

MANAGEMENT AND PERFORMANCE OF CARROTS VALUE CHAINS IN KENYA'S CURRENT DOMESTIC AND REGIONAL MARKETS IN UGANDA AND TANZANIA

MARY MOKAMI CHACHA

Global Food and Agricultural business, The University of Adelaide.

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ABSTRACT

Aim: The aim of this studies is to analyses and understand the carrot value chain actors and their characteristics while participating in production, distribution, marketing, and sales of carrots. This mapping will help the reader to understand how carrot value chain is performing in terms of productivity, employability and responsiveness on profit, cost structures, food safety and information flows across the value chain.

Scope: The studies was conducted in Kenya focusing on the major counties producing carrots by following carrot value pathways from production to consumption across East Africa community markets.

Study design: The study used secondary data and various statistic from past and current studies conducted by different referenced researchers and writers from Kenya, and other researchers in the world on carrot value chains in Kenya. Various information was reviewed and used in this study to identify actors location in the specified counties in Kenya across the value chain, then M4P tool book and value link guideline was used to map the physical process in the value chain while characterizing the actors and activities in each process, The study also used the recent data to show linkages and coordination of carrot value chain actor and the direction of product and information flow across the value chain, this was followed by gross margin analysis while considering carrot productivity and efficiencies in each process. Excel techniques used to plot and analyze the data.

This study also reviewed the role of enabling business environment and the current stakeholder supporting the carrot value chain for up scaling and sustainability, this was done through swot analysis to show the level of influence and interest. Environmental impact assessment was also reviewed and possible externalities identified. Key findings on carrot value chain were highlighted and recommendation suggested on areas for improvement, then conclusion was drawn on carrot value chain performance level.

Limitation: There is limited literature on carrot value chain in Kenya and even where it exists it is always bundled with other vegetable like turnips. Potatoes and peas, time allocated for this study was short and limiting as well.

1.0 INTRODUCTION

In Kenya Agriculture sector accounts for 65% of the total export earnings and it also provide income, employment and food security needs to more than 80% of Kenya populations, hence contributing in rural economy development, in addition the sector has led to improved nutrition through production of nutrient diverse food (FAO, 2019). Horticulture sector contribute 33% to total Agriculture GDP, in 2015 horticulture contributed 1.44% to total country GDP. Horticulture sector is the second foreign exchange earner for the country after tourism generating approximately KES 90 billion in 2015. Horticulture sector in Kenya comprise of flower, fruit, vegetable nut, medicinal and aromatic subsector, vegetable production is the leading subsector accounting for 44.6% of the total horticulture production. Small scale contributes about 50-60% of the total production, where as 95% of horticultural production is sold to the domestic market and 5% to the export market, With European Union (EU) being the major destination accounting for over 80% of total exports (Agriculture and Food Authority, 2017)

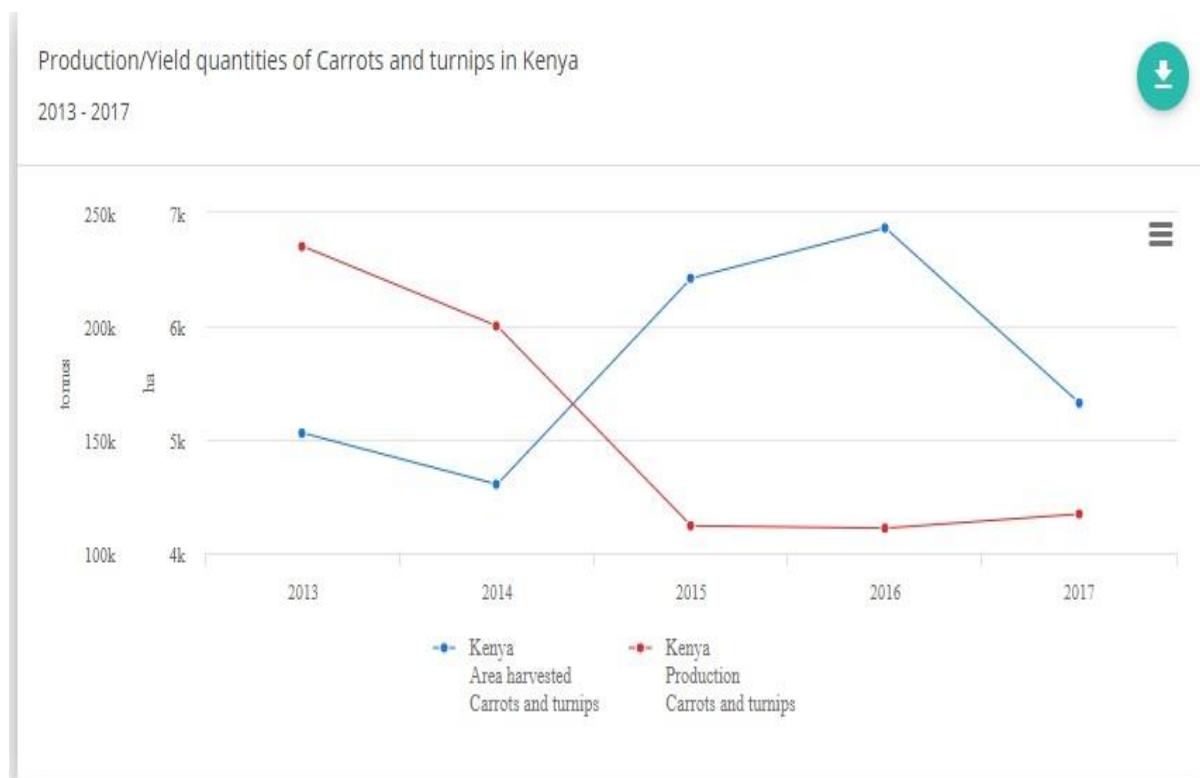
Carrot production in Kenya is done by small scale farmer, and it's among the top ten vegetable grown and consumed in Kenya and also exported to regional market in Uganda and Tanzania. (Magubira, 2018) Carrot is biennial crop with a thick fleshy conical taproot of 5cm to 50cm range. And the root is the in primary product in carrot value chain Carrot roots are usually orange, but there are also white, black, yellow, red and purple varieties (Tran, 2016.) However, the writers state that, there is huge diversification in carrot shapes and sizes, carrot are usually consumed fresh, pre- packed, boiled, canned, frozen, diced and sliced. However, fresh carrot are commonly sold.

Market analysis of carrot in Kenya.

Over the year's carrots demand has been increasing in Kenya and in the recent past, huge carrot demand emerged from Uganda and Tanzania market with willingness to pay up to Ksh 40/ kg, the current information on carrot health benefit and national value has created such demand in both Kenya, Uganda and Tanzania (Omondi, 2014). This has led to increase in carrots production, and being an early maturity crop with low costs in field management, carrot has become a crop of choice for many small-scale farmers in Kenya.

Carrot is mainly grown in Kiambu, Nyandarua and Nakuru counties whereby area under carrot production increased by 10% from 6,106ha in 2016 to 6,744ha in 2017, production volume increased by 3.3% from 93,860tons to 96,968tons, as result carrot value increased by 20% from Ksh1.468bilion to Ksh1.763billion (AFA -Horticulture crops directorate 2017). The report also show that carrot produced a total value of 2.34% among the vegetable produced in Kenya

Figure 1



Sources: (faostat 2019)

County	Year 2016			Year 2017			% of Total Value
	Area (Ha)	Volume (MT)	Value(KES)	Area (Ha)	Volume (MT)	Value ((KES)	
Nyandarua	1,655	31,487	324,324,000	1,921	35,745	470,928,000	26.71
Meru	1,180	13,363	246,301,395	1,221	10,195	301,441,395	17.10
Kiambu	832	18,954	329,172,860	871	12,300	287,166,000	16.29
Nyeri	530	5,578	92,346,000	438	12,969	255,527,348	14.49
Nakuru	1,111	13,007	159,465,000	1,207	13,980	188,757,000	10.71
Narok	120	1,896	52,720,000	286	1,976	44,650,000	2.53
Baringo	43	290	10,900,000	86	597	26,480,000	1.50
Kisii	50	722	18,140,000	72	849	22,697,896	1.29
Trans Nzoia	74	602	18,700,000	61	631	19,200,000	1.09
Bomet	49	544	40,560,000	68	900	18,750,000	1.06
Bungoma	70	2,112	63,150,000	54	1,185	13,105,000	0.74

Table 1. Showing the performance of carrot in the year 2016/ 2017 for the selected counties Source: (AFA- Horticulture crops directorate 2016- 2017 validate report.)

1.) **Carrot value chain mapping.** Carrot value chain cover a wide a scope of flow, this is because it is produced in specified counties in Kenya but trading and consumption happens at both national and regional markets located in Kenya, Uganda and Tanzania. (Agundo, 2014)

Actors	Mau Narok Nakuru county	Nairobi	Nyandarua	Limuru & Kiambu	Mombasa Kongow eamarket	Busi a/ Ugan da border	Naman ga Tanzani a border
Producers	x		x	x			
Traders	x	x	x	x	x	x	x
Brokers	x	x	x	x	x	x	x
Wholesaler		x			x	x	x
Processors		x			x		
Retailers	x	x	x	x	x	x	x
Consumers		x			x		

Table 2. Showing, location mapping of actors in the selected regions of the product flow. (Source: own formulation) using data from Agriculture and food authority2017)

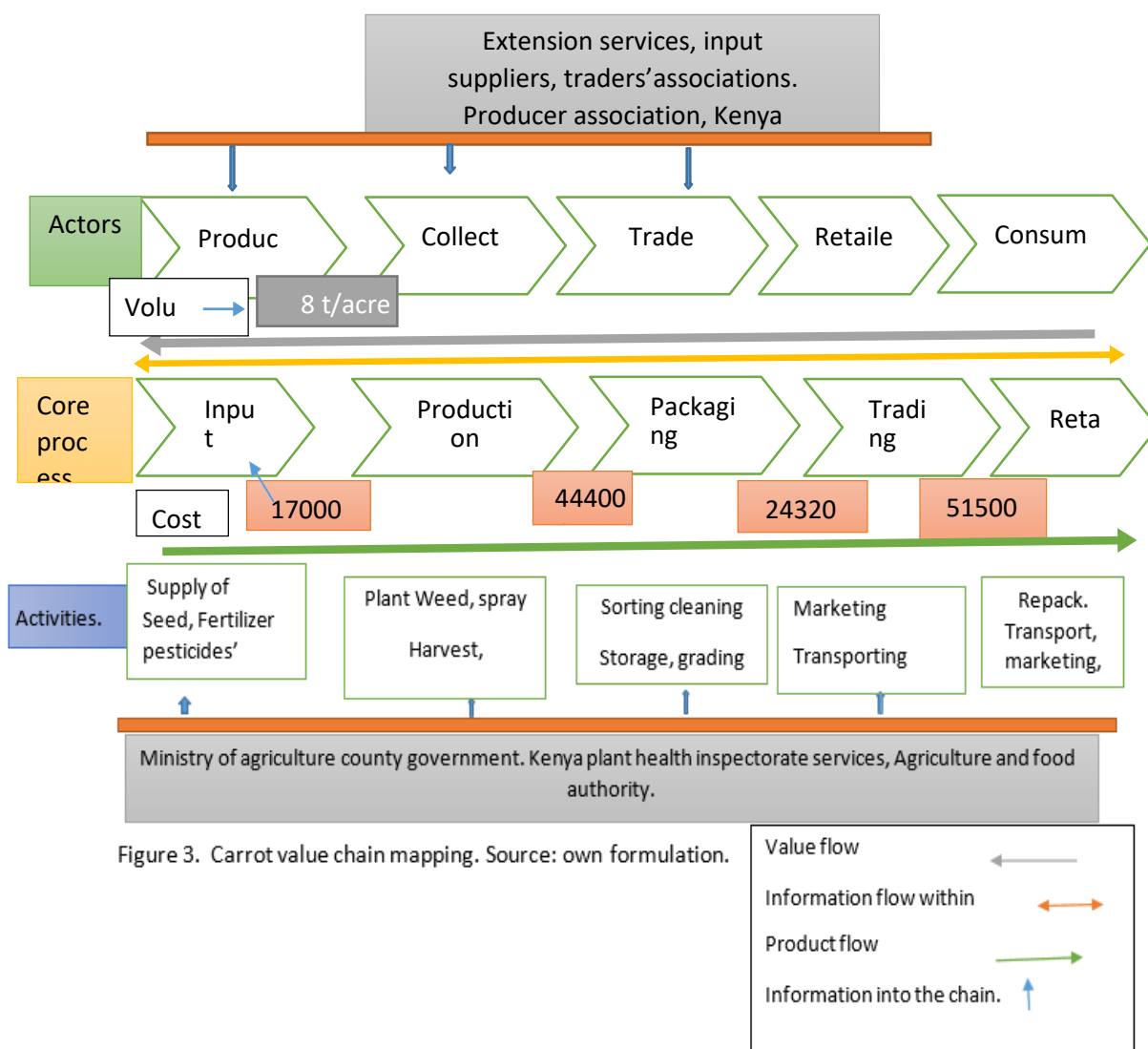


Figure 3. Carrot value chain mapping. Source: own formulation.

2. Describing the value chain mapping. Input provision.

Registered carrot seed companies in Kenya.

- Kenya seed (simlaw seed)
- Kenya highlands
- Royal seed and
- Monsanto seed company,
- seedco.
- Syngenta
- Amiran Kenya and East Africa seedcompany.

Regions in Kenya	Carrot Seeds Stokists
Nakuru	Farmers World
Nyahururu	Kappepharm
Nyahururu	Green Acres Centre
Naivasha	Naivasha Farmers
Naivasha	Ziochem
Kinungi	Mash Agrovot
Kimende	Kamau Stores
Kimende	Jamaa Wholesalers
Githunguri	Mboga Centre
Kinangop	Isamark G. Hardwares
Mau Narok	Mauche Farmers
Ol Kalou	Bekin Hardware
Gatundu	Ngatho Agrovot
Limuru	Limuru Farmers

Table 3. List of carrot inputs supplier and agents located in different regions in Kenya. Source. (Similaw seeds 2019).

Production process. Carrot require cool climate of temperatures ranging from 15 to 20 degrees (Farmtrends,2018). Carrot production in Kenya is all year round and this process involve several activities starting from land preparation, which involves making fine soil because the carrot seeds are tiny and struggle to germinating in lumpy soils, some farmer raise beds and make half- inch deep furrows to contain the seeds, while other farmers choose to plant do broadcasting. According to the article, seed rate is about 6-7 kg per hectare or 2.5kg per acre on a 30 cm spacing of row to row, after germination thinning is done 2-4 weeks after planting, followed by weeding. Another activity in carrot production is pest and diseases management because carrot crop is susceptible to aphids, nematodes and cutworms, common fungal diseases are powdery mildew and leaf blight hence require chemical spraying, carrot mature 2-3 months after planting but depending on the variety. Harvesting done by manual pulling the crop from the soil by hand or using a spade this require huge labor. The main actors in this process are individual farmers and farmer groups or saccos, however the study found that there are number of individual large-scale carrot farmers who are producing carrot for export market like Uganda, Tanzania middle east and Europe. For Europe market the most preferred product is the baby carrot.

Collection process start from harvesting, this is because farmers start harvesting process when there are buyers who are ready to harvest and collect the produce on the same day this is due to lack of storage facilities hence farmers transfers harvesting activity to collectors or transporters who own trucks and are able to transport the produce from the farms to the cleaning

facilities. In this process the core activities include, harvesting, collecting and transportation, most transporter are the potential buyers or agents from potential buyers.

Packaging process, (Mambili, 2019) in this process the main actors are traders who hire cleaners, graders, and packers in the cleaning facilities, and the main activities in this process is cleaning and sorting, grading carrot then packaging in required specification (onset of value addition) ready for the market, after Packaging carrot are loaded into trucks for market delivery.

According to recent studies by (Agundo, 2014) a favorable packaging policy in Uganda is enticing Kenyan carrot farmers who have long been buffeted by intermediaries/ brokers who uses extended bags of more than 180kg which is against the law of packaging in Kenya. The writer further state that there is huge price difference , whereby a bag of 120kgs is sold at kSh4,000 in Uganda while an extended bag of 180kg is kSh1800 in Kenya.

Trading process. In this process trader, wholesaler and retailers are the main actors who are majorly involved in collection and transportation of carrot to the respective markets and consumers across Kenya, Uganda and Tanzania markets, traders combine other vegetable during transportation, selling and retailing process. (USAID, 2013), the main market of Kenyan carrot is wakulima market in Nairobi in Kenya, this market operates from 4.00am to 1.00pm. carrot produce is transported at night from the farms then offloading is done at the designated parking area in the market, then after that the produce is carried by porters to wholesaler. There are more than 3000 wholesalers in wakulima market (Koenig 2018), The study also states that in many occasion carrots is sold to retailers before offloading, the main retailer markets are located in the suburbs this include Gikomba, Kangemi and Kibera, Thika and for some instance the produce delivered to retailers at Machakos. The second market is Kongowea wholesale market in Mombasa and other regional market are Kilombero wholesale market in Arusha - Tanzania, Owino and Nakasero market in Kampala Uganda. (USAID,2013). Traders sell carrot for different prices depending on the market whereby 138-kilogram bag of carrots retail price was highest in Kitale, at a market price of 7,000 Kenya shillings and lowest in Nakuru at 2,000 Kenya shillings. (Shawiza, 2017)

Consumption. Consumer of carrot are located in various market of the product flow, main consumption is at fresh market, the demand for carrot depend on the taste and preference of consumer in terms of freshness and price. According to (FAOSTAT 2019) willingness to pay for carrot across East Africa is 40/kg, this data is comparing the demand of carrot and change in price from 2002 to 2013. However, the demand is based in consumer segmentation process depending on the variety and consumer group locations for example fresh market group, juice market, supermarket, hotels vegetable and salad parlor, (Manyara, 2019) huge amount of carrot consumed in Uganda is imported from Kenya.

Product flow –According to Kavoi Mutuku Muendo, David Tschirley, and Michael T. Weber (2004) the carrot value chain follow the regional and international marketing channel of other horticultural process in Kenya this is because carrot actors deal with other horticultural crop like potatoes, onion and peas which follow the same channel.

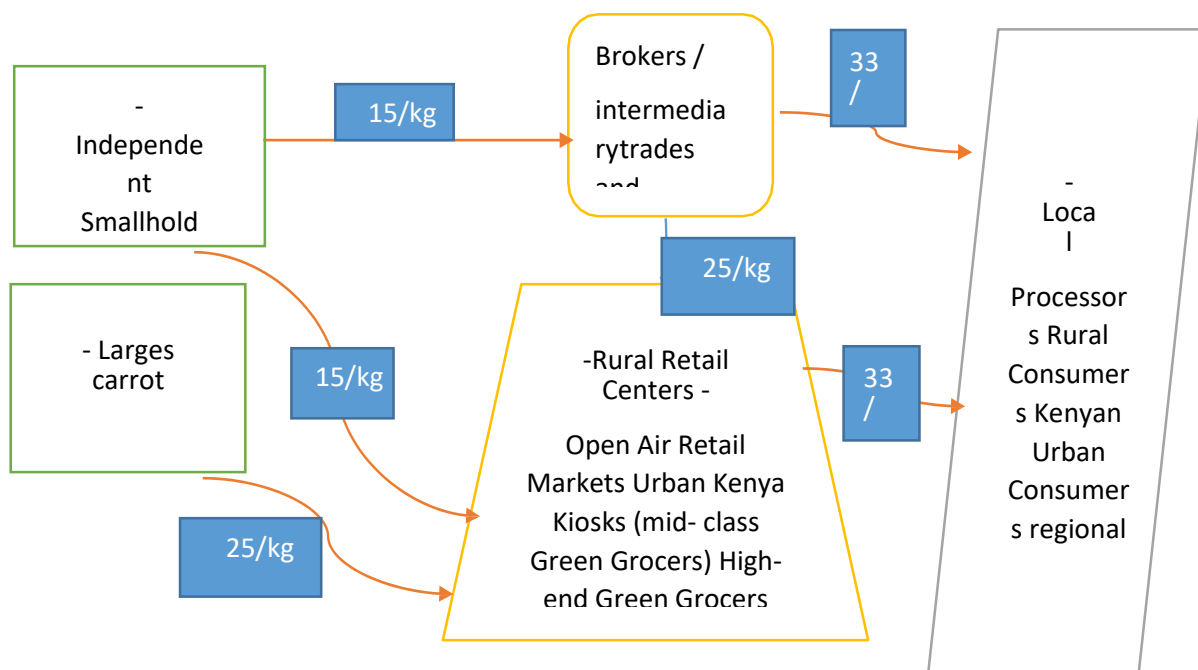


Figure 3. Showing carrot flow from production to consumption and the price at each stage.

Information flow in carrot value chain. Current information in the value chain goes in both directions, whereby, carrot traders in wakulima market get information from consumers on product specification, price fluctuations and available demand, then this information is passed to producer. On the other hand, carrot producer, for example carrot farmers in Mau Narok send information on quantity of carrot available in the farms to trader who in turn inform the wholesaler and the retailers on the amount available so that they can place orders and pay in advance. All this communication is done through telephone conversation. (FarmLink 2017) Extension services information come from County government -ministry of agriculture to the different stages in carrot value chain, in this case farmers are the targeted group who get technical advice from sub county agriculture extension on carrot production, pest and disease management, post-harvest handling and value addition. (Nakuru County, Ministry of agriculture 2016). This information also come from the input suppliers and non-governmental organizations through carrot demonstrations farms which are organized during field days and agricultural shows (Kenya seed, 2018). In addition Kenya Crops act 2013) contain information on Policies and legal regulation on the carrot value chain in Kenya (crops Act 2013)

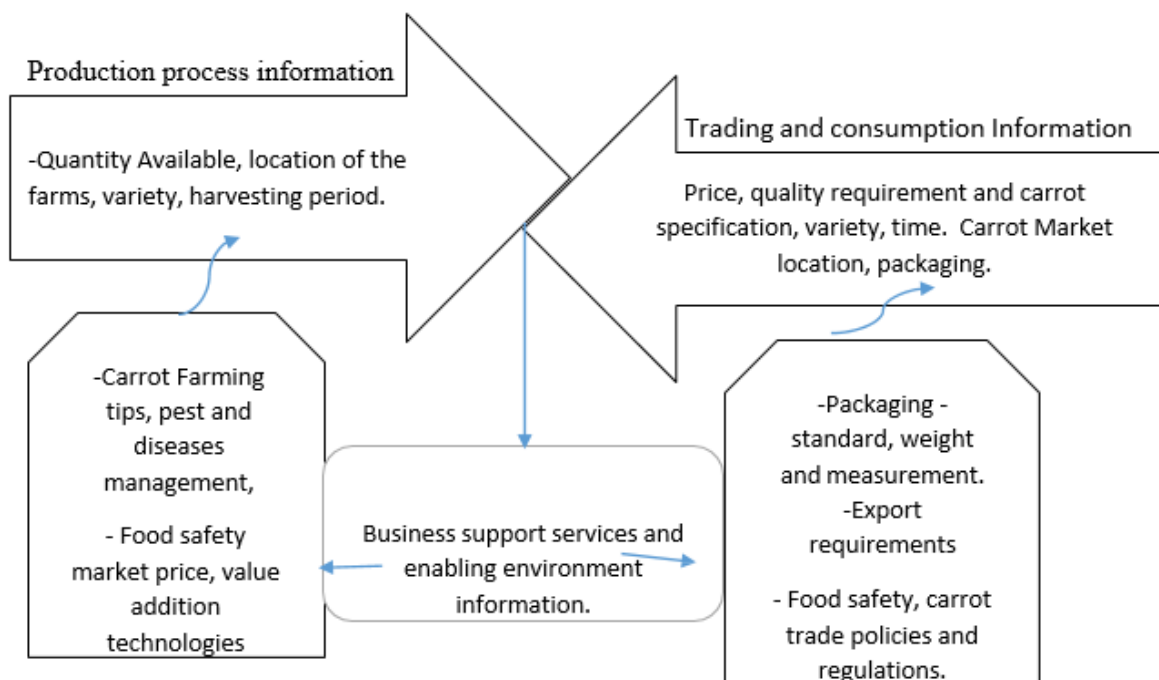


Figure 4. Showing the type of information, direction flow and feedback mechanism within the value chain

3. Value chain productivity, drivers and performance.

Production cost structure Gross margin analysis show that total cost of producing carrots per acre is 44,400/= and total volume produce per acre is 8 tones that is, if farmer follow proper planting plan (Mutongi, 2014).

Production	ACTIVITIES.		
	LAND PREPARATION	Quantity	Cost in ksh
	.		
	Ploughing		3000/=
	Harrowing		1800/=
	Furrow making		1200/=
	PLANTING.		
	requirements	quantity	amount
	D.A. P	100kgs	8000/=
	Seeds	2kgs	4400/=
	Labor		6000/=
	Total		18400/
	CHEMICALS:		
	requirements	quantity	amount
	Fungicides	1kg	1500/=
	Insecticides	1litre	1800/=
	Bio- stimulants	100ml	500/=

	Foliar	3kgs	2400/=
	Labor	2 per day	400/=
	Total		6600/=
	TOP DRESSING:		
	requirements	quantity	amount
	C.A. N	100kgs	6000/=
	N.P.K(17:17:17)	100kgs	7000/=
	Labor	2 per day	400/=
	Total		13400/
		44400/ =	
	volume / acre	8tons	
	Farm gate price / kg		Ksh 15/ kg
	total sales		120000
	Profit		75600

Table 4. Showing the cost of producing carrot per acre.

Source: (Mutongi, C 2014, ‘carrots’, blog post, M-farm,)

Collection and packaging cost structures.

Actors		
Transporters		
collectors		
packers		
Brokers A		
	Activities	cost / acre
	Harvesting	6320
	collection	6000
	Transportation	6000
	loading and offloading	6000
	Total cost	24320
	price / kg	20
	volume in ton/ acre	8
	Total sales	16000
	Profit	135,680

The cost of labor in collection process is equally the same as in production process and this apply in both counties the standard cost of labor ranges between Ksh 6000 and 7000 (Mutongi Nov 2014) According to (Abdi 2004) the cost of transporting 8 tons of carrot from 1 acre farm is Ksh 6320/= in Nyandarua County, the actors incur total cost of Ksh 24230/=, at the end of this process the price of carrot increase from Ksh 15/ kg to Ksh20/kg. Table 5. showing collection and packaging efficiencies

Trading and marketing cost structure.

Actors		Activites	Costs in KES
Traders		Marketing	1500
Brokers		Transportation	30000
Intermditary traders		Negotiation	6000
Wholesalers		Storages	4000
Processors		Taxes on road and borders	5000
		Export license	5000
		total cost	51500
		price /kg	35
		volume / T/ acre	8
		total sales	280,000
			228500

The main cost incurred in this trading is transportation to domestic market as far as to the regional market like Uganda and Tanzania, (Oyugi,2019), Previously trucks would charge about Sh30,000 to transport goods regardless of the volumes carried and the destinations. After the formation of traders’ associations, the traders who deal with small quantities of produce, now are able pay Sh250 per 90kg bag. Table

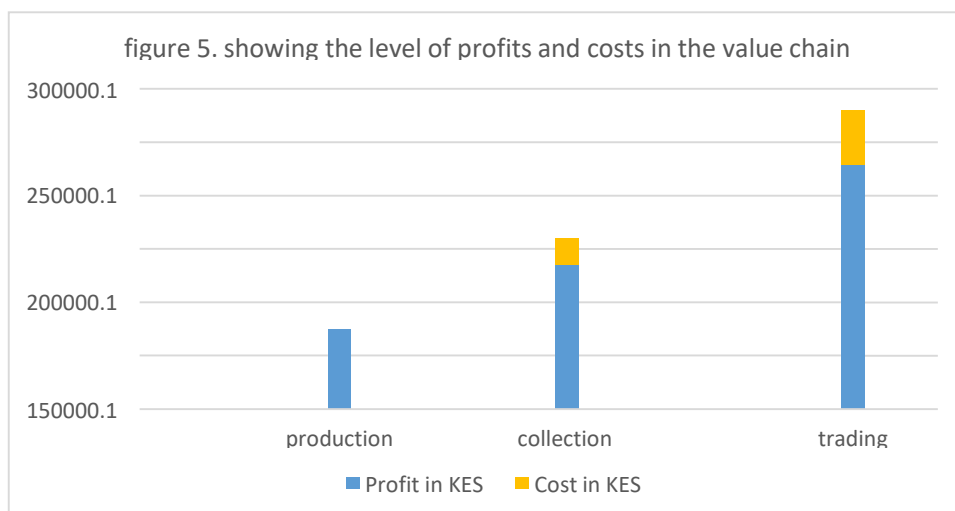
6. Showing trading and marketing efficiencies.

Incomes variability among Value Chain actors

Analysis of profit margin between actors in production collection and trading process,						
process	Actors	Profi t in KES	Marg in in KES	Cost in KES	Cost variab ility in KES	Drivers of the profit.
Production process.	Individual carrot Farmers					
	Carrot farmers Sacco					
	Carrot production firms					
	Profit	75,000		44 400		High cost of production and low prices
collection process	Transporters					
	Collectors					
	Brokers A					
	Profit	135680	60680	24320	20080	Low cost of production, high price
trading process,	Traders					
	wholesalers					

	processors					
	Brokers B					
	profit	228500	92820		51500	27180
						High cos of production, high prices.

Table.7. showing the analysis of cost structure and profit margin across the value chain . source: own formulation using excel)



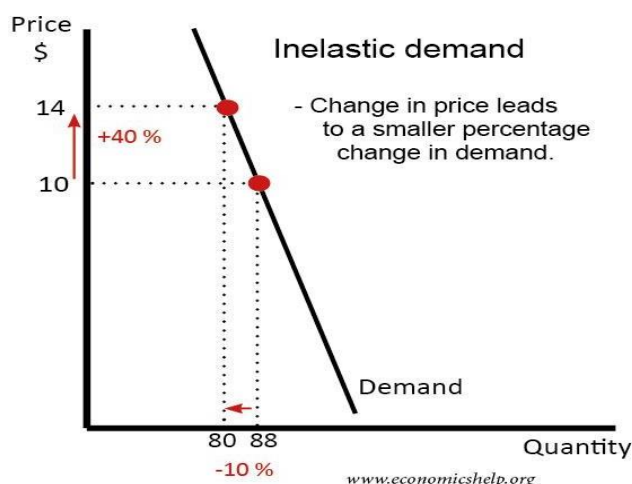
Responsiveness to customers demand and environmental changes.

Here we look at Carrot value chain flexibility to internal and external changes which are measured through customer satisfaction, volumes, information flow and response on time, to start with, carrot is a short-term crop which can be grown on interval plantings as per orders, also carrot mature within 3- 5months (Mutongi 2014) hence it is flexible to increase and decrease volumes produced. However, the value chain may not perform well in storage and transportation flexibility, because it is bulky and perishable, currently the value has no cold chain facilities to store and maintain carrot freshness for longer period of time. Also, consumer are have low willingness to buy at higher price. Figure 4. Show a Summary of the responsiveness and how is measured in the carrot value chain in Kenya.

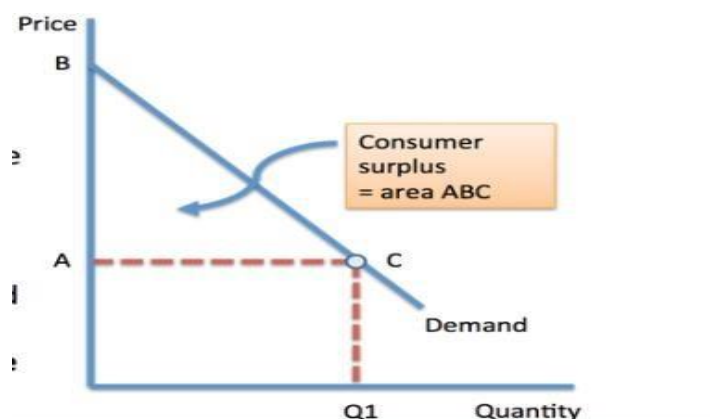
Consumer Requirements	Chain response
Quantity and orders	Continuous supply of carrots from farms.
Quality	Sorting, cleaning and grading before packaging
Packaging	Packaging in different sizes of weights foreach market e.g. Uganda and Mombasa
Lead-time	Carrots Orders to major markets are transported during night to be delivered inthe morning ready for sell.

Table 8. Value chain responsiveness and flexibility measurements.

Value chain performance on price, consumer and producer surplus. The price of carrot has been increasing due to high demand, however this change in price have little effect on demand, in this case, it shows inelastic demand, this is because carrot is classified in food basket of the value chains with few substitutes hence price does not affect demand, (FAOSTAT 2019). The price of carrot is 35/kg but the consumers are willingness to buy at higher price of 40/kg, especially in Uganda market. This has increased consumer surplus because of the value they put on the carrot is her than the market price. figure 6. Showing inelastic demand. For example, if the price of carrot increases from 10 to 14 then qty dd will decrease by 10% from 88-80.



Consumer surplus, this is measuring the economic welfare that consumer are gaining when purchasing and consuming carrots whereby, willingness to pay is at point B and the market price at point A , then the consumer surplus is the difference from the willingness to pay and the actual price paid, for example carrot in market price is Ksh35 but according to consumer willingness to pay is KSH 40 hence giving consumer surplus of ksh 5, shown by area ABC, that is the area below demand curve and the area above market price Figure 7. Showing consumer surplus. Source: (<https://www.tutor2u.net/economics/reference/consumer-surplus>)



Price discrimination and market power. large scale traders in the carrot value chain are often taking advantage of consumer surplus by benchmarking and setting prices based on the groups

of consumers in Uganda and Tanzania market who are willing and able to pay different prices for the same carrot products, these trader does this through price discrimination hence increasing their surplus as result there is higher revenues and profits to traders in the value chain. One of the main arguments against this move is seen in Mau Narok carrot value chain traders who want monopoly power to exploitation actors by creating barrier to Uganda market entry (Kibet, 2016).

Value chain performance on food safety

Kenya face food safety issues in most vegetables and fruits, it has been a challenge in most vegetable value chain for example French beans export to EU is linked to cases of interception and notifications. This situation is similar to carrot value chains in Kenya. (Okata, 2017), Agriculture and food expert has advised the carrot export farmer to improve their food safety standard if they wanted to retain their export market. The article further explains from the regulation’s authority perspective that, the country has many reference points for quality management but farmers and actor in most value chain are not adhering to, for example Mau Narok carrot value chain were being denied export license for exporting their carrot to Uganda and Tanzania in 2013, due to failure on food safety compliance (Agriculture and food Authority 2017).This noncompliance is due to poor packaging and post-harvest handling procedures which are posing risks to carrot contaminations and food poisoning, another factor is lack of coordination and information distortion which create threat between actors leading to failure on food safety compliance, (Okata, 2017) this study finds that, the value chain performance in food safety is very poor.

Employment characteristics, (Mambili ,2019) to carrot value chain has created job and business to women and youth in Mau narok at Njoro subcounty- Nakuru county. (USAID 2013) observed that, most traders in markets are youth, and over 70 %of those engaging in cross-border trade on formal and informal trade are under 30 years. Carrot sector thus provides employment opportunities that are open to youth. However, the writer state that the working condition are unbearable to women and no proper protective equipment are provided. Other counties like Kiambu and Nyandarua, carrot farming is done by family members, but in the second and third process of the value chain, they employee unskilled labors to clean and transport carrot to the market and other youth group are doing value addition, for example Mashmakh Youth Group in Limuru (youth fund 2016)

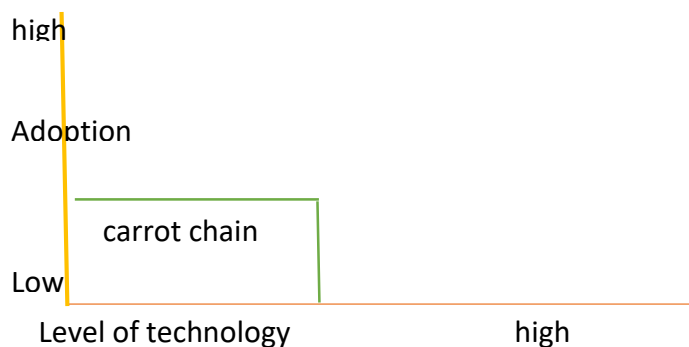
Actors	Gender	Process	Skills	Status	Ethnicity	period
Input and seed suppliers	Men	Input provision	High skilled	hired	mixed	Permanent
Farmers	Men and Women	Production process	Low skilled	family	mixed	permanent
Collectors	Men	Collection Process	unskilled	hired	mixed	Day labor
Cleaners	Women and Men	Packing process	unskilled	hired	mixed	Day labor
Packers	Men	Packing process	unskilled	hired	mixed	Day labor

Transporters	Men	Collectio n and trade process	Low skilled	hired	one	Day labor
Traders	Women and Men	Trade process	Low skilled	hired	one	permanent
Wholesalers	Women andmen	Trade process	Low skilled	own	mixed	permanent
Retailers.	Women and men	trade process	Low skilled	own	mixed	permanent

Table 9: Source: (own formulation.) using USAID 2013 Data.

Current Rate of technology adoption, knowledge and Upgrading of carrot value chain in Kenya. Despite the fact that, Kenya has a well-developed agricultural research system, the use of modern technologies in carrot value chain is still low, farmers who are the main actors in the production process of value chain use traditional method of production with low technology adoption , this is because most actors in this process are small scale farmer with low level of education and information on modern technology of carrot farming (Mwangi , 2018) .however there is ongoing research conducted by Delphy,(a Dutch organization that specializes on plant cultivation) on how to grow carrot in saline soil (Okinda 2018) ,

Other farmers from Kiambu are using Netting technology progressively to protect carrot from pest and diseases which in the end it has reduced cost of carrot production the net is Eco-friendly as well, (Icipe,2017). similarly, carrots farmers are constantly using M-FARM website to access carrot production and investment plan, and through M-Farm, farmers in the same areas can share their experiences and advice, pose questions to industry experts, and connect with each other to combine crops and find larger buyers through SMS. M-farm online platform was founded by Jamila Abass from Kenya, (foodtank,2018) another platform is Taimba, which connects farmers to retailers, However, carrot value addition technology through drying and processing carrot into carrot flour and carrot flakes has been increasing (youth fund Kenya 2016), and also the emerging industry of processing carrot into juice and flavors but done in small scale level at hotels and juice parlors or at household levels. Figure. showing Level of technology adoption in carrot value chain in Kenya.



Carrot Business support services. The main support services are carrot seed supplier agents located in various region where carrot is produced, this support mainly come inform of, provision of highbred carrot seed and online technical advice on carrot producing and marketing, for example farmer in Limuru Kiambu county get supported by Kenya high land seed company on how to farm carrots. (Simlaw seed 2016)

Another support in this value chain is the online bloggers with Various information on carrot , for example M- farm blog has developed carrot production forum for farmers to post the issues with carrot production and market price then the blog platform generate an automatic response on the specific issue,(M- farm 2014) In addition Kenya county governments where carrot is produced and traded has supported the value chain through extension services and marketing linkages in carrot value chain) for example ,Nakuru County government has plans to setting up a regional carrot export market to meet standards of East African Community's requirement,(Mburu,2017) Recently the carrot value chain received support when Kenya and Uganda traders agrees to share transportation cost by forming the association linking trader at the borders of Kenya and Uganda this led to decrease in transportation cost (Oyugi, 2019) Kenyan crops and research development is conducted by Kenya agricultural and research organization, in the case of carrot little has be done on carrot seed improvement and development because carrot seed are majorly imported, but ,more research is done by private organization especially on consumer nutritional value of carrot and this information is increasing carrot consumption and also carrot supply hence value to actors.

Carrot value chain Governance and regulations. Kenya has basic requirements on carrot for domestic and export market, this regulation are in line with the crop act procedures governing carrot value chain and vegetables in Kenya (Kenya crop act 2013) according to the act carrot is belong the crop schedule class of crop with no certified breeding program in Kenya, the act further state that, carrot crop is regulated on production, food safety, value addition, marketing and export aspects. There are bodies in Kenya which are mandated by the act to ensure that compliance by all the actor in the value chain.

Agriculture and food authority regulate carrot export and food safety system compliance on carrot through traceability and documentation procedures (AFA 2013). Secondly, Kenya plant health inspectorates service regulate carrot seed importation by ensuring that seed are certified as per Kenya (KEPHIS 2018) However Current Carrot value chain attract political interest especially in Nakuru county because of the large numbers of actors involved in the chain making it hard for the enabling environment to reach the targeted group on regulations. (Mambili2019), other regulation in the chain come from, Kenya ministry of environment, public healthy , land use policies worker unions ,ministry of labor and ministry of trade.

Carrot Value chain coordination and linkage, (Odhiambo ,2018) Carrot value chains in Kenya depict atypical vertical integration among the actors in specific stages or process. For example, carrot farmer in Mau narok carrot value chain based in Nakuru county formed a partnership between farmers in order to produce carrot in bulky to reduce marketing and transportation cost, according to (Kibet 2018) The ultimate goal of the coordination was to eliminate the intermediary and middlemen in the value chain and acquire a direct market in Uganda and major cities in Kenya including Nairobi, Mombasa and Kisumu. The writer further state that ,County government of Nakuru has improved coordination in the carrot value chains

by creating a market platform where farmers and buyers can share the view opinions and grievances and be able to give recommendation on carrot value chain management, especially marketing (Ministry of Agriculture Nakuru county 2017),in addition the county government , encourage citizen’s participation in policy formulation whereby, Farmers are involved in development of the county’s integrated plans concerning carrot and other horticultural produce.

Obstacles and opportunities in the carrot value chains in kenya.

Actors	Constraints	Opportunities.
Production	<ul style="list-style-type: none"> ○ Disease and pest ○ Declining soil fertility and land inaccessibility ○ Poor horizontal cooperation ○ Poor quality of produce and noncompliance to Standards ○ Lack of market-based production ○ Asymmetric information ○ Lack of record keeping ○ Climate change 	<ul style="list-style-type: none"> ○ Low cost of production. ○ Low skilled required ○ Favorable climate and weather for carrot production ○ Increasing demand
Collection packaging and processing	<ul style="list-style-type: none"> ● Inefficient postharvest handling ● Lack of cold storages facilities ● Lack of collection coordination and distribution Centre, ● Carrot theft and destruction 	<ul style="list-style-type: none"> ○ Available cheap labor, ○ Carrot are Easy to clean and grade
Distribution	<ul style="list-style-type: none"> ○ Poor Rural roads ○ Lack of cold chain facilities s e.g. refrigerated trucks ○ Lack of coordination and distribution Centre 	
Wholesale	<ul style="list-style-type: none"> ○ Infra-structure (cold) storage ○ Poor market infra-structure (storage, waste disposal, hygiene) ○ High wastage ○ Traders dominate the value chain ○ Incentive on Product quality is not awarded 	<ul style="list-style-type: none"> ○ Value addition, ○ Online marketing and selling ○ Carrot nutritional information.
Retail	<ul style="list-style-type: none"> ○ . Poor storage conditions ○ Lack of hygienic conditions for markets ○ Non-compliance to food safety laws 	<ul style="list-style-type: none"> ○ Value addition opportunities ○ Standard reference point
Consumer	<ul style="list-style-type: none"> ○ Shelf life (from harvest to consumption) ○ . Limited choice on taste and preference ○ food safety concerns &lack of label 	<ul style="list-style-type: none"> ○ High nutritional value ○ Low price and high consume surplus

Table 8: Summary of obstacle in carrot value chain and potential opportunities.
 source:<<http://edepot.wur.nl/216872>>

Carrot value sustainability and level of externalities, Carrot farming is majorly done in Kenyan fertile area near the forests, and due to high demand of carrot from Uganda and Tanzania markets, farmers tend to increase supply by practicing putting more land on production. (African documentaries 2016) this is because of lack of technology to practice intensification in carrot farming for example, Mau Narok and Kiambu carrot farmers are increasing production through deforestation of Mau forest, and this is leading to destruction of flora and fauna in Mau Narok forest causing forest degradation.

Vegetable production in Kenya is highly susceptible to pest and diseases, and carrot production is prone to fungal diseases because the crop is mainly grown in cool areas of the country this has led to farmer using exceeding level of pesticides to control pest and disease in carrot, hence leading to unintended high level of pesticide residues on carrot as result causing food safety concerns in the carrot value chain and the widespread of this chemical has been found to cause air and water pollution, posing risk to animal and human health (Macharia, 2015)

Carrot cleaning is conducted along the rivers because farmers lack proper cleaning facilities, and sanitation services like toilets, this process create a lot of dumping waste in the rivers hence water contamination and more health risk to users downstream.

According to Kenya horticulture statistic (2010) Uganda import 98% of Kenyan carrot, whereby carrot transportation to different markets happens daily for 12 month of the year by road, this is because carrot are produced all year around and supply to the market is continuous, as result trucks loaded with carrot travel every night from Nakuru and Nyandarua to either Mombasa , or Uganda market and others to Tanzania market, (magubira, 2018).During this transportation there is fuel burning and CO2 emission hence contributing to air pollution and global warming Accumulation of carrot waste from postharvest handling of carrot across the value chain especially at cleaning and grading process has led to increasing environmental degradation, such waste is also seen in the major market , especially wakulima markets in Nairobi and Mombasa . All this waste contributes to land fill (Research solutions Africa (rsa) ltd 2015).

Key findings.

Characteristic	Performance level
Productivity	○ Low productivity, current production volume is 8t per while optimal is at 12t per acre using the same input
Efficiencies	○ High input and low output = low efficiency
Cost structures	○ Low cost of production, high cost of inventory, logistics and post-harvest handling, ○ Low cost of production at production process but high cost of logistics at trading process,
Profit	○ High profit margin for all the actors
Responsiveness on flexibility	○ High flexibility due to short season and continuous supply but low on lead time due to poor coordination and information flow and lack of storages facilities
Pricing	○ Low price at production process
Responsiveness on time	○ Low responsiveness because of low consumer willingness to buy at higher price.
Information flow	○ High information into the value chain, but Low information flow within the value chain leading to low response and inefficiencies.
Income variability	○ High difference on the income due to costs structures differences in each stage and process.
Employability	○ High inclusive employability (age, gender and skill)

Demand	○ Inelastic demand
Risk and uncertainty	○ Low risk and high uncertainty on supply and demand
Consumer surplus	○ High consumer surplus, due to low price.
Coordination and linkages	○ Vertical coordination ○ Low coordination and poor linkages, ○ Coordination for individual surplus rather than whole supply chain
Value chain support services	○ Low level of support. due to asymmetric information and weak coordination
Technology adoption	○ Low level of technology and low technology adoption
Food safety	○ Low compliance on food safety, ○ Consumer willing to pay higher for food safety and organic produced.
Externalities	○ Negative externalities in the first and second stages in the value chain but low in the last stages

Transformational change on the carrot value chains in Kenya

Adoption and use of crop calendars tool. Adopting the use of carrot crop calendars tool by small scale farmers, will help to plan and being able to control supply of carrot in the market , as result the farmers will reduce wastage , this can be done when the whole value chain actors come together and agree on how much carrot to releases to the market on certain period this will increase efficiency , hence reducing carrot overproduction and losses which in the end all actors will increase their surplus, and because there is no import of carrot in Kenya , it will be an added advantage to the actors when managing demand and supply without the world price effects.

Improvement of information flow. There is a need for Improvement of information flow to enhance coordination and linkages between the actor, this can be done through Contract farming, whereby information on price, quality, quantity and time is set on the contracts and agreed upon prior to beginning of carrot production. Farmers will plan production based on the contract information and this contract can be between traders and farmers in the value chain or between traders and retailers depending on which position the actor is, by doing so value chain will be more responsive and at low cost. in addition, the contract should be valid document that can be enforced by law, hence less complain on exploitation within the actors.

Gross margin analysis and record keeping. Gross margin analysis to be done by each farmer and by all other actors in the chain, this can be done through record keeping to show each actor the cost of production and efficiency level. Using these records actors will be able to know how much profit they are getting in each stage they are and the difference across the value chain, and for those unskilled actors they can use the ministry of agriculture or agribusiness office information desk to do the calculations for them. This may lead to reduction of the existing unhealthy competition among the actors, whereby every stage of the supply chain will focus on total value chain surplus and not on individual benefits.

Information and knowledge sharing and food safety. A successful coordination will encourage information and knowledge sharing from both direction of the chain, and this will increase level of trust because with perfect information even the poor farmers will understand how the carrot value chain is performing in the market in terms of consumer and demand requirements. As result, compliance to food safety will be achieved among the actors hence minimizing food safety noncompliance on carrot, for example actors from Nakuru and Nyandarua county, can be supported by County government of Nakuru and Nyandarua who can link them with Kenya Defense Forces (KDF) in Gilgil purchase produce from the farmers who are complying with food safety standards

Construction of carrot cleaning and storage facility. The large-scale farmers in mau narok who are exporting carrot to Uganda and Tanzania, are the major producer of carrot waste during carrot cleaning process, hence by them constructing carrot cleaning sites and sheds in Nakuru with a proper waste disposal channels will reduce the conflict between farmer and water users downstream, they can also charge small fee on other users of the cleaning facilities and the funds can be used for site maintenance. however, through county agribusiness officer, small scale farmers can write proposal requesting for fund from international investors who I believe that, with proper justification farmers will be funded to construct carrot cleaning shed.

Value addition and technology transfer to traders and wholesalers. Trainings and relevant support on value addition and technologies should focus more to traders and wholesalers this is because, traders have high chance to adopt the technologies compared to farmers, in addition carrot farmers are not financially empowered to undertake value addition process, as most farmers are classified as poor, and on the other hand, traders are young and entrepreneurs' who are faster in adopting the technologies. In this case any organization or ministry of agriculture, especially from Nakuru and Nyandarua county should rethink on smart economic objective for any training conducted in the value chain this apply on information delivery as well.

Agritourism. Carrot value chain may consider Including Agritourism for the value chain diversification and upgrading for example farmers in Mau narok- Nakuru county can promote tourism on their carrot farms by practicing environmentally friendly farming methods that bring visitors to the farms, since most farm in this region are near if not inside the mau forest, the forest scenery and view will bring visitors and investors in the value chain and it may increase the value of carrot by being forest friendly product. this move will help to market their carrot both in domestic and international markets, an example of agritourism in Kenya is tea farms in Kericho county.

Processing of carrot waste. Concerning carrot and the environmental impact, we all agree that Carrots are fragile and perishable vegetables hence their production and consumption can be wasteful leading to environmental degradation especially in Kenya where disposal waste facilities are not well developed. according to studies reviewed there are several uses of the discarded carrot. The study found that carrot can be used as animal feed by incorporating into other animal feed supplement, traders can start processing discarded carrot into animal feds .and because of its nutritional value it will give a double benefit to society by reducing environmental cost and also value to livestock farmers and animal product consumer,

Research and development. Carrot value chain need proper Research connection which can lead to value chain expansion to explore other economic uses of carrot in addition to its use as

a vegetable, for example research is needed on carrot seed and carrot leaves uses and also on carrot seed improvement for higher yielding varieties, this can be done by both private and public research organizations in Kenya or from international research organization.

CONCLUSION

Carrot farming is a profitable business in Kenya with a low cost of production which require low skilled labor to manage , but high profits among the actors which show less fluctuations but on increasing curve, Despite the challenges of the carrot value chain , there is potential opportunities beyond unhealthy competition and jealous between actors this is shown by the trends of carrot demand from Kenya, and the culture attached to carrot produced in Kenya to be of better quality and high nutritional value compared to carrot produced in Uganda Tanzania ,and Rwanda, However, it is important for the actors to embrace and appreciate the function of each other in the value chain, and focus more on the total surplus of the chain rather than on individual benefit. because even if they remove the brokers and the middlemen from the chain, the function will still remain, hence they will need someone to perform it, I believe that, knowledge sharing and coordination among the actors will increase response on efficiency and performance of this value chain Carrot value chain study is limited to existing information and statistics available on the carrot value chain performance, most studies are limited to first part of the chain which deal with production and marketing only, however from this study perspective, carrot value chain has many economic characteristic that need to be analyzed for policy interventions, in addition the chain is very promising on actors and their future profit, income growth, employability and environmental sustainability ,hence high value to Kenyan economy at large.

Being a high value crop farmer are likely to benefit more and increase their producer surplus and furthermore this product is traded in 3 countries, Kenya, Uganda and Tanzania whereby with good trade agreement relationship, actors in the carrot value chain will have great advantage of selling carrot at regional price if not world price. I consider this value chain as an emerging area for further research and study.

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CONFLICT OF INTERESTS

The author has not declared any conflict of interest

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