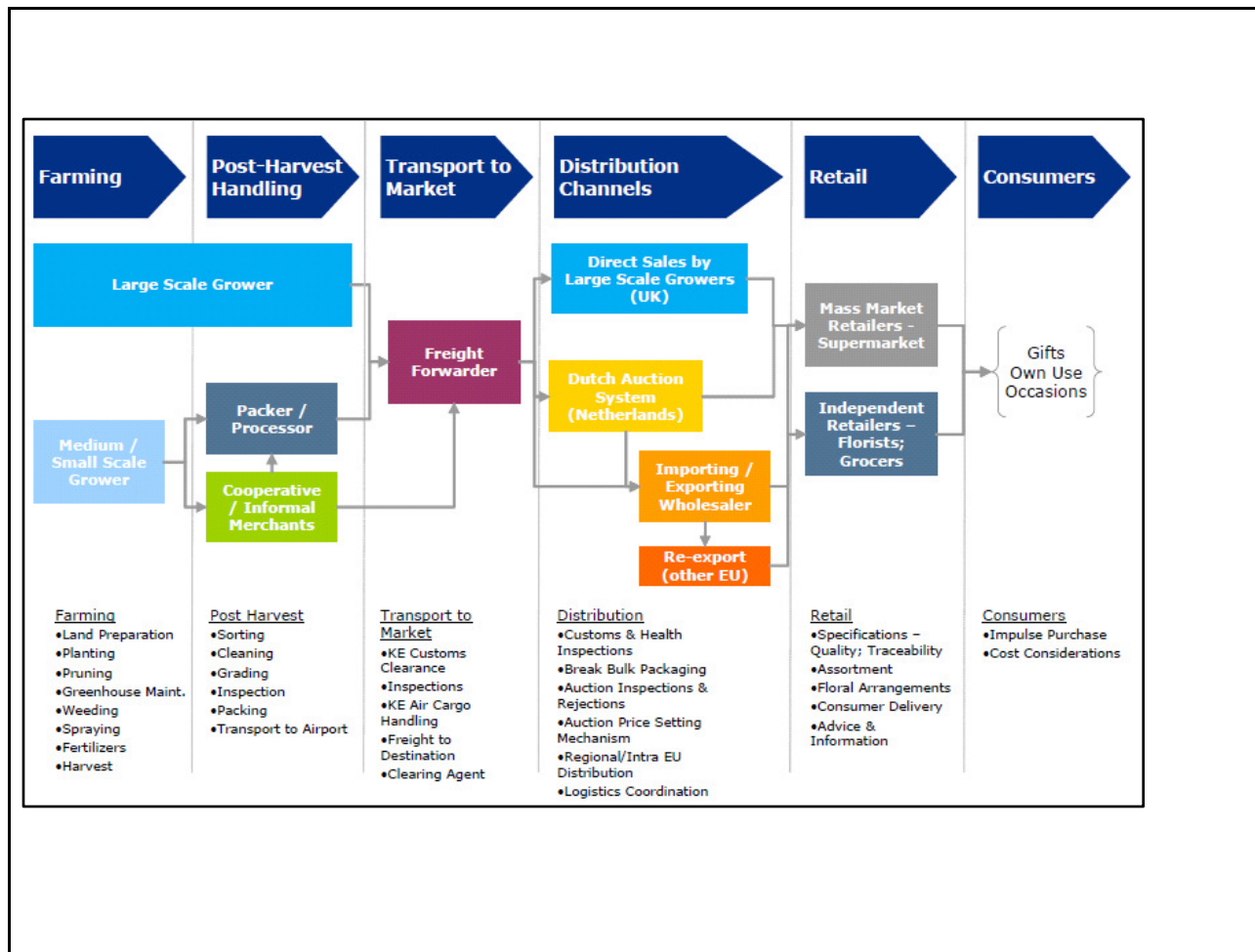


Fig.1.6: The Cut-flower value chain

Source (Hornberger et. al. 2007)

More than 90% of Kenya's flowers are handled by four specialized air freight forwarders (three of which are owned or linked to top flower producers) that aggregate all horticultural produce and in turn are able to secure better air freight purchasing power. After export, the large scale exporters have a logistics infrastructure for direct distribution to the mass market (Hornberger et. al., 2007).

Financing

According to Dodd (2010), banks consider the flower industry a high risk sector for lending due to some of the following reasons: long production cycle—nearly three years for the flower industry compared to just 210 days for the manufacturing industry; dependency on customer tastes / trends in the end market; perishability of product; availability of constant water supply; lack of industry knowledge within the industry knowledge within the banking industry; market issues such as airfreight cost versus competition, dependence on the dutch auctions/ UK supermarkets.

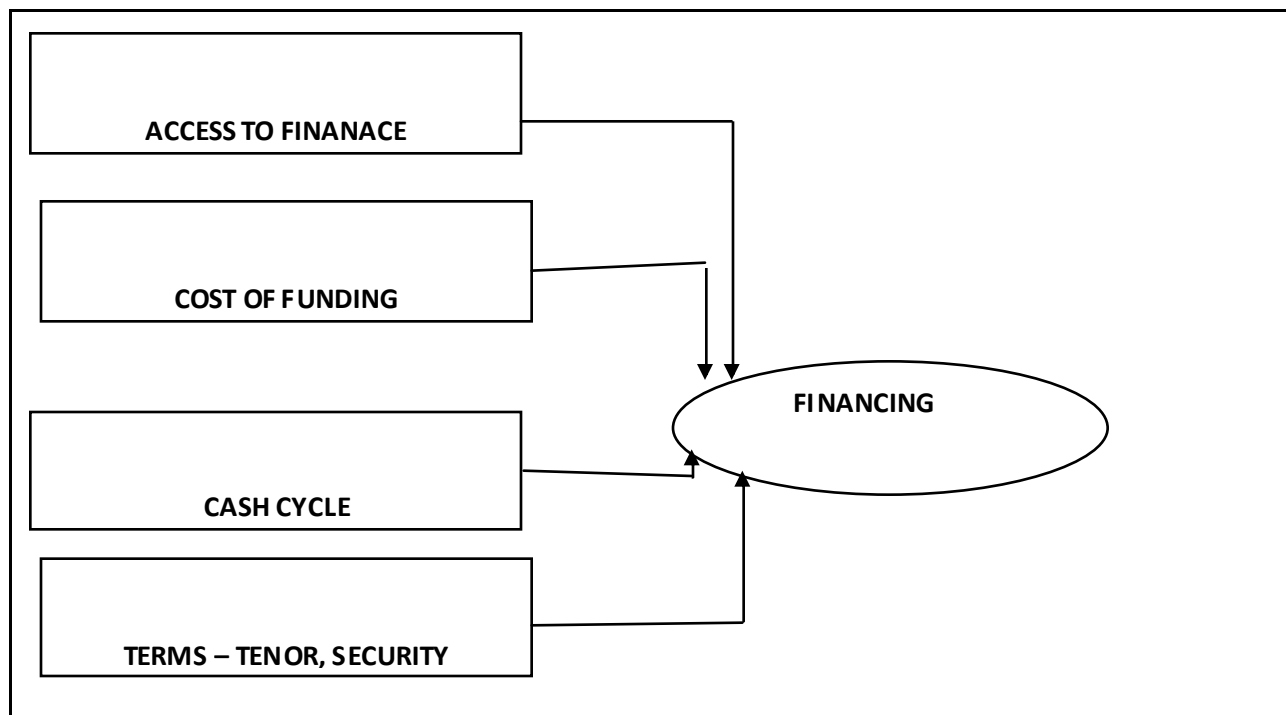


Fig. 1.7: Key factors influencing financing in the flower industry

Possible future trends with regard to financing could include; diversification to other markets; consolidation within the industry; automation to reduce costs and the government coming in to protect and promote the industry.

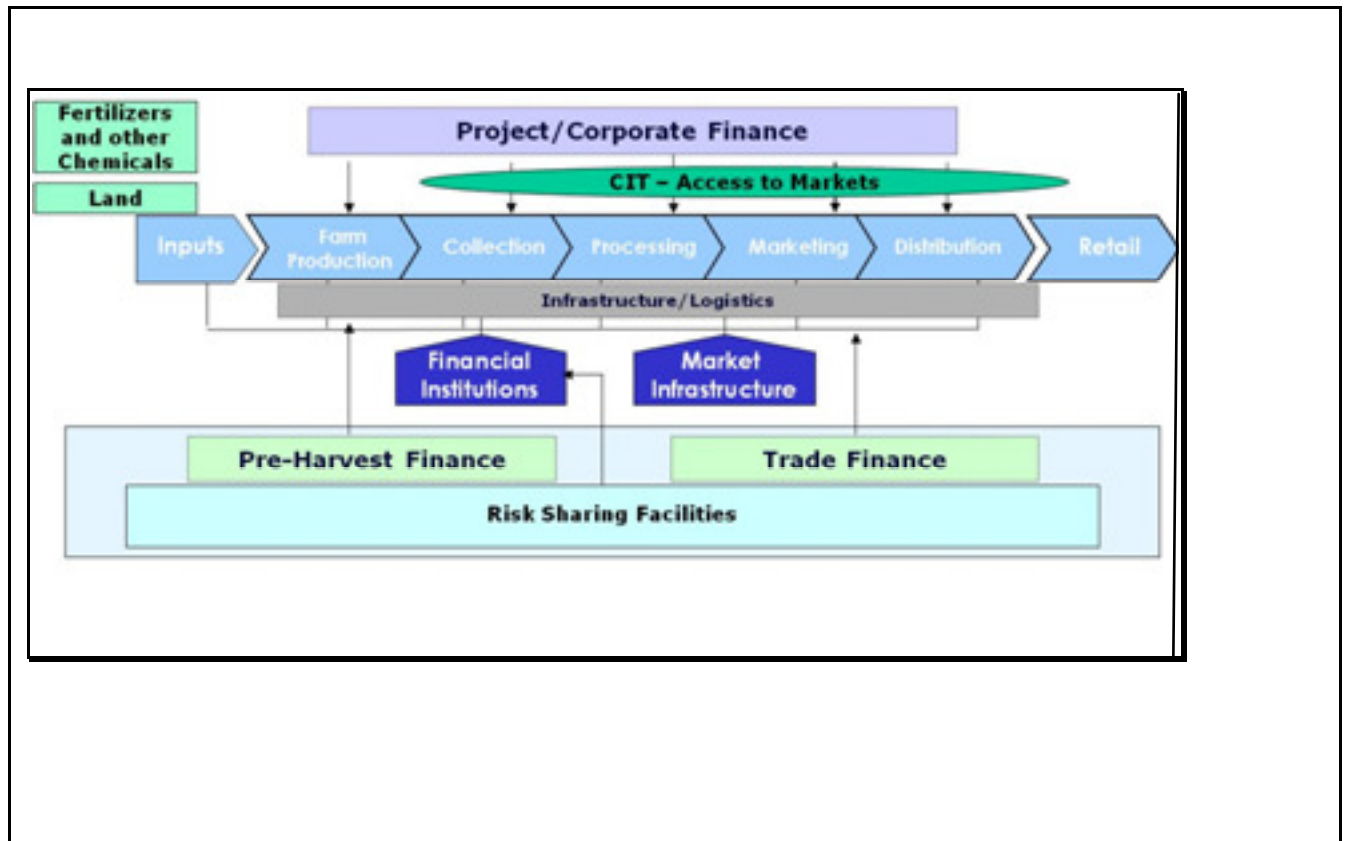


Fig 1.8: Financing the value chain

Source :(Magwenzi, 2010)

The model illustrated in figure 1.8 shows how financing is done across the cut flower value chain which includes pre-harvest and post harvest financing. Suffice to note that because of the risk element associated with the flower sector, small scale farmers are at a better position of securing financing through consolidation efforts (Magwenzi, 2010).

Country Development and information integration

Kenya competes with almost all of its neighbors as a destination for investment in the flower sector. Tanzania, Ethiopia and Uganda have all put in place aggressive tax favorable export regimes including grants for ten year holidays for new investments (All Africa, 2007). Kenya has responded with several initiatives to maintain attractiveness that apply to new investments in floriculture as well. These include (Hornberger et. al., 2007): incentives to allow manufacturers to import plant; machinery; equipment and raw materials tax free, for exclusive use in the manufacture of goods for export.

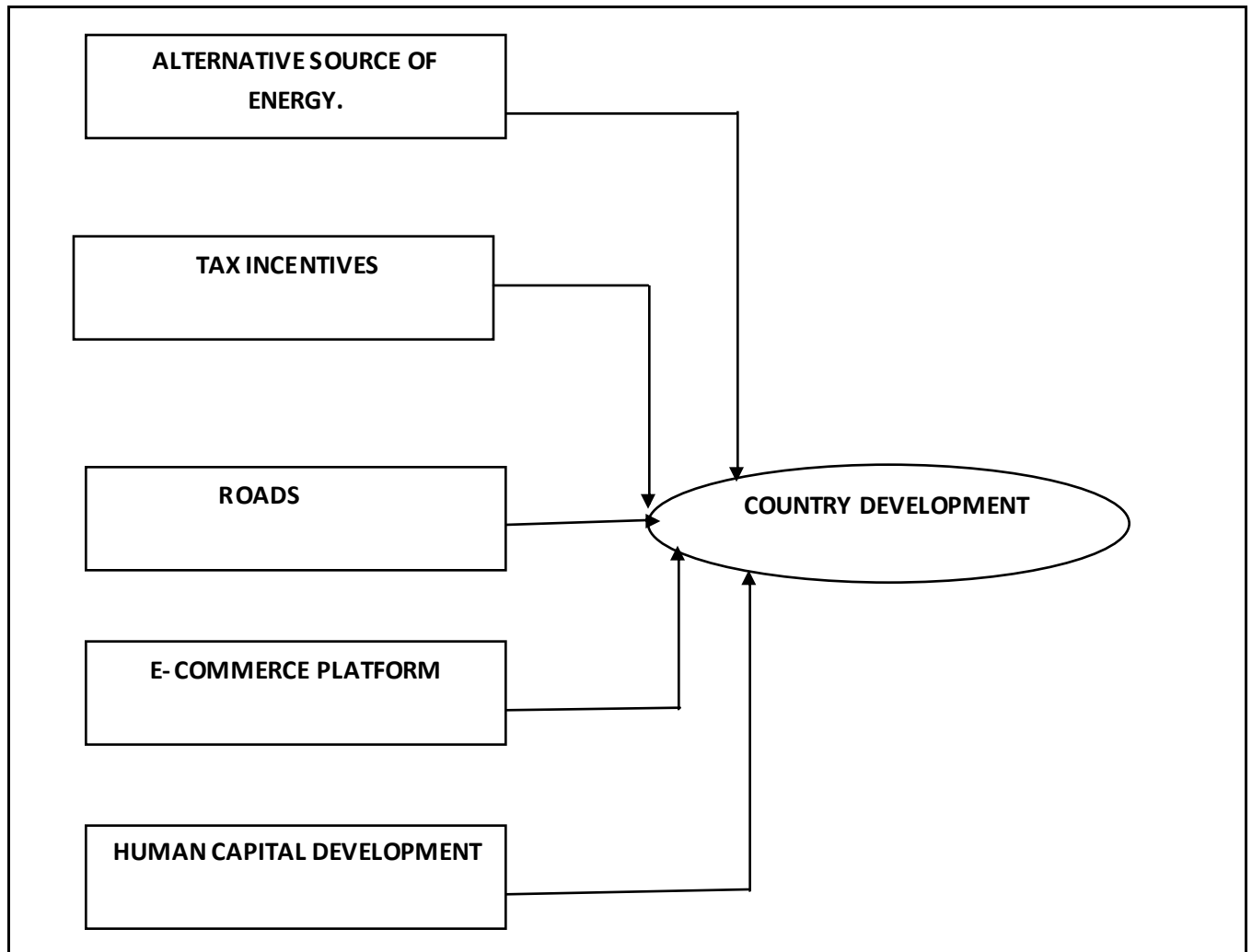


Fig. 1.9: Key factor affecting country industry development

It is asserted by Ngige (2010), that the Kenyan government is supportive of the flower industry through: i) favorable bilateral and multiple trade protocols; ii) aid for trade; iii) research and development. According to Muia (2010), the agricultural sector is made up of four major sub-sectors namely industrial crops, food crops, horticulture, livestock and fisheries. The vision of the agriculture sector is to be “innovative, commercially- oriented use modern farming methods (Ngige, 2010). Hence, the floriculture industry needs to be styled up to this. The achievement of this vision will require (Muia, 2010):

- i. reforming institutions by transforming key organizations such as cooperatives into contemporary and high-performing entities that facilitate growth in the sector;
- ii. increasing productivity through provision of widely-accessible inputs and service to farmers;
- iii. transforming land use to ensure better utilization of high and medium potential lands; and
- iv. developing arid and semi- arid areas, (which accounts for 80% of Kenya’s land mass) for crops.

An interesting feature of the floriculture industry in Kenya is the tendency towards concentrated activity in defined and limited geographical locations. This may have been informed by climatic conditions and logistics considerations. It is important to note that the Kenyan government is trying to address these issues through the development of infrastructure with respect to energy from geothermal, wind, solar, coal and nuclear power. The Ksh. 34 Billion that was allocated to Energy in the 2010/11 budget speaks to this (Muia, 2010). In addition, recent development of roads and investment in water will also significantly reduce the cost of transportation and perhaps open up new areas for horticulture (Ngige, 2010).

Since the launch of the vision 2030 in June 2008 (GOK, 2008), the focus is on implementation of its first 5-year phase that is guided by the medium term plan (MTP) covering the period 2008 – 2012. Implementation of Kenya Vision 2030 relies heavily on the direct and indirect involvement of the private sector – the business community as well as civil society organizations. It is noted that one of the flagship projects identified in the MTP 2008 –2012 was fertilizer cost reduction programme (GOK, 2008). In 2009, bulk procurement of fertilizer commenced and was injected into the market through National Cereals and Produce Board

(NCPB), resulting in the reduction of fertilizer prices. With the launch of the optic fiber cable network across the Indian ocean internet access has become achievable even to the small and medium scale firms. The cost of internet has also tremendously gone down thus enhancing information integration and customer responsiveness. These being critical in improving the performance of the floriculture industry.

Research and Development

For any research activity to be useful, it must be sensitive to local needs and priorities as well as allow ownership of its agenda by the intended beneficiaries. In the case of floriculture research, farmers and exporters are the key stakeholders and their views should help inform research decision (Bolo et. al., 2006).

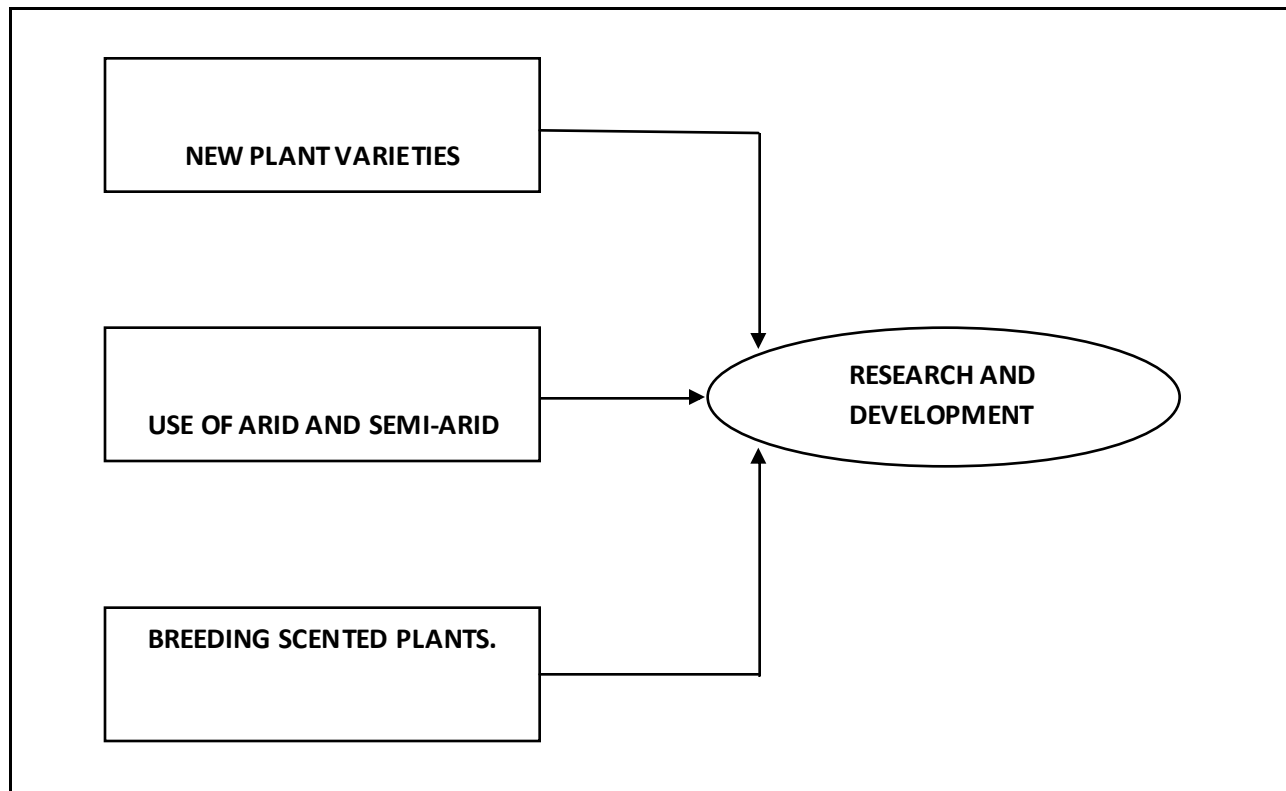


Fig. 2.0: Key factors affecting research and development

The floriculture sub-sector has numerous institutions for collaboration with regard to research and development. This includes NGOs, research institutions and government agencies. The Kenya Agricultural Research Institute (KARI) has productivity research programs in horticultural and industrial crops as well as other food crops, livestock, land and water management (Hornberger et. al., 2007).

Available information indicates that most of the exports of Kenya's floriculture have been to a limited range of export markets resulting in a concentration that expose the industry to systemic market risk (Muia, 2010). Whilst there is need for pro-active efforts to maintain and defend existing markets there I that have a also a clear need to diversify into other markets especially those that have significant growth potential and whose economies are not closely correlated with those of the traditional Kenyan markets. Besides increasing the volume of sales, this development would greatly enhance Kenya's bargaining power in the global agricultural markets.

It is important to look at the range of products that are offered in the Kenya Floriculture industry. It is vital that the floriculture industry devote time to increase its product depth and width. According to Muia (2010), the industry should address the following questions:

- i. Is there scope to grow scented plants in large scale?
- ii. How about trying new varieties of fruits, vegetables and flowers that have never been grown before e.g. Cactus for breakfast vegetable and perfumes? and,
- iii. How about trying Olives in Kerio Valley and semi arid parts of Kenya?

The government is keen on adopting a cluster strategy in dealing with this issue. It involves employing the triple helix concept which brings together government, private sector and researchers (Muia, 2010).

The study gives recommendations on what needs to be done to improve on the following areas that positively impact on the performance of the floriculture industry in Kenya: key success factors; financing; country development including transportation; research and development.

Improving key success factors

These are critical in enhancing the performance of the floriculture industry. The issues addressed includes: quality of inputs; post harvest handling and marketing. Table 1.1 is a summary of the suggested solutions for operational cost improvement:

Table 1.1: Operational costs improvement

Problem Area	Problem Description	Suggested Solution
Inputs	<ul style="list-style-type: none"> - Poor skills in fertilizer and technology application - Water catchment areas getting destroyed due to bad farming methods - Farmers do not know which fertilizers to use and when to apply them. - High input costs, such as, seed and inorganic fertilizers - Inadequate clean planting material techniques, protection of catchment areas and chemical use; irrigation equipments and methods. - High energy costs 	<ul style="list-style-type: none"> -Research on and train farmers on efficient fertilizer use, water harvesting -Mass production of clean planting materials e.g. through tissue culture and certified seeds. -Improve access to affordable and reliable soil pH analysis and pest analysis advisory centers. - Development of indigenous materials into pesticides -Develop biological methods/plant extracts to reduce the excessive pesticide use. - Research on water use efficiency for different flower types. -Research on energy use efficiency in the farm

Source: (Bolo et. al., 2006)

Additional issues to be addressed in enhancing operational cost includes; pest and disease control; post harvest handling and marketing as a summarized in the table 1.2. These have the potential to improve industry wide performance.

Table 1.2: Additional key success factors

Problem area	Problem description	Suggested solution
Pests and Disease	<ul style="list-style-type: none"> - Farmers lack know ledge and adequate information on alternative bio-control methods for pest control. 	<ul style="list-style-type: none"> - More research on available, affordable, effective bio-control methods. - Training on relevant pest control methodologies and options of pest control.
Post harvest handling	<ul style="list-style-type: none"> - Lack of post-harvest handling know ledge. - High post harvest losses. - Lack of adequate, accessible facilities and capacity. 	<ul style="list-style-type: none"> - Training of farmers on post harvest handling techniques and practices. - Conduct research on enhancing the post harvest quality of different flower types.
Marketing	<ul style="list-style-type: none"> -Exploitation by middlemen / brokers -Lack of awareness of international trade agreements. - Lack of information on market trends/ requirements 	<ul style="list-style-type: none"> - Enhance the capacity of farmers to sign/enter into binding contracts with middlemen. - Educate farmers on

	<p>-inability to meet standards/ regulations.</p> <p>-Branding and brand identity (need to develop marketing 'slogans' for Kenyan products).</p> <p>- Lack of domestic market for flow ers</p>	<p>relevant international trade agreements such as the Lome IV Convention, Economic Partnerships Agreements (EPA 's and WTO) and their implications</p> <ul style="list-style-type: none"> - Organize regular forums to sensitize framers on market trends, requirements and standards. - Research on changing market trends, preferences and requirements. - Increases farmers' access to ICTs to enable them obtains market information through the internet. - Develop a Kenyan brand/ slogan for Kenyan flow ers. - Conduct research to quantify the local demand/ market and develop it for local varieties.
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Source: (Bolo et. al., 2006)

Improving financing

The issue mainly addressed in financing is poor access to credit facilities and what need to be done to improve it especially for the small and medium scale farms since most financial

institutions regard this category as high risk for extending credit facilities. The following table is a summary on improving financing.

Table 1.3: Improving financing

Problem Area	Problem Description	Suggested Solution
Financing / Credit Facilities	<ul style="list-style-type: none"> - Lack of farmer-friendly products financing/ credit institutions. - High interest rates on loans from commercial banks 	<ul style="list-style-type: none"> - Farmers should be facilitated to form savings and credit cooperatives (SACCOS) to offer soft loans to them. - Banks should have innovative products tailored to the needs of the industry.

Source: (Bolo et. al., 2006)

Improving country development

On country development the recommendations is mainly on the role of the government in terms of support to the industry and improvements that can be made on the area of infrastructure. The following table is a summary on improving country industry development.

Table 1.4: Improving country development

Problem Area	Problem Description	Suggested Solutions
Government Support	<ul style="list-style-type: none"> -Government is aloof to small-scale farmer problems. -High cost of production/inputs -High taxation (flower farmers are exposed to 	<ul style="list-style-type: none"> - Government to set up an audit system for farmers and certify those who attain these standards. - Government to set up and enforce quality standards. -Harmonize and reduce

	<p>multiple of taxes)</p> <p>-Strong shilling affects exports/instability of prices.</p>	<p>taxation on flow ers.</p> <p>-Government to formulate a market- driven curriculum in educational institutions to support the industry</p> <p>-Government to formulate policies to and framew orks to facilitate e-commerce.</p> <p>-Government should facilitate small –scale farmers to attend local and international exhibitions and trade fares.</p> <p>- Government should support manufacturers to produce cheaper local fertilizers.</p> <p>- The Central Bank of Kenya should regulate the appreciation of the shilling against major currencies to stem losses.</p>
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Source: (Bolo et. al., 2006)

Table 1.5: Additional areas on improving country development

Problem Area	Problem Description	Suggested Solution
Infrastructure	<p>-Few /lack of cooling facilities for small-scale farmers.</p> <p>-High cargo/freight and handling charges.</p> <p>-High electricity costs</p> <p>-Poor road and rail netw ork.</p>	<p>-Create conducive environment for investment in freight services.</p> <p>-Local Authorities to maintain all feeder roads.</p> <p>-Cooling facilities to be established at farm collection points to prevent quality deterioration.</p>

		- Harness solar energy for use as alternative sources of heating during cold nights or other sources of energy.
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Source: (Bolo et. al., 2006)

Improving research and development

The recommendations on improving research and development are mainly on information dissemination which is vital to all the industry players. Also outlined are recommendations on the development of new and indigenous plant varieties. The following table represents a summary on improving research and development in the flower industry:

Table 1.6: Improving research and development

Problem Area	Problem description	Suggested solution
Information dissemination	<ul style="list-style-type: none"> - Farmers are not exposed to research findings. - Lack of information on flower varieties suitable for direct agro-ecological zones on the new innovation in products and farming techniques - Inaccessibility of information in rural areas. 	<ul style="list-style-type: none"> - Disseminate research findings widely through non-technical brochure and in local languages. - Set up a floriculture centre with branches in major growing areas. - Set up information desks in the major growing areas. - Hold regular meetings/ interactions between researchers and farmers. - Tap, document and disseminate farmers' discoveries and

<p>Development of new / indigenous varieties.</p>	<ul style="list-style-type: none"> - Farmer's over-reliance on same flower varieties since the early 1990's. - The potential of local biodiversity is not being fully harnessed /exploited. - Kenya over-reliance on imported varieties yet the country is a key exporter of flowers 	<p>indigenous know ledge.</p> <ul style="list-style-type: none"> - Research should focus on identification and testing of different flora for potential use. - Development of indigenous varieties for commercialization; collect local germplasm, improve them and test in overseas markets. - Harness indigenous know ledge on wild flow ers within local communities, document and test them. - Breeders should be supported to come up with new varieties and get a "Kenyan Brand"
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Source: (Bolo et. al., 2006)

Recommendations for the flower growers

The following recommendations to the flower growers were made as a result of the findings of the study:

- i.** Intensify lobbying efforts for the government to allocate funds for road construction and maintenance of the existing road network;
- ii.** The large farms should consider efforts to hedge currency risk;
- iii.** Promote strong brand recognition for Kenyan cut flowers;
- iv.** Exploit direct-to-retailers channel where Kenya has advantage over regional competitors;
- v.** Increase value-add activities such as bouquets, mixed floral arrangements;
- vi.** Further develop diversification of varieties through research and development;
- vii.** Small scale growers can provide fillers and additional varieties to large scale producers;
- viii.** Incentives to encourage integration of small growers into large producers' supply chain network;
- ix.** Intensify lobbying efforts for direct sales to emerging markets;
- x.** Increase direct sales to supermarkets, florists, etc; avoiding the intermediaries;
- xi.** Expand direct sales to markets outside traditional European markets (Eastern Europe, South Asia and Middle East);
- xii.** Prepare farms to meet tougher standards both domestic and international markets (KFC Silver Gap and EUREGAP) ahead of time; and
- xiii.** Advance product positioning through international lobbying by industry associations.

Recommendations for the government

The following recommendations to the government were reached as a result of the findings of the study:

- i.** Allocate funds for road infrastructure;
- ii.** Enhance security services to farmers and facilities;
- iii.** Consider development of commodity insurance markets;
- iv.** Continued investment in education;
- v.** Co–investment with private sector on research and development institutions to address increased local breeding of plant stock;
- vi.** Resist attempts to intervene with subsidies for small growers, but encourage larger growers to integrate them into their supply networks;
- vii.** Provide information through export promotion agencies on new markets outside traditional European markets;
- viii.** Assist in joint lobbying with industry associations against potential UK supermarket bans for Kenya’s produce;
- ix.** Negotiate new trade agreements;
- x.** Facilitate preferential treatment for growers that meet tougher environmental standards;
- xi.** Linking small farmers to high – value urban and export markets as a strategy for raising rural incomes, reducing poverty and potentially maintaining export competitiveness as well; and
- xii.** Promoting institutional innovation by providing market information, extension services, mediating disputes and establishing standards, for instance, allows a variety of private institutions and marketing arrangements to develop which can then adapt to changing environments.

CONCLUSION

This study makes important contributions to the management of supply networks for simultaneous optimisation in the flower industry end to end and within country. The study has through rigorous statistical analysis tested popular perceptions about the determinants of performance in the flower industry. The study confirmed the determinants for performance of the flower industry through effective supply network optimisation. The study also provides a conceptualisation on operational costs, financing, country industry development and research and development.

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