

Challenges in the supply chain of cabbage in Nelson Mandela Bay Metropolitan municipality, Eastern Cape, South Africa

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ABSTRACT

The main objective of the study was to advance good supply chain management practices for cabbage through improved shelf life, safety and produce quality, with a view to improving the sustainable supply of cabbage to the Nelson Mandela Bay Metropolitan Municipality. Twenty-nine (29) cabbage farmers were interviewed using a semi-structured questionnaire. The data obtained was analysed descriptively using the Statistical Package for Social Sciences (SPSS) software Version 22. Descriptive statistics identified the modes, means of variables, frequencies, and percentages. The results of the study showed that the majority respondents face cabbage losses due to poor management during transportation. Moreover, challenges experienced by the cabbage farmers included mould growth, poor transport services, poor temperature management, poor stock handling practices, and location of the farms in relation to the market. The findings further revealed that insect infestation in some cabbage consignments was also a contributing factor which led to a high rejection rate among the retailers. The researchers propose that extension advisers should train cabbage farmers to address the identified challenges and ensure a regular monitoring and evaluation process to ensure the success of farmers.

Key words: Supply Chain Management, Cabbage Farmers, Nelson Mandela Bay Metropolitan Municipality

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1. INTRODUCTION

The Nelson Mandela Bay Metropolitan Municipality is situated in the Eastern Cape Province of South Africa. The Eastern Cape came into existence in 1994 after the apartheid era had ended and was formed out of Xhosa homelands (the Transkei to the east and the Ciskei to the west), together with the eastern portion of the Cape Province (Hamman & Tuinder, 2012:11). The Nelson Mandela Bay Metropolitan Municipality is known for its high rate of poverty due to a lack of employment and poor infrastructure. Most people earn an income from their communal land by small-scale farming and working on nearby commercial farmers (Westaway, 2012:117). The unavailability of quality food is one of the major challenges that are experienced in the province, and that is causing a major threat to food security (Hendriks *et al.*, 2016:148). Despite this dire situation in the Eastern Cape, tons of food go to waste due to poor supply chain management practices in the retail and informal sector (Li & Wang, 2017:5127; Rezaei & Liu, 2017:26; Matharu, De Melo & Houghton, 2016:2). In relation to the focus of this study, poor supply chain management is the main cause of cabbage losses in the Nelson Mandela Bay Metropolitan Municipality.

Cabbage is among the perishable food products with a short shelf life like fruits, vegetables, dairy, and fresh meat (Musavi & Bozorgi-Amiri, 2017:2). One of the most challenging yet vital tasks in the perishable produce industry is controlling the inventory and supply of the optimal product quality through the dynamics of the agricultural supply chain to fulfil consumer demands (Sinha & Anand, 2020:3). According to Musavi and Bozorgi-Amiri (2017:2), the supply chain of perishable agricultural products is different from the supply chain of non-perishable products. Cabbages show continuous quality changes throughout the supply chain, until they reach the end user (Liu, Liu & Liu, 2017:47). According to Verdouw *et al.* (2016:128) agricultural perishable products are extra challenging in the supply chain due to their limited shelf life. There are numerous factors that need to be taken into account in the processes of the agricultural supply chain, for example, the location of the farms/producers, the location of the warehouse from the farm and to the stores/market, time keeping of the inventory, road infrastructure for vehicle routes, and the distance covered to reach the market.

According to Sejeso and Ali (2019:14), the fresh produce of farms must be processed and be transported through various supply chain channels. These perishable products, after being harvested or processed, must be collected from the farm and arrive in the market as quickly as

possible. The focus of this study is on the three aspects in the supply chain of cabbages: food safety; food quality; and the sustainable supply of cabbages (Garcia, Osburn & Jay-Russell, 2020:2). To enhance sustainable food security, agriculture extension is one of the most important tools that can be used to achieve this goal (Zwane, 2020:128). Cloete et al. (2019:14) reported that at a global level agricultural extension is important in transferring information from research to farmers, and inputs from farmers to researchers. Agriculture extension is a type of education that is used to make farmers aware of alternatives from which they can choose the most desirable (Igene et al., 2018:36).

According to Kroll (2016:5), the Eastern Cape Province is poverty-stricken and cannot afford to waste food products and resources due to the poor management of the supply chain. The damaging of cabbages because of poor supply chain management has negative consequences on food security, as well as farmers and their economic stability (Mhazo, 2018:1). Reducing cabbage losses and waste in the Nelson Mandela Bay Metropolitan Municipality could be one of the most vital measures to improve food security and boost economic growth (Kummu et al., 2012:477; Read et al., 2020:136).

1.1 Issues and challenges in the supply chain of cabbage in the Nelson Mandela Bay Metropolitan Municipality

Poor coordination between the supply chain actors of perishable products, along with inefficient retail cold chain management practices have been identified as the vital causes of food wastage (Sejeso & Ali, 2019:14). Both commercial and small-scale farmers utilise considerable time in coordinating the supply chain of their cabbages to reach markets (Sejeso & Ali, 2019:14). A large percentage of their produce is spoilt before it reaches the market (Sejeso & Ali, 2019:14). According to Aleruchi (2019:2), the general business principle is that cabbage spoilage, deterioration and wastage, results in catastrophic revenue losses. Good supply chain management might contribute to positive social change through reduced food wastage and food spoilage; job losses; lawsuits; revenue losses; increased food supply; improve customer satisfaction; lower prices and safer food for consumers (Aleruchi, 2019:28). However, there is limited information regarding challenges in the supply chain of perishable agriculture produce such as cabbages in the Nelson Mandela Bay Metropolitan Municipality, South Africa.

This study seeks to assist the key players in supply chain management and presents prevention tactics and contingency plans that could be put in place in the event of risk. A good supply chain management should lead to less food wastage and food spoilage; fewer job losses and lawsuits; and reduced revenue losses. This could increase the profit margin for all the actors that are involved within the supply chain.

2. METHODOLOGY

2.1 Study area

The study area is the Nelson Mandela Bay Metropolitan Municipality which is situated along the Southeastern coastline of the Eastern Cape Province of South Africa (Melly *et al.*, 2017:313; Zuze, 2019:5). The Nelson Mandela Bay Metropolitan Municipality consists of three local councils, which are Gqeberha (previously known as Port Elizabeth), Despatch, and Uitenhage (Zuze, 2019:4). The geomorphic boundaries of the Nelson Mandela Bay Metropolitan Municipality are formed by Van Stadens River Mouth in the west, the Sundays River in the East, the Cassie Mountain View in the north, and Cape Recife in the south (Zuze, 2019:5).

2.2 Research design, sampling procedure, and sample size

The study follows a quantitative design, wherein data were collected using close-ended questionnaires. A stratified sampling technique was used to select 29 cabbage farmers from the following areas of the Nelson Mandela Bay Metropolitan Municipality: Gqeberha, Despatch and Uitenhage. Through this sampling technique, the sample frame was divided to make homogenous and non-overlapping subgroups, and a simple random sample was further drawn from each subgroup.

2.3 Data collection and analysis

Data was collected from 29 cabbage farmers. Questionnaires that consisted of close-ended questions were used as the main data collection instrument. Three different sets of questions consisted of key indicators which were included in the questionnaires. The first set of questions was utilised to elicit information on the respondents' demographic and personal information. The second set of questions was utilised to gather information on challenges in the cold chain management, and the last section sought to collect information on the causes of cabbage spoilage in the supply chain. The respondents expressed their views by rating their answers

using a Likert scale. Data were then analysed using the Statistical Package for The Social Sciences (SPSS), to identify the modes, mean of variables, percentages and frequencies.

3. RESULTS AND DISCUSSION

3.1 Demographic information

3.1.1 Gender of Respondents

The demographic information indicates that 31% of the respondents are women and 69% men. This indicates that majority of the respondents, who supplied cabbages to the Pick n Pay Food Distribution Centre in the Nelson Mandela Bay Metropolitan Municipality are male. This reveals that a gender gap exists between men and women, which implies that any strategy that may be used for the development of cabbage farming systems in the area will not equally benefit men and women. Gender balance has potential for improving both national and household food security. This finding is consistent with Esabu and Ngwenya (2019:110), Zenda and Malan (2021:110) who found that women were having less access to resources as compared to males. The women in the Nelson Mandela Bay Metropolitan Municipality are the most disadvantaged gender, but their circumstances are changing.

3.1.2 Age of Cabbage Farmers in Nelson Mandela Bay Metropolitan Municipality

The age of cabbage farmers plays an important role in assessing the challenges in the supply chain of cabbage. The study shows that 34% of the respondents are below the age of 35, while 62% of the respondents are older. These results indicated that the youth is not interested in cabbage farming, a challenge that needs to be addressed. This finding concurs with the results of Zenda and Malan (2021:111) who found that in South Africa the youth is not interested in agriculture. This is despite the fact that there is potential for the younger generation to grow in the agriculture industry. A more nuanced understanding of the youth's interest in agriculture is important when considering development strategies that can contribute to food security and poverty alleviation.

3.1.3 Level of Education

Education is vital as it opens farmers' minds to knowledge, and they are able to incorporate the latest technology, scientific advances, better methods of farming and changing innovations, and share the information and their experiences which could lead to agricultural productivity. In addition, it was established that 45% of the respondents had completed a tertiary

qualification; a further 48% had matriculated; and 3% had not matriculated. These results indicate that the level of education of the selected cabbage farmers is adequate for them to understand and interpret the fundamental economics of cabbage farming.

3.1.4 Farming experience

Farming experience is important when farming with cabbages, due to the level of knowledge and skills required to successfully farm with this type of vegetable and to deal with the supply chain processes. The study found that 14% of the respondents were involved in cabbage farming for more than 20 years and supplied the retail market; 48% for more than ten years but less than 20 years; and 24% for more than five years, but less than ten years. These results indicate that farmers had experience in cabbage farming, thus suggesting that they can easily adopt innovative ideas and technology.

3.1.5 Farm Size in Hectares under Cabbage Production

The study further illustrates the size of the farms, under cultivation by cabbages for the retail market, in hectares (ha) (1 hectare = 10 000 square metres). About 7% of the farms are smaller than 80ha, 41% are between 80 and 100ha, 35% are between 101 and 120ha, 7% are between 121 and 140ha, another 7% are between 141 and 160ha, and 3% are between 161 and 180ha. This indicates that the majority of the cabbage farmers who supplied the Pick n Pay Food Distribution Centre in the Nelson Mandela Bay Metropolitan Municipality, have sizeable farms or land. Most of the respondents produce cabbage in a space of more than 100ha and can produce sufficient quantities to supply the Nelson Mandela Bay Metropolitan Municipality.

3.2 Challenges in cold chain management

3.2.1 Main mode of transport for the distribution of cabbages to the Pick n Pay Food Distribution Centre

According to FAO (2019:13), cabbage storage methods, especially during transportation, are vitally important and affect their quality and whether they are safe for human consumption. Cabbages have a higher respiration rate in high temperature environments. Furthermore, refrigerated transport prevents the breakdown of organic molecules, deterioration, mould growth, ethylene production, and decay. The results of the study indicate that 100% of the respondents utilise refrigerated transport vehicles during the transportation of cabbages to the retail market/Pick n Pay Food Distribution Centre in the Nelson Mandela Bay Metropolitan

Municipality. Refrigerated transport is needed to maintain the quality of cabbage, and to enable sufficient storage time. However, because cabbage has a larger cut surface, loss of quality parameters, such as moisture and flavour, results in a limited shelf-life and rejection by consumers. Therefore, it is important that transportation methods are developed to not only preserve the quality of cabbages but also guarantee its food safety.

3.2.2 Cabbage Losses during transportation to the Retail Market/the Pick n Pay Food Distribution Centre

Transportation is the most crucial factor in the marketing of cabbages. Transport is utilised to distribute cabbages from the to the market stores. The results of the study illustrate that 100% of the respondent's face cabbage losses during transportation to the retail market. These losses are caused by various factors, such as poor management, poor handling, careless handling, poor packaging, poor packing (squeezing), poor ventilation (blocked refrigerator air vents), poor unloading, and poor road infrastructure (Hou, 2017). Refrigeration of the logistic transport is a leading contributing factor of in transit damage due to faulty refrigerators; they could be producing hot or cold air which is not in the perimeter of the cabbages; this could ultimately lead to cabbage wastage (Coulibaly & Thomsen, 2016:24). Breakdowns of the logistic transport during transportation could also be a significant cause of losses, as cabbages could be left exposed to the sun for hours, days, or more, while repair work is being done (Albertzeth *et al.*, 2020:139).

3.2.3 Reasons for cabbage production losses during transportation to the retail market/Pick n Pay Food Distribution Centre

'Inventory' is the term used for the products in stock available for sale or the raw material used for producing stock for sale. Inventory represents one of the most vital assets of a business or company because it is classified as a current asset. Inventory management is vital for cabbages because of their limited shelf life. The results indicate that the issue of inventory is an issue that needs to be addressed. According to Ali *et al.* (2013:3864), timekeeping of the inventory is important, as cabbages are perishable products, with a limited shelf life. Furthermore, Ali *et al.* (2013:3864) and Fernandes *et al.* (2013:2578) concur that a disorganised inventory, without a strategy or process that will guide the farmers on when and how to order the stock so that the inventory can meet the demand of consumers, lead to excess supply and over-stocking. This results in large numbers of cabbages deteriorating and becoming food waste.

The location of the farms from the market plays a vital factor in contributing to cabbage wastage due to poor infrastructure in the Eastern Cape. This study further indicates that 86% of the respondents' losses of cabbages can be linked to the location of the farms in relation to the market. The fresh perishable produce/cabbage farmers who supply the Nelson Mandela Bay Metropolitan Municipality are situated in the rural farming areas, some 100 to 300 kilometres from the market or retail stores. Khapayi and Celliers (2016:34) assert that the distance of the location from the market affects various factors, such as logistics (transport/vehicle breakdowns), high insurance cover, high fuel consumption, tyre wear, and longer working hours for drivers, which affects overtime payments. These factors influence wastage, pricing, and availability. Ethylene gas is vital to commercial agribusiness it assists in speeding the ripening process of the product. However, ethylene also decreases the product's quality and its shelf life (Liao *et al.*, 2016:1).

Globally, ethylene is the main contributing factor to perishable products waste (vegetables), with 45 to 50% of all harvested perishable products being wasted within the agricultural supply chain. Moreover, this study shows that 35% of the respondents' cabbage losses are due to ethylene production. Ethylene production decreases the products' quality and the shelf life of cabbages during distribution. According to Kang *et al.* (2019:436), ethylene gas, if concentrated, causes premature aging, decay and wilting of cabbages, and results in a deterioration in the quality and a reduction in the shelf life. Furthermore, it accelerates the breakdown of chlorophyll in cabbages, and increases sensitivity to injuries. Ndraha *et al.* (2018:3) state that extreme temperatures (hot or cold) accelerate cabbage spoilage. The higher the temperature, the more quickly decay occurs in cabbages. Extreme cold temperatures, up to the freezing point build up water inside cabbages' cell tissues which expand and destroy the cell wall. These results indicate that extension advisers need to address the issue of cabbage losses due to ethylene production to reduce losses during transportation to the market.

3.2.4 Handling and Storage Problems during Transportation of the Cabbages to the Retail Market/ the Pick n Pay Food Distribution Centre

Handling is the way the cabbage is treated by various persons that are involved post-harvest. According to Negi and Anand (2016:55), poor handling is one of the contributing factors in cabbage wastage caused by injuries during careless handling, which contribute to internal bruising, skin breaks and splitting, which causes a rapid increase in water loss. The results of

the study further indicate that 35% of the respondent's face handling and storage problems during the distribution of the cabbages. According to Li and Wang (2017:5130), transport storage, during the distribution of cabbages, must be air-cooled to keep the product fresh. Nkolisa (2017:12) concurs that transport vehicle storage for cabbages must be refrigerated at temperature – between 0 and 2 degrees Celsius. A good transport vehicle storage, within the required temperature, will provide a longer shelf life by decreasing the rate of respiration, mould growth, ethylene production, and decay.

3.2.6 Cabbages Losses during transportation route to the Retail Market/the Pick n Pay Food Distribution Centre

The results of the study further indicate that 72% of the respondents' cabbages mature during distribution, while 24% of the respondents' cabbages do not mature during transportation. The levels of maturity at which the cabbages are harvested influence the taste and quality when they arrive at the market. One of the important factors that maturity also affects is whether the appearance and taste of the cabbage is such that consumers are prepared to pay a premium price for the unit.

4. CONCLUSION AND RECOMMENDATIONS

The purpose of the study was to outline the various crucial challenges in the supply chain management processes, which affect cabbages. The main objectives of the research were to advance good supply chain management practices for cabbages by improving shelf life, agricultural safety and agricultural produce quality, and the sustainable supply of cabbages to the Nelson Mandela Bay Metropolitan Municipality. Furthermore, the constraints facing cabbage farmers were highlighted. The study established that cabbage farmers in the Nelson Mandela Bay Metropolitan Municipality experienced the following constraints: poor transport services, poor cold chain management/temperature management (100%), development of decay, ethylene production (35%), maturity during distribution, location of the farms in relation to the market. Based on the presented challenges, the researchers point a gap where extension advisers can play a role to minimize profit losses. The areas in which extension personnel can play a role include training all the relevant players in the cabbage production (from farm to fork), with the focus being placed on the following operational processes: post-harvesting, cold chain management/temperature management, stock handling, stock rotation, good transport loading procedures, and communication channels. Furthermore, there must be regular

monitoring and evaluation after training to achieve the goal of a sustainable supply chain of cabbages to enhance food security. Extension advisers should also train Cabbage farmers to come up with strategies to overcome poor-harvesting management practices, poor stock rotation, poor transport services, poor road conditions and poor communication to avoid low profit margins on the supply chain and on cabbage farms. There is also a need for monitoring the supply chain processes to guarantee ideal productivity and improve the revenue for all actors involved. Future studies on the cabbage supply chain frameworks should focus on developing a sustainable supply chain of cabbages.

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