

# The Floriculture Industry in Kenya: A Complex Adaptive Environment

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## Abstract

This is a concept paper based on literature review on complex adaptive systems and the research findings on the floriculture industry in Kenya. A wide range of issues on complex adaptive systems are discussed. These issues include: definition of complexity; the meaning of complex adaptive systems; characteristics of complex adaptive systems; the level of complexity of the floriculture industry in Kenya and managing complex adaptive systems. Preliminary research findings on the supply networks optimisation under complexity are also highlighted. It is apparent that there is a need for further developments in all these areas. As such, the issues provide a basis for a research agenda in complex adaptive systems.

**Key words:** Complex adaptive system, Complex adaptive environment.

## 1.0 Introduction

Complex adaptive systems as a field of study began in the mid-1980 at the Santa Fe Institute in Mexico. It is distinguished by extensive use of computer simulation as a research tool, and emphasis on systems, such as markets or ecologies, which are less integrated or “organised” than the ones studied by the older tradition ( e.g. organisms, machines and companies) ( Chan, 2001).

The paper aims to outline the key issues in complex adaptive systems. Based on a review of current literature in the field a series of issues are identified. The aim is not to address the issues here. The hope is that in identifying the issues and the extent to which they have (or have not) been identified a research agenda for complex adaptive systems in the floriculture industry in Kenya might emerge. The issues are discussed under the following headings: i) definition of complexity; ii) the meaning of complex adaptive systems; iii) characteristics of complex adaptive systems; iv) the level of complexity of the floriculture industry and; v) managing complex adaptive systems.

Floricultural exports are Kenya’s biggest export earning, surpassing tourism as of the year 2008. The value of the exports rose from Ksh. 1 billion in 1990 to a record over Ksh. 43 billion in 2008. Annual growth in the sector has averaged over 10% for the past five years and is projected to continue. Hence, the economic stability of the country is dependent on the continued success of the industry (HCDA, 2008). Floriculture in particular is estimated to employ over 100,000 people directly, while indirect employees in transport, packaging, inputs etc are approximately 1.2 million people who derive a livelihood from the export industry. The fact that these employments are in the rural areas is very important, as it not only stems rural urban migration but also contributes to poverty alleviation, a major focus of the government (Kenya Economic Survey, 2009).

## 2.0 The meaning of complex adaptive systems

Concepts that deal with complex adaptive systems (CAS), hence facilitating operation in a complex adaptive environment (CAE) have many names: chaos theory (Tetenbaum, 1998), complexity theory (Smith, 2005), complex science (Kelly and Allison, 1999; Stacey, 2003) and systems thinking (Senge, 1990). Complexity results from the inter-relationships, inter-action and interconnectivity of elements within a system and between a system and its environment (Chan, 2001). The meaning of complexity is traced to the word *plexus* meaning braided or entwined, from which is derived *complexus*, meaning braided together (Gell-Mann, 1996). Hence, the word complex is derived from latin. Complex adaptive systems (CAS) on the other hand results in a complex adaptive environments.

Complex adaptive systems are dynamic systems able to adapt in and evolve with a changing environment. It is important to realise that there is no separation between a system and its environment in the idea that a system always adapts to a changing environment. Rather, the concept to be examined is that of a system closely linked with all other related systems making up an ecosystem. Within such a context, change needs to be seen in terms of co-evolution with all other related systems, rather than as adaptation to a separate and distinct environment (Chan, 2001). In reality change, especially large scale changes, defies logical rules and simple management

actions (Stacey, 2003). Complex theory and a view of organisations as “complex adaptive systems”, attempts to consider some of those realities and arguably provides a better model for change when considering the floriculture industry in Kenya.

### 2.1 Characteristics of complex adaptive systems

According to Gisogon (2006), a system is considered to be complex when: i) Causality is complex and networked – i.e. simple cause –effect relationships does not apply. There are many contributing causes and influences to any one outcome; ii) The number of plausible options is vast – it is not possible to optimise (in the sense of finding the one best solution in a reasonable amount of time; iii) Systems behavior is coherent – there are recurring patterns and trends, but; iv) The system is not fixed – the patterns and trends vary, for example, the “rules” seem to keep changing. Something that “worked” yesterday may not do so tomorrow and; v) Predictability is reduced – for a given action option it is not possible to accurately predict all its consequences, or for a desired set of outcomes it is not possible to determine precisely which actions will produce it.

According to Stacey (1996): “Most textbooks focus heavily on techniques and procedures for long-term planning, on the needs for visions and missions, on the importance and the means of securing strongly shared values, on the equation of success with consensus, consistency, uniformity and order. However, in complex environments the real management task is that of coping with and even using unpredictability, clashing and counter-cultures, disensus, contention, conflict and inconsistency. In short the tasks that justifies the existence of all managers has to do with instability, irregularity, difference and disorder”.

The following propositions by Stacey (1996) as a basis for complex theory and applicable to the floriculture industry in Kenya also needs to be considered: i) All organisations are webs of non-linear feedback loops connected to other people and organisations by webs of non-linear feedback loops, ii) Such non-linear systems are capable of operating in states of stable and unstable equilibrium, or in the borders between these states, that is far from equilibrium, in bounded instability at the edges of chaos, .iii) All organisations are paradoxes. They are pulled towards stability by forces of integration, maintenance controls, human desires for security and certainty and adaptation to the environment on the one hand. They are also pulled towards the opposite extreme of unstable equilibrium by the forces of division and decentralisation, human desires for excitement and innovation and isolation from the environment, iv) If the organisation gives in to the pull of stability and it fails because it becomes ossified and cannot change easily. If it gives in to the pull of instability it disintegrates. Success lies in sustaining an organisation at the border between stability and instability. This is a state of chaos and difficult to maintain dissipative structures.

It is further affirmed by Stacey ( 1996) that: i) the dynamics of the successful organization are therefore those of irregular cycles and discontinuous trends, falling within the quantitative patterns, fuzzy but recognisable categories taking the form of archetypes and templates; ii) because of its own internal dynamic, a successful organisation faces completely unknowable specific futures, iii) agents within the system cannot be in control of its long-term future, nor can they install specific frameworks to make it successful nor can they apply step-by-step analytical reasoning or planning or ideological controls to long term development. Agents within the system can only do these things in relation to the short term; iv) Long term development is a spontaneous self-organising process from which new strategic directions may emerge. Spontaneous self organization is political interaction and learning groups. Managers have to pursue reasoning by analogy; v) in this way managers create and discover the environments and the long-term futures of the organisation.

The general approach to complex adaptive environments can be visualised using the Stacey agreement vs. certainty matrix (Stacey, 2003):

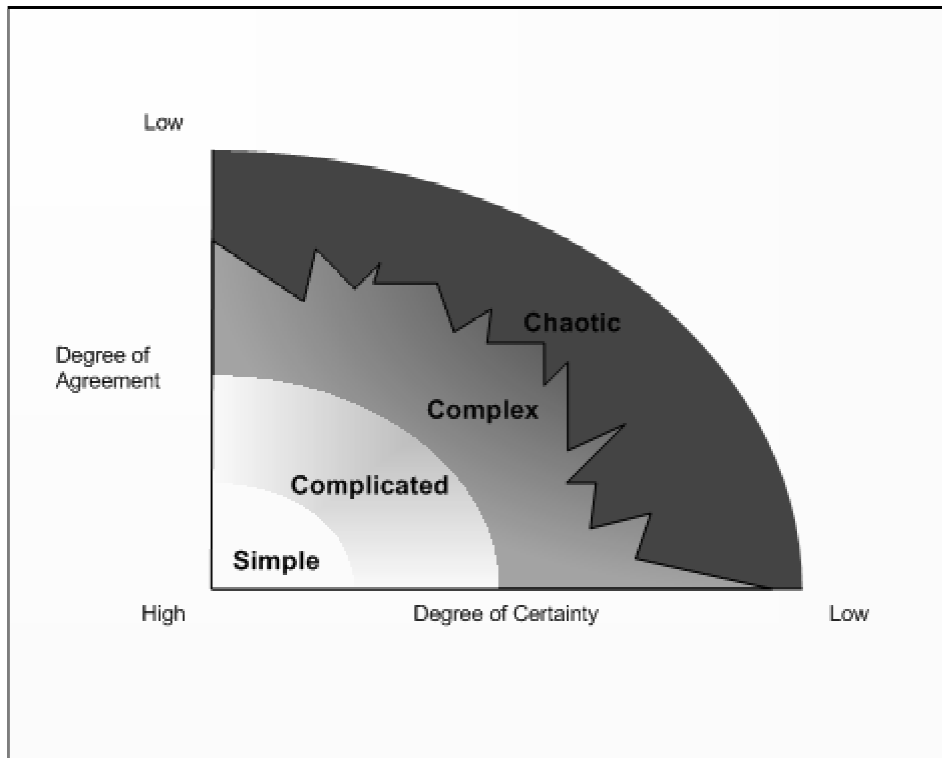


Fig 1.1: Stacey's agreement vs. certainty matrix

Adapted from: (Stacey, 2003)

It is emphasised by Stacey that traditional decision making applies in the rational area of the matrix at the bottom left. The chaos area is the area to be avoided – the area of guess work and randomness. However, much decision-making takes place in the area of complexity where there are many alternatives with differing degrees of predictability ( and little certainty). Operation in this area requires a high level of interaction amongst organisational agents – those involved in implementing change. Change in this case cannot be driven but must be fostered and supported (Stacey, 2003).

When analysed, CAS are not predictable in detail, because of their interdependencies and non-linearity. However, it is still possible to find inherent order in the complex systems (Palmberg, 2009). It has been asserted that: “The art of systems thinking lies in seeing through complexity to the underlying structures generating change” (Senge, 1990:290).

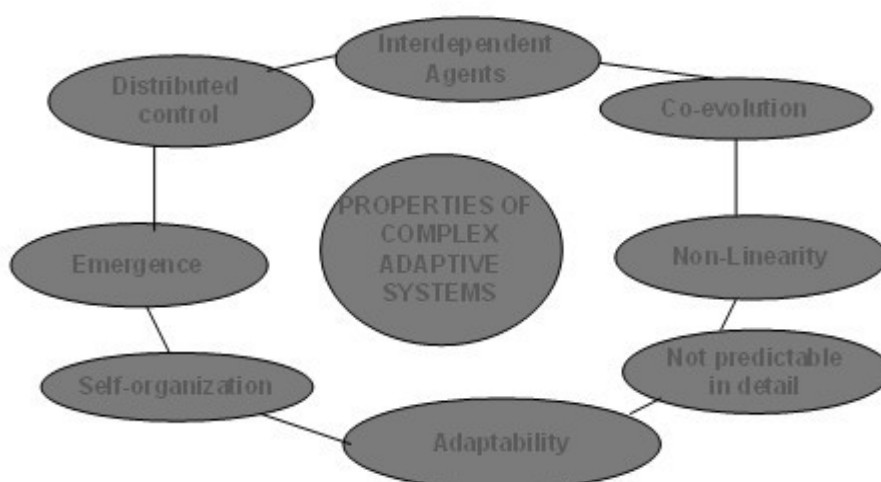


Fig. 1.2: An overview of the properties of CAS

Adapted form: (Palmberg, 2009:485)

Complex adaptive systems are seen as adaptable, which means that they have the ability to learn from their own

experience and adapt to new, unexpected conditions (Zimmerman *et al.* 1998). Further, Richardson (2008) defines the autonomy of each agent as the local memory of the agent and the ability to learn from his or her experience and to generate new response.

### 2.2 The level of complexity of the floriculture industry in Kenya.

The floriculture industry in Kenya is composed of active 412 flower exporters (HCDA, 2009). The analysis this data revealed that there are only five international players in this industry (Awuor, 2012). The vast majority are local firms which are mainly small scale and most operating as free agents, see table 1.1 below.

Table 1.1: Stratification of the Floriculture Industry in Kenya.

	INTERNATIONAL	NATIONAL	FREE	TOTAL
<b>LARGE</b>	05	42	07	54
<b>SME</b>			358	358
<b>TOTAL</b>				<b>412</b>

(Source: HCDA, 2009)

Some of the players in the industry especially the international firms operate in a well embedded supply chains whereas the small scale firms and the free agents are unimpeded. Hence, the complex adaptive systems characteristic of non –linearity and uncertainty. Pellissier (2009) assets that: “in a complex project there is non-linearity of outcomes. For example, even small differences between stakeholders or changes during execution, can lead to differing solutions and outcomes. Non-linearity occurs when these changes cannot be predicted at the design (call them ‘unknown unknowns’).

The specific challenges exhibited by the floriculture industry which further compound its complexity dimension are as outlined below ( Awuor, 2012): i) extremely short shelf life; ii)very specific demand cycles with extreme peaks; iii) changes in consumer trends; iv) mixing characteristics of service and product dimensions; v) operating part of ‘first world’ supply network in developing country; vi) a composition of large, small, international, local, embedded, unimpeded and free agents operating in the industry; vii) simultaneous optimisation of supply networks, both vertically and horizontally in an effort to realise country specific benefits (financial, environmental and social).

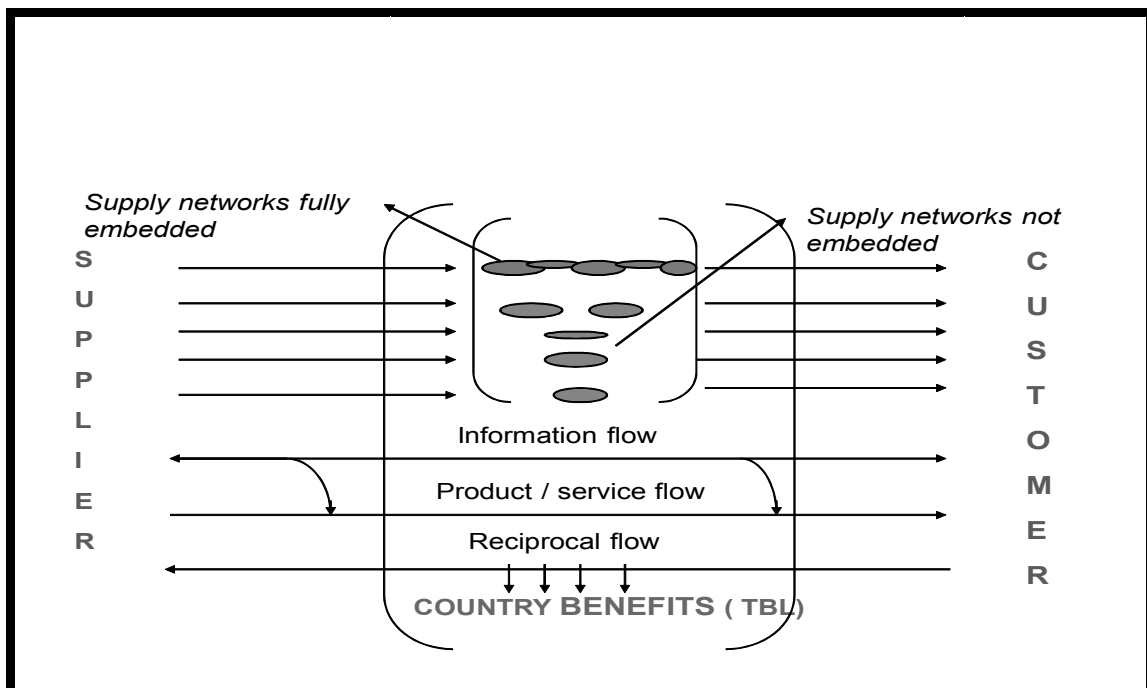


Fig.

1.3: supply networks in the floriculture industry in Kenya.

Source: (Awuor, 2012)

Figure 1.3 is a diagrammatic representation of the supply networks in the floriculture industry, constituted of both fully embedded and non–embedded supply networks. It also constitutes the supply networks of first world economies operational in a developing economy. This further compound the complex nature of the floriculture industry in Kenya.

The industry uses many chemicals – fertilizers, insecticides, fungicides, nematocides etc. Some of these

chemicals have potential for 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 scanty (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. 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.

Hence, some questions of concern in the floriculture industry in Kenya are: a) who benefits from the industry? Is the industry fighting poverty among the Kenya poor?; b) What are the long term effect on the environment?; c) What are the long term effects of the industry on reproductive health, cancer related diseases, child health?; d) Where do the elderly workers go, and what health effects may manifest later; and e) what are the impacts of urbanisation with poor planning which is a social problem. This further emphasises the complexity of the industry and the need to deal with it as a complex adaptive environment.

### 2.3 Managing complex adaptive systems.

A number of authors strongly agree that CAS cannot be controlled (Cillers, 2000). However, according to Tapscott and Williams (2006), even though a CAS cannot be controlled, as is assumed in the approach of the traditional management of hierarchical organisations, a CAS can be managed. It is asserted by Deming (1994) that: “A system must be managed, and that it is the job of the management to direct the efforts of all the components towards the goals of the system”.

According to Palmberg (2009) the one idea that has inspired organisations is the capacity to hold a shared picture of the future we seek to create – visioning. Another suggested approach is to use attractors (Gharajedaghi, 2007). According to Sandberg and Targama (2007), there is no such a thing as resistance – there is only attraction. To change something, all one has to do is create stronger attractors than the ones in place. The basic idea is to leave behind the principle of managing through detailed instructions, which decreases the freedom of individual agents, and, instead, to lead by making people embrace visions, creating attractors and stimulating individual agents and organisations to use their inherent abilities.

Though simplicity is advocated for by Palmberg in managing CAS, it does not mean that everything should be simplified indeed just the opposite is required. Traditionally, in industrial era, stability was a success factor among organisations. Today, with the pressure to remain innovative and flexible, managers instead need to create an environment of tension and instability. However, challenge is to keep the tension level where it generates dynamic imagination without exceeding people’s ability to handle the stress generated (Tetenbaum, 1998). One approach to creating tension is to ensure that the organisation is diverse (Zimmerman *et al.* 1998).

The vision of the agriculture sector in Kenya is to be “innovative, commercially- oriented use modern farming methods (Ngige, 2010). Hence, the floriculture industry needs to be styled up to this. According to Muia (2010), the achievement of this vision will require:

- i) Reforming institutions by transforming key organisations 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. Which may have been informed by climatic conditions and logistics considerations. 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).

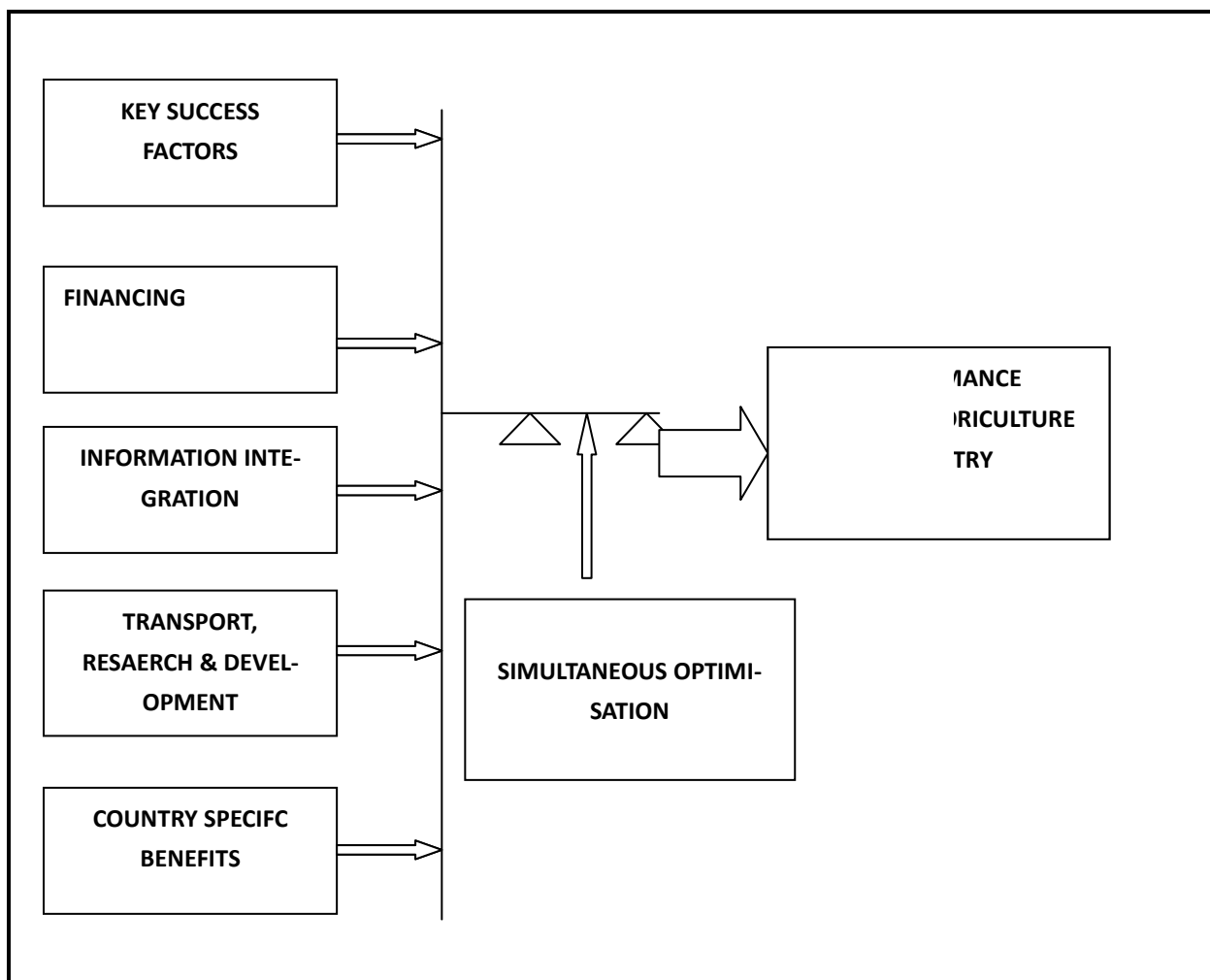
Since the launch of the vision 2030 in June 2008 (GOK, 2008), the focus is on implementation of its first 5-year phase that is guided by the medium term plan (MTP) covering the period 2008 to 2012. Implementation of Kenya Vision 2030 relies heavily on the direct and indirect involvement of the private sector, the business community as well as civil society organisations. One of the flagship projects identified in the MTP 2008 to 2012 was fertiliser 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 fertiliser prices.

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 is 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 critical to look at the range of products that are offered in the Kenya Floriculture industry. The floriculture industry need to devote time to increase its product depth and width. The following questions are further posed:

- 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?
- 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 these issues. This involves employing the triple helix concept which brings together government, private sector and researchers. The complexity of the floriculture industry is revealed by Awuor ( 2012) in a study that found the following factors to be important for the performance of the industry: i) financing; ii) key success factor; iii) country specific benefits; and iv) transport, research and development as positively influencing the performance of the floriculture industry in Kenya. The conceptual model is as illustrated in figure 1.4.



*Fig 1.4: Conceptual model for managing the floriculture industry in Kenya*  
 Source: (Awuor, 2012)

In his study, Awuor (2012) concludes that for simultaneous optimisation of the floriculture industry and given its existence in a complex adaptive environment then it is vital that emphasis is put on four main factors: factor 1 – key success factors; factor 2 – financing; factor 3- information integration; factor 4- transport, research and development and; factor 5 – country specific benefits.

### 3.0 Conclusion: A research agenda?

The discussion above identifies a set of issues that need to be seriously investigated in trying to understand and subsequently improve the performance of the floriculture industry in Kenya. The issues include; i) developing consensus over the definition of a complex adaptive system and a complex adaptive environment with regard to



the floriculture industry in Kenya; ii) identifying the characteristics of a complex adaptive system with regard to the floriculture industry in Kenya; iii) determining the level of complexity of the floriculture industry in Kenya; iv) establishing methods of managing complex adaptive systems with reference to the floriculture industry.

A befitting conclusive remark for this article from Grisogono (2006) asserts that: clearly there is still much work to be done to operationalise our growing understanding of CAS and to increase our ability to effectively exploit it. There are also some difficult implementation issues arising from traditional ways of thinking and doing things, and from the inherent nature of human cognition and the history and structure of our organisations. However the overall take-away lesson from this discussion should be an optimistic one, if we make proper use of adaptability we do not need to know all the answers, we do not need to make better plans, or get everything right the first time. We just need, as nature has ever done to start with a straw man and know how to grow it to a better one.

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