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ENVIRONMENTAL TENSIONS AND COMPATIBILITIES IN AGRIBUSINESS SUPPLY NETWORKS: A CASE OF THE FLORICULTURE INDUSTRY IN KENYA

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Abstract
The paper is part of a wider study on supply networks optimisation in the floriculture industry in Kenya. It is an analysis of environmental tensions and compatibilities in agribusiness supply networks addressing the floriculture industry in Kenya. The choice of the floriculture industry is due to the fact that it is currently one of the top contributors to the country's Gross Domestic Product (GDP). The industry has been a subject of debate with regard to environmental sustainability. The principal research question was to find out the environmental consequences of the floriculture industry in relation to its supply networks. The study took both a qualitative and quantitative approach in its methodology. The former involved focused interviews with key stake holders in the floriculture industry in Kenya while the later involved a quantitative approach using mainly principal component analysis (PCA). This identified environmental issues as factor two (2) described as country specific benefits. The paper concludes by making an observation that the floriculture industry needs to apply routine performance measurement and business efficiency techniques to; water, energy and wastewater management as a measure to reduce negative environmental impacts. A recommendation is made for a moving from old cooperate social responsibility to the new sustainability communications. A further recommendation is for the flower farms to engage into research with the Kenya Agricultural Research Institute and other research bodies in Kenya, for water stress tolerant flowers, increase hydroponics agriculture area and invest in rainwater harvesting and treatment systems and, install water water recovery/recycling plant.
Key words: Environmental tensions, Environmental compatibilities, supply networks

Introduction

Discussed in this paper is the background of the study, literature review, the research methodology including a presentation of findings and results. The paper winds up by making a conclusion and recommendations to the industry players and stakeholders on what needs to be done in order to address the environmental issues affecting the floriculture industry.

Background of the study

The paper addresses environmental tensions and compatibilities in the agribusiness supply networks. The issues that need to be considered include: i) extent of environmental pollution caused by the industry; ii) efforts for environmental conservation by industry players. Further studies may be necessary to show that the floriculture industry is neither polluting lakes nor encroaching on wetlands. The drying up of Lake Naivasha, which is situated in one of the most densely populated area with flower farms, has been attributed to the chemical effluents from the surrounding flower farms. It is to be appreciated that high altitude growing at equatorial latitudes produce quality flowers and vegetables without fossil fuels (heating and lighting) – Kenyan produce is grown under the sun.

There is need to examine the extent to which Kenyan growers are reducing carbon footprint by using geothermal and solar techniques for power generation. Carbon footprint stands for certain amount of gaseous emissions that are relevant to climate change and associated with human production activities (Wiedmann and Minx, 2007). Currently, there is a debate on how to measure and quantify a carbon footprint. A survey of definitions, Scopus (2009), defines carbon footprint in terms of how much carbon dioxide emissions can be attributed to a certain product, company or organization. Carbon trading is already gaining foothold into the country, showing how critical it is to environmental conservation.

The financial and social benefits should also be seen to trickle down to the communities where the flower farms are situated. This should be seen in the form of employment creation and improved standards of living. It needs to be observed that most workers in the flower farms are casual laborers earning at least one United State dollar (USD) per day (Fedha, 2009); this has had its consequences in low standards of living, proliferation of slums. The fact that the floriculture industry is at the moment one of the largest single export earner for Kenya as well as a major employer does necessitate a need for improvement on productivity. If each employee in this sector has four

dependants then, the total beneficiaries are 4.8 million people or 13% of the population (Assumption based on average family size in the cut–flower growing areas in Kenya). These therefore necessitate the fact that Kenya has to retain its position in the supply chain network by providing end to end as well as within country optimization. This has to be seen in the backdrop of competition from other countries such as Ethiopia, Uganda, Zimbabwe and South Africa.

The social condition is characterised by high poverty rates since most workers earn less than one USD per day. There is also high prevalence of human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS). About 65% of the workers are casual laborers earning about UDD 30 per month. It is also to be noted that 75% of the casuals are women that have single parenthood families (Fedha, 2009). The industry uses many chemicals such as fertilizers, insecticides, fungicides, nematocides etc. Some of these chemicals have potential to cause serious harm to the ecosystem and human health. Studies / statistics on pesticides use and pesticide related health effects in the floriculture industry in Kenya are very rare and incomplete (Fedha, 2009).
Most of the flower farms are situated around Lake Naivasha. Lake Naivasha is a Ramsar site. Implying that it is a protected wetland under the Ramsar convention in which Kenya is a signatory (HCDA, 2008). Therefore, Kenya has the international obligation to protect such a site from ecological damages. However, pesticides and the degradation products find their way into the lake. This has had serious consequences on pollution of the lake. There is also need to develop the road infrastructure in Kenya in order to make the industry more competitive. There is, however, reasonable investment in cold chain facilities at the airports. Liberalization of trade which has resulted in the removal of exchange control and other constraints has been instrumental in the success of the industry. The Kenyan government has tried to give incentives in the form of nil or reduced duties on inputs for the sector.
Some questions of concern in the floriculture industry that exist in Kenya are: who benefits from the industry; is the industry fighting poverty among the poor in Kenya ; what are the long term effect of the pollutants from the industry on the environment; what are the long term effects of the industry on reproductive health, cancer related diseases, child health; where do the elderly workers go, and what health effects may manifest later; and what are the impacts of urbanisation with poor planning which indeed is a social problem? It is necessary for Kenya to stay competitive while addressing the possible problems that may be as a result of the mismanagement of the supply networks end to end and within the country.

Literature Review
The literature in this paper originates from the academic discipline of supply chain management, supply chain networks, organization structure and design, country industry development and triple bottom line benefits. The complexities of the floriculture industry which includes: extremely short shelf life; very specific cycles with extreme peaks; mixing characteristics of service and product dimensions; and the challenge of operating part of 'first world' supply network in a developing economy. This creates the need for end to end optimisation of the supply networks (Awuor, 2012)
The study will be of benefit to supply chain practitioners in the floriculture industry and any other industry with similar peculiarities. It will also be of benefit to the academia interested in the subject of supply chain management and indeed contribute to the body of knowledge in the subject. Existing theory that would be used as a basis for this study is depicted in the Venn diagram in fig. 1.1.

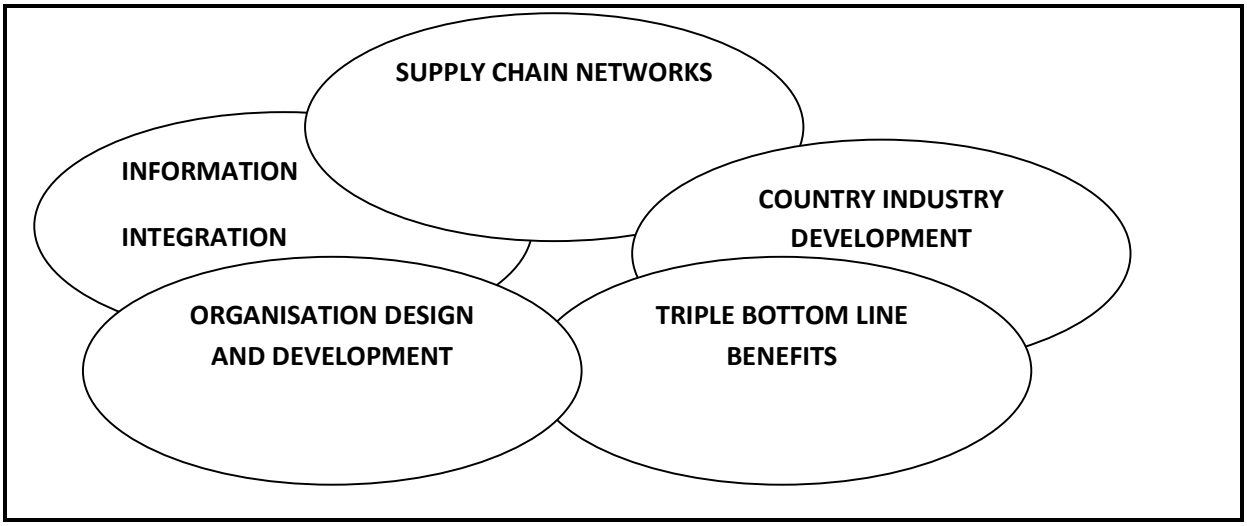

Fig. 1.1: Venn diagram illustrating theory covered
(Source: Awuor, 2012)

In order to consolidate further the research problem, a brief literature overview from the following five fields can be formulated as shown on the Venn diagram on fig. 1.1. These fields are: i) theory relating to supply chain networks; ii) theory on organisation design and structure; iii) issue to be addressed is theory related to Information communication technology; iv) country industry development; and v) triple bottom line benefits.
The supply chain network is the facet of the supply chain that translates organizational goals of the company. The network in this regard refers to the physical movement of the goods from suppliers' supplier to the company and ultimately to the customers' customer (Bolstorff, 2006). The factors considered in setting supply chain network goals include service level, order fulfillment cycle time, supply chain management costs and inventory days of supply.
Supply chain networks links to supply chain process which is in reference to the supply chain operations reference (SCOR) model (plan, source, make, deliver and return). Factors considered in setting supply chain process goals includes transactional productivity for sales orders, purchase orders, work orders, return authorization, replenishment orders and forecasts (Bolstorff and Rosenbaum, 2003).

Use of information communication and technology (ICT) software's such as enterprise resource planning (ERP), electronic data interchange (EDI) and warehouse management systems offer the obvious benefits of better, faster, more accurate information capture and sharing, but there are benefits found also in what it avoids: the human element (Goldsby *et al*. 2005).
Organisation structure and design is important from the point of view of the individual firms and the industry at large. The organisation may refer to elements in a single company or to a bigger part of the complex system itself. It prioritizes organizational performance by balancing customer requirements for delivery reliability, responsiveness and flexibility with the internal needs of cost, profitability and asset utilization (Bolstroff, 2006). Organization structure will also involve determining the influence of power relationships in SCM. According to Bolstroff (2006), the following questions are important with regard to organization design: does your organization structure address centralization, globalization, and functional silos; are all relevant functions in place; are all the functions necessary; is the current flow of inputs and outputs between functions appropriate; and does your organization structure support your suppliers and customers organization structure?

Environmental tensions
Studies suggest that increasingly there are health challenges associated with the floriculture industry in Kenya (Awuor, 2012). There are unknown effects of pesticides and other agro-chemicals used in the industry (Shivoga,

2008). There is also concern that employment is mainly temporal and part time, targeting mainly the youth with gender bias toward women workers at seventy five percent. but the supervisors are mainly men (Shivonga, 2008). This suggests that job security is nearly nil. Hence questions on the economic and social benefits of the industry still lingers.

There are also challenges of environmental concern. The flower farms occupy about 2000 hectares (20 Kilometers Squared) which are mainly concentrated around Lake Naivasha (KFC, 2008). The lake is currently shrinking mainly due to excessive abstraction of water for irrigation, industrial and domestic use. The southern shores of the lake are already blinded with algal bloom. The shrinkage of the lake is also attributable to pollution from pesticides and fertilizer run off. Cut – flowers are grown in greenhouses and the predominant pesticide used is methyl bromide (Shivonga, 2008).This chemical is a health risk when inhaled. Workers are exposed to these chemicals through transplanting, pruning, cutting, packing, spraying / fumigation and dusting. Also, through re-use of pesticide – saturated green house plastics for domestic purposes such as covering houses. Therefore, there is need for close collaboration between researchers and the floriculture farms and industry player to develop home – based solutions.

Environmental compatibilities

The National Environmental Management Authority (NEMA) is the national body mandated with the responsibility of conducting environmental audits before the flower farm are given a go ahead to establish their activities. The Kenya Flower Council (KFC) also has a code of regulations to be observed by its members. The silver standard is laid out in five sections (Awuor, 2012):

i) "Farm management, responsibilities and documentation" requires growers to keep records on health and safety, worker terms and conditions, employee remuneration, wage deductions, and agrochemical stocks, application and training. It also requires growers to pay royalties to plant breeders according to international rules'';

ii) "General Worker Welfare" covers worker wages, labour conditions and health and safety. The section stresses the importance of complying with national labour and health and safety legislation (particularly the Regulation of Wages and Conditions of Employment Act). In only a few instances does the code go beyond the provisions of the law and consequently few responsible flower industry employers fall foul of the code;

iii) "Agrochemicals" covers crop protection strategies, worker protection, and the use, application, storage, transport, and disposal of pesticides. Kenyan law contained in "The Factories Act" and "The Pest Control Products Act" gives some guidance on these issues. However, the code takes most of its provisions from widely recognized principles of best agricultural practice";

iv) "Protection of the natural environment" covers use of fertilizers, water management, soil conservation, disposal of non-hazardous waste, and the protection of wildlife and water sources. Until recently there has been little legal guidance on protecting the environment. However, in 1999 new legislation was enacted to cover a wide range of environmental issues. Implementation of the act has yet to take place and the extent to which it will affect the KFC code has yet to be fully gauged. The Kenyan flower industry continues to come under considerable criticism from environmentalists worried that pollution and over-exploitation of natural resources will permanently degrade the natural environment. The KFCs silver standard code, and more particularly the gold standard, is designed to deflect criticism from KFC members. During the course of the fieldwork for this study, several KFC members expressed the apparently genuine opinion that maintaining a sustainable natural environment was crucial to the long term future of the industry;

v) "Post harvest" covers health and safety, and environmental requirements that are specific to grading, packing houses and cold stores.

It is however, of much concern that there is no strict compliance with this rules as was noted in March 2010 when the fish in Lake Naivasha were virtually dieing as result of pollution of the lake (Awuor, 2012). Lake Naivasha has the highest concentration of flower farms in Kenya. The Lake Naivasha region is the hub of the Kenya's cut flower industry. The region is situated around 100 km northwest of Nairobi in the Great Rift Valley at an altitude of between 1,800 – 2,000m above sea level. The temperature range for the region is between 7.3 – 22.7 degrees Celsius and annual rainfall ranging from 156.0 mm/month to 1134.0 mm/month distributed throughout the year with peaks in April/May for the long rains and October/November for the short rains (HCDA, 2008).

It is estimated that close 70 per cent of the country's total flower production is concentrated around Lake Naivasha. Other than the growers, the Lake Naivasha cluster comprises other key actors in the flower industry including research institutions, breeding farms, quality control and regulatory agencies, input suppliers, credit and finance institutions, trade promotion agencies and other intermediary organizations. The emergence and growth of Lake Naivasha cluster has been attributed to a number of factors. Key amongst these includes:

i. Proximity to Jomo Kenyatta International Airport (JKIA), Nairobi: By its location along the Nairobi – Nakuru highway, approximately one hour from the city center, the Naivasha cluster has easy access to the airport making transportation easier. Nairobi is considered a major hub in the East African region and served by major airlines according Kenya an easy access into Europe and other parts of the world;

ii. Availability of fresh water resources for irrigation: Lake Naivasha is the only fresh water lake in the whole of the Rift Valley region. Flower growing requires a lot of water for irrigation and the presence of Lake Naivasha attracted many farmers to this region. Besides the lake, there are lots of underground water resources (aquifers) which the farms drill to use for irrigation;

iii. Large farms for large-scale commercial production: The availability of large, inhabited tracts of land with suitable soils for flower production around Lake Naivasha was another contributory factor to the development of the cluster. Historically these large tracts of land were owned (through leasehold) by white settlers such as Lord Delamere Estates which owns most of the land around Naivasha town. Both the white settlers and the government therefore leased out the fallow land to the large scale commercial flower growers; and

iv. The soils and climate are conducive for horticultural production: Both the soils, temperature and annual rainfall range around Lake Naivasha are favourable for cut flower production.

The case of March 2010 in which a lot of fish died from the lake has gone further to confirm that environmental audit is not strictly observed. The heavily polluted and shrinking, Lake Naivasha is in dire trouble. Environmentalists say the cause is clear: flower farms. Some 60 flower farms line the entire lakeside, growing cut flowers for export largely to the EU. While the flowers industry is Kenya's largest horticultural export (405.5 million last year) it may have also produced an environmental nightmare.

Interviews with environmentalists revealed that flower farms have taken water from the lake for irrigation and then dumped pesticide-waste back into the lake. Long-ignored by policymakers, the situation has recently reached a head due to thousands of fish and other freshwater organisms perishing in the lake. Fishing, once common in the lake, has since been banned. A preliminary inquiry linked the flower farms to the lake's troubles stating that the fish mortality was likely caused by low levels of dissolved oxygen. The lake is also shrinking due to a variety of factors: over-irrigation from the farms, water requirements for nearby Naviasha town, and climate change. However, it is to be noted that Lake Naivasha is a Ramsar site and Kenya has the international obligation to protect it from environmental degradation.

Research Methodology

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.

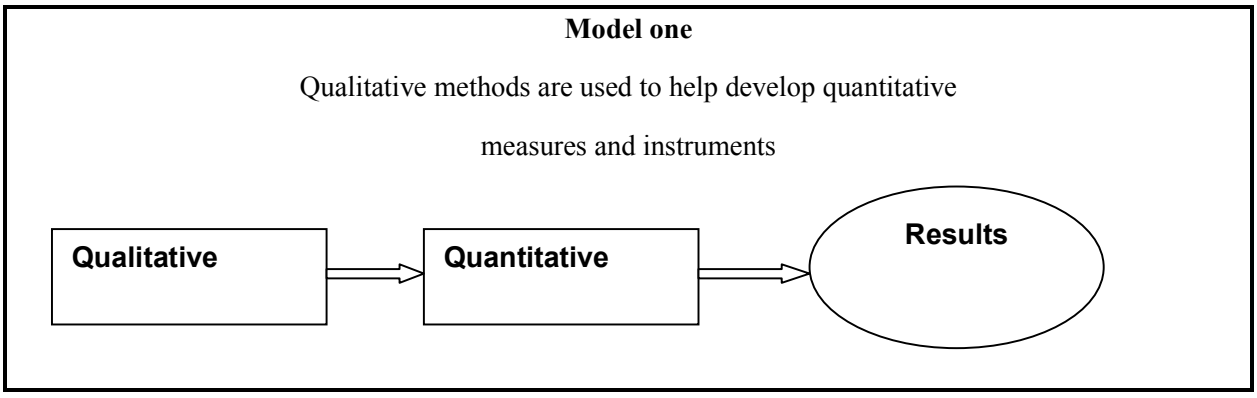

Fig. 1.2: Integrating qualitative and quantitative research
(Source: Steckler *et al.* 1992)

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 1.3 below 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.

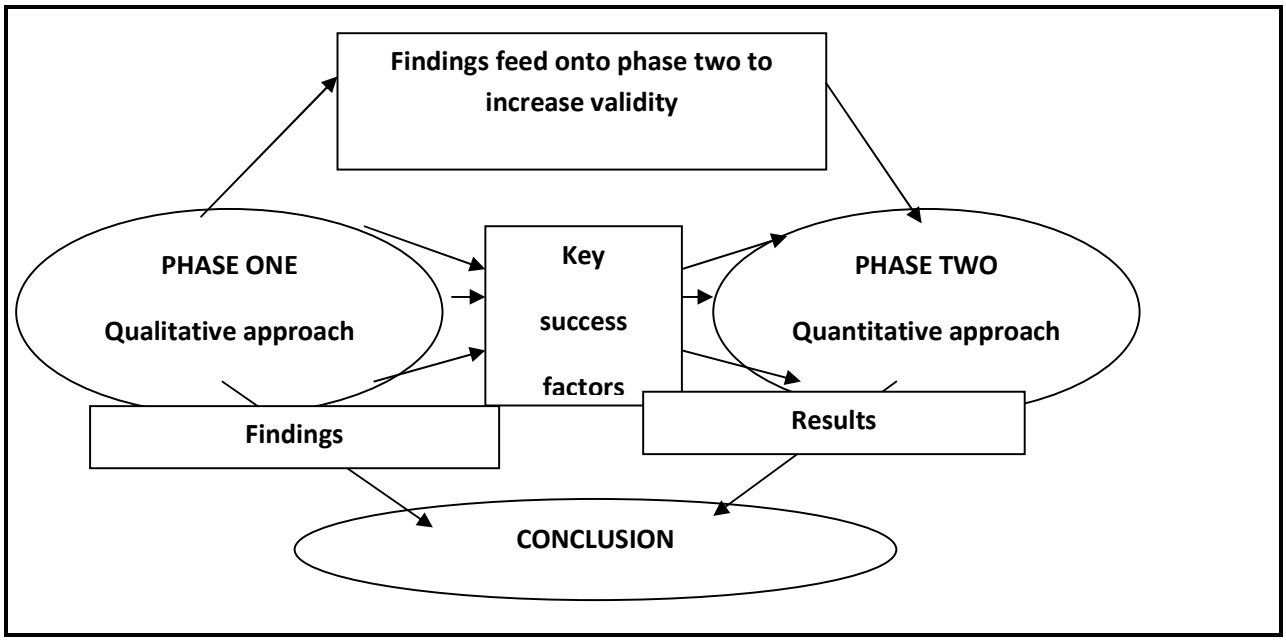

Fig. 1.3: Framework for this research process

(Source: Awuor, 2011)

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 were 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 proposed conceptual model shows that there are four main factors of interest in developing the conceptual model which were identified from phase one of the study (Awuor, 2012). The factors identified through phase one of the study are: country specific benefits; end to end benefits; key success factors and constraints. The constraints form a negative factor in the model and are identified as: access to finance; information integration; and ability to integrate into the supply networks of large firms. This explains the reason for forcing principal component analysis to produce four factors with loadings greater than 0.49. Environmental issues emerged as factor 2, described as country specific benefits.

Table 1.1: Summary of main factors from proposed conceptual model

Factor	**Description**
Factor 1	**Key success factors** – country development, research and development, financing, operational cost, customer responsiveness and information integration.
Factor 2	**Country specific benefits-** environmental audit, social audit and financial audit.
Factor 3	**End to end benefits-** operational cost, financing, country development, research and development.
Factor 4	**Constraints-** access to finance information integration, ability to integrate into supply networks of large firms

(Source: Awuor, 2012)

Principal component analysis only forced for four factors with loadings higher than 0.490 revealed results outlined in table 1.1. This was in an attempt to raise the factors previously identified through analysis data captured in the phase one of the study. By performing PCA and having five factors extracted was in attempt to identify the presence of any significant factors left out in the proposed model.

Table 1.2: PCA with verimax rotation forced to four factors reflecting factor loadings greater than 0.49

	Component			
	1	2	3	4
VAR00001				
VAR00002				
VAR00003				
VAR00004				

VAR00005				
VAR00006			.563	
VAR00007			.564	
VAR00008			.621	-.504
VAR00009			.609	
VAR00010				
VAR00011				
VAR00012				
VAR00013				
VAR00014	.602			
VAR00015	.647			
VAR00016	.569			
VAR00017		.798		
VAR00018		.820		
VAR00019		.841		
VAR00020		.815		
VAR00021		.856		
VAR00022		.812		
VAR00023		.728		
VAR00024				
VAR00025				
VAR00026				
VAR00027				
VAR00028				
VAR00029				
VAR00030				
VAR00031				

VAR00032				
VAR00033	.560			-.502
VAR00034	.549			-.545
VAR00035				-.522
VAR00036	.546			-.500
VAR00037				
VAR00038				
VAR00039			.527	
VAR00040			.513	
VAR00041				
VAR00042				
VAR00043				
VAR00044	.498			
VAR00045				
VAR00046	.490			
VAR00047				
VAR00048	.569			
VAR00049	.531			
VAR00050				
VAR00051				

(Source: Awuor, 2012)

The result of PCA forced for four factors with loadings greater than 0.490 resulted in four factors being identified based on information provided by the research instrument on appendix H. For instance VAR0017 to VAR0023 formed a distinct grouping isolated as factor 2 whereas VAR006 to VAR009 and VAR0039 to VAR0040 also formed a distinct grouping isolated as factor 3.

Conclusion and recommendations

Need for all players in the industry to be members of the Kenya Flower Council to ensure that there is compliance with the silver code of practice which emphasizes on (Awuor, 2011): farm management responsibilities and documentation; general worker welfare; use of agrochemicals; protection of the natural environment and post harvest treatment. Kenya flower growers have been granted an international label that recognizes good environmental and social practices. Growers who have a Kenya Flower Council Silver Certification or higher can

now register with Fair Flowers Planters (FFP) that partners with more than 4,000 European flower vendors (Doughman, 2010);

The industry need to apply routine performance measurement and business efficiency techniques to water, energy and wastewater management as a measure to reduce negative environmental impacts; moving from old cooperate social responsibility (CSR) reporting to the new sustainability communications; engage into research with KARI for water stress tolerant flowers; increase hydroponics agriculture area and invest in rainwater harvesting and treatment systems and, install water recovery/ recycling plant;

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