OPTIMIZING TRANSPORTATION COSTS IN THE SUPPLY CHAIN OF PALM FRUITS: A CASE STUDY OF JUABEN OIL MILLS LTD

by

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DECLARATION

I hereby declare that this submission is my own work towards the MBA and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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ABSTRACT

Transportation is very crucial to the operations of most organizations. It is the essential link between organizations within a supply chain. It serves as the link between an organization and its suppliers upstream and its customers downstream. Although supply chain experts agree that transportation tends to fall through the supply chain management cracks, receiving less attention than it should, it can be a significant supply chain cost. Rising petroleum and diesel costs over the years have made a very essential facilitator of transport, fuel, very expensive. Increasing transportation costs therefore, largely affect organisations' bottom line and they are fast becoming a key factor in determining the difference between profit and loss. Meanwhile, the increasing rate of competition among organizations both domestically and abroad, requires that organizations improve their internal processes rapidly in order to stay competitive. It is against this backdrop that this study seeks to investigate the current transportation efficiency of Juaben Oil Mills Ltd and examine the challenges the transportation system faces in the organization, and to recommend ways whereby transportation resources can be maximised so as to optimize transportation costs. This exploratory survey was facilitated by the use of questionnaires which were administered to a population comprising all twenty-four (24) drivers, one (1) Transport Officer and one (1) Chief Executive Officer. The study revealed that road transport is the main mode of transport used by the organization in hauling palm fruits. This is because the farms, where the palm fruits are obtained, are mainly accessible by road. Therefore, vehicles and drivers were at the centre of the organisation's transportation system. It was also identified that fuel was less efficiently used by drivers and vehicles in the organization. It was realized that there were no training programmes

for drivers, routine maintenance schedules for vehicles and monitoring of drivers and vehicles. It was therefore recommended that drivers should be trained on fuel –efficient driving practices, maintenance be carried out regularly on vehicles and the Dijkstra's Algorithm be adopted as a routing guide to determine shortest routes from farms to the Mills in order to reduce transportation costs.

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ABBREVIATIONS

1.	CSCMP	-	Council for Supply Chain Management Professionals
2.	DWT	-	Tons Dead Weight
3.	EEBPP	-	Energy Efficiency Best Practice Programme
4.	FAO	-	Food and Agricultural Organization
5.	FAOSTAT	-	Food and Agricultural Statistics
6.	FFB	-	Fresh Fruit Bunch
7.	GRC	-	Ghana Railway Corporation
8.	GRT	-	Gross Register Tons
9.	GSCF	-	Global Supply Chain Forum
10.	JOPOCOS	-	Juaben Oil Palm Out growers Cooperative Society
11.	Km	-	Kilometers
12.	LTL	-	Less-than-Truck Load
13.	MPG	-	Miles per gallon
14.	MPH	-	Miles per hour
15.	MT	-	Metric Tonnes
16.	NAS	-	National Academy of Sciences
17.	PSF	-	Private Sector Foundation
18.	SC	-	Supply Chain
19.	SCC	-	Supply Chain Council
20.	SN	-	Supply Network
21.	TL	-	Truck Load

22. USDA - United States Development Agency

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DEDICATION

This research is dedicated to my dear and loving husband, Rev. Patrick Amo Amoah whose unflinching support saw me through this programme.

CHAPTER ONE

1.0 Introduction

In Ghana, over the past three years, fuel prices have more than doubled. This alone lays a considerable strain on companies' budgets regarding transportation costs. Other factors such as insufficient roads coupled with their bad nature especially during the rainy season further impose a huge financial burden on organizations. It is, therefore, imperative that managers of organizations make prudent decisions to put resources at their disposal to the best use so as to minimize transportation costs.

1.1 Background of the study

The increasing rate of competition both domestically and abroad has compelled organizations to improve their internal processes rapidly in order to stay competitive. In the 1960-1970's, companies came up with detailed marketing strategies focusing on creating and capturing customer loyalty; design engineers also had to translate customer needs into product and service specifications leading to the production of high level quality products at reasonable costs. With increasing demand in the '80s, manufacturing organizations were required to become increasingly flexible and responsive in terms of (i) modification of existing products and processes and or (ii) to developing new ones in order to meet ever changing customer needs. As manufacturing capabilities improved in the 90's managers realized that materials and services inputs from suppliers had a major impact on their organization's ability to meet customer needs (www.wikipedia).

This led to an increased focus on the organization's supply base and its sourcing strategy. The new challenge was the ability of the organization to get products to customers when, where, how, and in the quality that they want (value), in a cost effective manner. This led to the era of the "Logistics Renaissance", spawning a whole new set of time-reducing information technologies and logistics networks aimed at meeting these challenges. Based on these changes, organizations have now found that it is no longer enough to only manage their organizations, they must also be involved in the management of the network of all upstream firms that provide inputs (directly/indirectly) as well as the network of downstream firms responsible for delivery and after-market service of the product to the customer. Then came the idea of supply chain, which encompasses all activities associated with the flow and transformation of goods from the raw materials stage (extraction), through to the end user, as well as the associated information flows (Russell et al., 2003).

The efficient management of this chain brought about the term "Supply Chain Management" which is the integration of these activities through improved supply chain relationships, to achieve a sustainable competitive advantage. If we consider an individual firm within the context of this definition, we must include both its upstream supplier network and its downstream distribution channel (Russell et al., 2003).

Supply chain management has come to the forefront of every company's business agenda. Responding to the demands of today's highly competitive global environment, traditional linear supply chains with their sequential processes are evolving into complex, global ecosystems that are highly responsive to customer needs. These "pull" (demand-

driven) environments that work in conjunction with traditional push environments are known as adaptive supply chain networks. This allows all stakeholders in the supply chain, both within and outside the enterprise, to share knowledge, make collaborative decisions, and sense and respond immediately to changing conditions. It allows companies to restore order to a chaotic supply chain for higher profits (www.SAP-AG.com).

Within a supply chain, products flow in many directions and in multiple modes. The lines between trading partners are increasingly blurring. Part of the movement to globalization is the desire to minimize costs (www.SAP-AG.com).

However, the idea that rising transportations costs can offset all supply chain economic gains has been highlighted in the Gartner report "Higher Freight Costs Increase Need for Transportation Management Solutions" (Klappich, 2006), which stated, "Transportation budgets worldwide could increase by as much as twenty-five (25) percent during the next few years, unless companies find ways to minimize the impact of freight cost increases." Numerous articles have noted the issue of transportation cost, and the situation is expected to plague industry well into the future.

Again, in Ghana, foreign donor support helped to increase the number of new vehicle registrations from eight thousand (8,000) in 1984 to almost twenty thousand (20,000) in 1989, (Wikipedia, 2009). The distribution of vehicles has been skewed, however, because, by 1988, more than half of all vehicles were in Accra, which contained approximately seven (7) percent of the country's population. Furthermore, most new vehicles are intended for private use rather than for hauling goods and people, a reflection

of income disparities. This further poses a strain on industry where more trucks for hauling goods are needed. Transportation is especially difficult in eastern regions, near the coast, and in the vast, underdeveloped Northern regions, where vehicles are scarce, (Wikipedia, 2009). These challenges calls for this research into how to optimize the cost of transportation in the supply chain of palm fruits in Ghana since transportation is one of the largest logistics cost and may account for a significant portion of the selling price of the products (Grant et al., 2006).

It has also been identified that less attention has been directed to transportation in the supply chain in this part of the world. In 1997 it was estimated that there was a total of thirty-nine thousand, four hundred and nine (39,409) kilometres of highways in Ghana of which eleven thousand, six hundred and fifty-three (11,653) kilometres are paved (including thirty (30) kilometres of expressways), the remaining twenty-seven thousand, seven hundred and fifty-six (27,756) kilometres were unpaved, (Wikipedia, 2009). This and others high light the kind of challenges facing the transportation sector in Africa and especially in Ghana resulting in costs that derail the benefits of the supply chain.

1.2 Statement of the problem

Transportation is one of the most significant areas of logistics management because of its impact on customer service levels and the firm's cost structure. Inbound and outbound transportation costs can account for as much as ten (10) percent, twenty (20) percent, or more of the product's price (Grant et al., 2006). For some manufacturing firms, transportation costs can be as high as twenty (20) percent of total production costs and run as high as six (6) percent of revenue.

According to Russell et al., (2003), freight transportation costs in the US are approximately $500 billion a year, which is about six (6) percent of Gross Domestic Product. If for a developed country like the US, freight transportation can get as high as six (6) percent of GDP, then less cannot be said about Ghana, a developing country with its fair share of inadequate road infrastructure in deteriorating conditions.

Transportation in Ghana is seriously challenged especially from the rural areas where most agricultural activity takes place to the urban centres. The deterioration of the country's transportation and communications networks has been blamed for impeding the distribution of economic inputs and food as well as the transport of crucial exports (Wikipedia, 2009). According to Grant et al., (2006), the cost of using rail as a mode of transport is low as compared to all the other modes of transport namely: Motor or road, air, water or pipeline. They go on to say that trains have a higher capacity than trucks which can further reduce the costs of rail transportation as they can carry more goods. Still according to them, trains can be rated equally moderate as trucks in terms of speed or time-in-transit. With all these cost-saving benefits of rail transportation, it is just prudent for organizations to use it more often to reduce transportation costs. However, this is not so in Ghana because the rail sector is not well-developed and the few existing lines are not in good condition as trains constantly derail.

The railway system in Ghana has historically been confined to the plains south of the barrier range on mountains north of the city of Kumasi. Most of the lines are single tracked, and in 1997, it was estimated that thirty-two (32) kilometres were double tracked. In February 2008 the Ghana General News reported that the Ministry of

Harbours and Railways and the Ghana Railway Corporation (GRC) were expected to complete a new commuter line linking Accra and Tema by June 2008. The formation was complete from Sakumono to the SSNIT flats near Tema. Diesel multiple-unit train sets will be imported for use on the line. Construction of sleeper plant for the far north line was also initiated in 2008. These projects, however, are yet to be completed. According to the Minister of Transport on a TV 3 news item on Friday, 10th July, 2009, rail transport in Ghana is seriously challenged and in need immediate help in order to salvage it. He made this statement when he visited Kwame Nkrumah Circle in Accra where a train had derailed.

Moreover, fuel prices have more than doubled in the past three years, from GHC 2.0 per gallon in 2006 to GHC 5.1 per gallon in 2009. It is therefore very important to tackle the problem of rising transportation costs for organizations especially in this era of rising fuel prices in order for them to be profitable.

It has also been ascertained that transportation is fast becoming a key factor in determining the difference between profit and loss. It is the essential link between the extraction of natural resources; the fabrication of industrial, commercial, and consumer products; and the final distribution of goods to wholesalers, retailers, and end users (Grant et al., 2006).

It is against this backdrop that this research seeks to come out with a timely intervention on how to optimize the transportations cost in the supply chain of palm fruits in Ghana, a case of Juaben Oil Mills Ltd.

1.3 Objectives of the study

In the broader sense, this study sets out to optimize transportation costs in the supply chain of palm fruits. The following specific objectives would be achieved by this research:

(i) To investigate the current transportation efficiency practices at the Juaben Oil Mills Ltd.

(ii) To examine the challenges associated with the transportation system in Juaben Oil Mills Ltd.

(iii) To adapt the Dijkstra's Algorithm to determine the shortest routes from the various farms to Juaben Oil Mills Ltd to optimize transportation costs.

(iv) To suggest recommendations that will help improve the transportation situation and reduce transportation costs.

1.4 Key research questions

The research will be guided by the following questions:

(i) Where are the sources of palm fruits to the Juaben Oil Mills Ltd.?

(ii) How are palm fruits transported from the farms to the Juaben Oil Mills Ltd.?

(iii) What are the challenges associated with the current transportation system in Juaben Oil Mills.?

(iv) How can transportation costs be optimized at Juaben Oil Mills Ltd.

1.5 Justification of the study

Taking cognizance of the fact that transportation costs largely affect organisations' bottom line, which in effect affect their operations, recommendations and suggestions from this research when implemented will help organizations achieve cost savings on transportation costs so as to be profitable and competitive in today's market place.

Organizations will also be able to expand their operations when they are able to make more profits. This will create more employment opportunities for people, which will in effect have a positive impact on Gross Domestic Product and eventually, on economic growth. Living conditions of people will also improve.

When organizations are able to make cost savings on transportation costs, such savings could also be utilized in enhancing corporate social responsibility, which will benefit the communities in which these organizations operate in particular, and the country as a whole.

This research will also help reduce transport energy demands, which will save the country a lot of foreign exchange and result in the long-term advantage of saving the environment from carbon dioxide emissions.

A company seeking to achieve more efficient transportation and greater profitability must make significant changes in the way it performs every phase of the transportation process. The study will help the company to implement new transportation and distribution strategies to improve carrier capacity utilization in a time of constrained supply to reduce cost.

Finally, the research work will broaden the researcher's knowledge in her field of study as well as serve as a reference material to the academia for subsequent research work.

1.6 Scope of the study

This study is limited to the optimization of transportation costs of raw materials, that is, palm fruits from the various farms to the Juaben Oil Mills Ltd. It does not deal with the distribution of finished products from the Juaben Oil Mills Ltd.

1.7 Research Methodology

The study was facilitated by the use of well-designed questionnaires that was administered to a sample made up of drivers, a Transport Officer and a Chief Executive Officer. Unstructured interviews and personal observation were also undertaken. Results were analysed using the software, Statistical Package for Social Sciences (SPSS).

1.8 Organisation of the study

The remainder of the thesis is organized as follows. Chapter 2 presents the literature review summarizing the most important theoretical and practical concepts that are used in pursuing the purpose of this thesis. Chapter 3 discusses the methodological issues in the work and gives a brief organizational profile of Juaben Oil Mills Ltd. Chapter 4 discusses the data analysis and Chapter 5 summarizes the research findings and contains recommendations and conclusion.

1.9 Limitations of the study

In this study the researcher encountered some difficulties including:

- Funding.

The money to travel round to administer questionnaire, purchase stationary and pay for other services posed a problem to the researcher.

- Time.

Undertaking this study at the same time as attending lectures and writing examinations was a limitation for this study. This did not give the researcher the chance to delve into the topic in depth. Chasing after questionnaires and moving round to collect needed materials for the research was also time-consuming.

1.10 Summary

In this chapter, a brief introduction and background of the study was given. The chapter also contained the statement of the problem, objectives, scope, justification and limitations of the study.

In the next chapter, a literature review of relevant topics to the study such as supply chains, supply chain management, transportation, routing problems, etc will be undertaken.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter reviews relevant literature on supply chain, supply chain management, networks, risks and supply chain structure. Literature on modes of transport, optimization and oil palm are also reviewed in this chapter.

2.1 Supply chain

A supply chain encompasses all activities associated with the flow and transformation of goods and services from the raw materials stage through to the end user as well as associated information flows. In essence, it consists of all the assets, information and processes that provide "supply". It is made up of many interrelated organizations, starting with raw material suppliers, and including parts and components suppliers, subassembly suppliers, the product or service producer, the distribution channels and ending with the end use customer. (Russell et al, 2003).

From another perspective, Russell (2007) indicates that a supply chain is the sequentially –connected organizations and activities (from Mother Earth to the ultimate customer) involved in creating and making a product available. He notes that "a supply chain can also be viewed as a value chain inasmuch as suppliers, manufacturers, transporters, and all other components of a supply chain add value. Conversely, if one looks in the reverse direction at the same activities, a supply chain can be viewed as a demand chain."

Again, according to Lysons and Farrington, (2006), a supply chain is that network of organizations that are involved, through upstream and downstream linkages, in the

different processes and activities that produce value in the form of products and services in the hands of the ultimate customer or consumer. This definition emphasizes that networks, linkages and processes are key characteristics of supply chains.

The Supply Chain Council (SCC, 2008) emphasizes that the term supply chain is now commonly used internationally and it encompasses every effort involved in producing and delivering a final product or service, from the supplier's supplier to the customer's customer. The SCC indicates that series of companies (actors) that interact for this "producing and delivering" is what will be called supply chain. The actors are connected through the flow of products, the flow of information and the flow of money. Another perspective to supply chain is given by Simchi-Levi and Kaminsky (2003), who state that "supply chains are flexible, dynamic and complex networks of organizations".

From these definitions, a summary definition of the supply chain can be stated as;... all the activities involved in delivering a product from raw material through to the customer including sourcing raw material and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, delivery to the customer and the information systems necessary to monitor all of these activities.

Within a supply chain, the linkage and information flows between various members of the supply chain are critical to overall performance. The integration of business processes across the supply chain is what we are calling Supply Chain Management ((Lummus and Vokurka, (1999)).

2.1.1 Definition of supply chain management

Council for Supply Chain Management Professionals (CSCMP's) define supply chain management as "the management that encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities". Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies.

According to Bowersox et al., (2002), supply chain (sometimes called the value chain or demand chain) management consists of firms collaborating to leverage strategic positioning and to improve operating efficiency. For each firm involved, the supply chain relationship reflects a strategic choice. A supply chain strategy is a channel arrangement based on acknowledged dependency and relationship management. Supply chain operations require managerial processes that span across functional areas within individual firms and link trading partners and customers across organizational boundaries.

The GSCF (Global Supply Chain Forum) defines supply chain management as "the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders".

Stank et al. (2005, p. 27) describe supply chain management as a "strategic level concept." Ho et al. (2002) conceptualize SCM as having three core elements:

- value creation;
- integration of key business processes; and
- collaboration.

Based on this conceptualization, they define supply chain management as follows: SCM is the philosophy of management that involves the management and integration of a set of selected key business processes from end user through original suppliers, that provides products, services, and information that add value for customers and other stakeholders through the collaborative efforts of supply chain members (Ho et al., 2002, p. 4422).

CSCMP considers supply chain management as the management of procurement, conversion and logistics activities (planning), but also the coordination of the channel partners. Bowersox and his colleagues underline the relational character of the channel partners. The final definition identifies supply chain management as all the key business processes which add value for the stakeholders including the customers.

From all the definitions presented above, it can be deduced that supply chain management covers the flow of goods from supplier through manufacturer and distributor to the end user. It is a technique that looks at all the links in the chain from raw material suppliers through various level of manufacturing to warehousing and distribution to the final customer. That is it requires all participants of the supply chain to be properly informed.

2.1.2 Supply chain networks

A supply network (SN) is a sequence of different and multiple numbers of functions and individual functional units that must satisfy all capacities and demand requirements imposed by customers with minimum cost to the network. The most important functions of an SN are warehousing and transportation functions (Tuzkaya 2009).

The supply chain, logistics network or supply network is the system of organisation, people, activities, information and resources involved in moving a product or service from supplier to customer. According to Private Sector Foundation (PSF) in Uganda (2003) supply chain is usually a complex and dynamic network of participants, facilities and organizations with different and sometimes conflicting objectives that enhance the movement of goods and services from the producers to the final consumer. One of the most significant changes in the paradigm of modern business management is that individual businesses no longer compete as solely autonomous entities but rather as supply chains. Business management has entered the era of network competition and the ultimate success of a single business will depend on management's ability to integrate the company's intricate network of business relationship (Douglas et al, 1998).

A supply chain is essentially a network consisting of suppliers, manufacturers, distributors, retailers and customers. The network supports three types of 'flows' that require careful design and close coordination:

- Material flows, which represent physical product flows from suppliers to customers as well as reverse flows for product returns, servicing and recycling

- Information flows, which represent order transmission and order tracking and which coordinate the physical flows.

- Financial flows, which represent credit terms, payment schedules and consignment arrangements (Kleindorfer and Van Wassenhove, 2004) cited in (Van Wassenhove (2006)).

In food logistics supply chain networks, it is crucial to have reliable suppliers and distributors to meet demands at demand points. Food supply chains are made up of organizations that are involved in the production and distribution of plant and animal-based products (Zuurbier et al., 1996). Such supply chains (SCs) can be divided into two main types (van der Vorst, 2000):

- SCs for fresh agricultural products: the intrinsic characteristics of the product remain unchanged and,
- SCs for processed food products: agricultural products are used as raw materials to make processed products with a higher added value.

The main fact that differentiates food SCs from other chains is that there is a continuous change in quality from the time the raw materials leave the grower to the time the product reaches the consumer (Tijskens et al., 2001). A food SC as defined in this paper consists of six links: primary production, ingredient preparation, product processing, distribution, retail and the consumer.

2.1.3 Supply chain risks

Supply Chain Risk refers to an uncertainty or unpredictable event affecting one or more of the parties within the supply chain or its business setting, which can negatively influence the achievement of your own business objectives (Deloitte, 2004).

Supply Chain Risk Management is a structured and synergetic process throughout the supply chain, which seeks to optimize the totality of strategy, processes, human resources, technology and knowledge. The aim is to control, monitor and evaluate supply chain risk, which will serve to safeguard continuity and maximize profitability (Deloitte, 2004).

Supply chain risks come in many different forms. (Harland & Brenchley,2001)) cited in (Christopher and Lee (2004)). First, the financial risks can be huge. Inventory costs due to obsolescence, markdowns and stock-outs, can be significant. The complexity and uncertainty within a supply chain can also increase the "chaos" risks within the supply chain. These chaos affects result from over reactions, unnecessary interventions, second guessing, mistrust, and distorted information throughout a supply chain (Childerhouse, et.al, (2003)) cited in (Christopher and Lee (2004)).

The well-known "bullwhip" effect (Lee, et.al., 1997), which describes increasing fluctuations of order patterns from downstream to upstream supply chains, is an example of such chaos. Deming called this "nervousness." This increased nervousness will of course lead to higher costs and inefficiencies through over-ordering and 'squirreling' of inventory (Christopher and Lee (2004)).

In addition, there are many unexpected and unpredictable disruptions that add to the risks of a supply chain. The closure of the United States air space after the terrorist event of September 11, 2001; the longshoremen strike in California in 2002, and the outbreak of SARS in 2003, are examples of events that paralysed supply chain flows. The impacts of such disruptions can be catastrophic (Christopher and Lee (2004)).

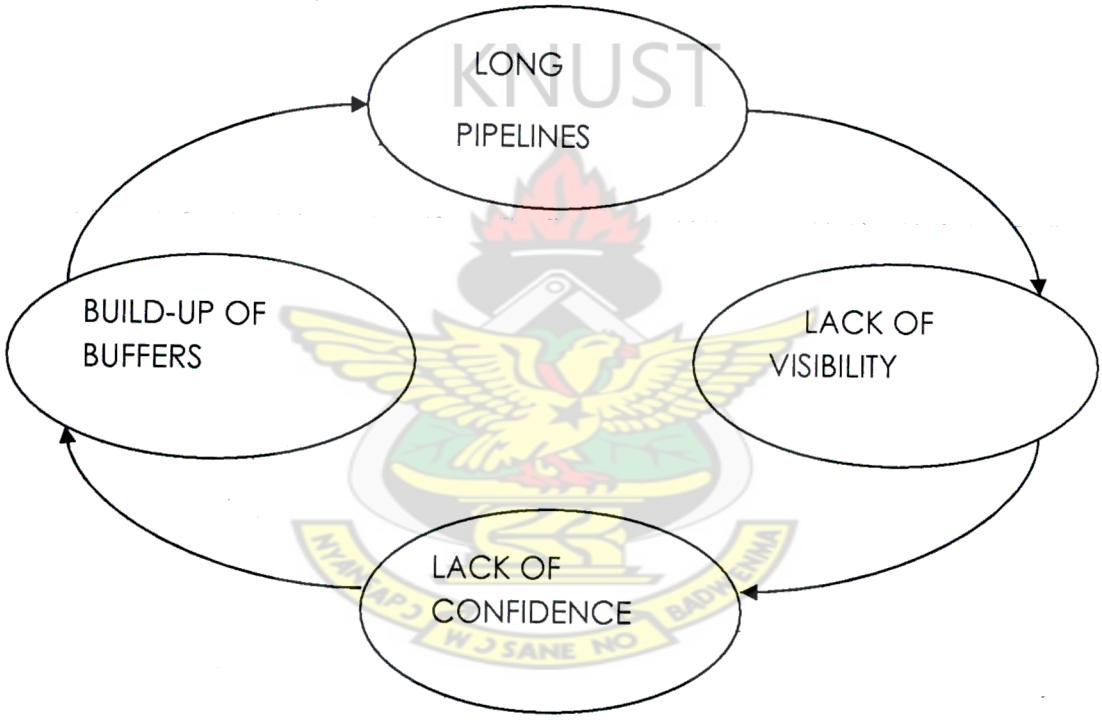


Figure 2.1: The Risk Spiral [modified from (Christopher and Lee (2004)]

Where do these supply chain risks come from? There are evidently tangible risks in the supply chain which lead to its poor performance (Wilding, 1998), for example, high levels of process variation, but what is not recognized in the same way is the intangible elements, for example, the attitudes and perceptions of the users and members of the

supply chain. The intangible lack of confidence in a supply chain leads to actions and interventions by supply chain managers throughout the supply chain, which collectively, could increase the risk exposure. Supply chain partnerships could also retain several inherent risks that can be potentially damaging to participants. These include heavy reliance on one partner which can be disastrous if the partner does not meet expectations (MacBeth and Ferguson, 1994). Also, firms risk decreased competitiveness due to loss of partnership control, complacency (Kalwani and Narayandas, 1995), and over specialization with an affirmed partner.

2.2 Transportation

Efficient transportation systems are the hallmark of industrialized societies. The transportation sector of most industrialized economies is so pervasive that often there is a failure to comprehend the magnitude of its impact on way of life. (Grant et al, 2006) Transportation moves products that are physically separated and provides added value to customers when the products arrive on time, undamaged and in the quantities required. In this way, transportation contributes to the level of customer service, which is one of the cornerstones of customer satisfaction: and important component of the marketing concept. Transportation is one of the largest logistics costs and may account for a significant portion of the selling price of some products. Generally, the efficient management of transportation becomes more important to a firm as inbound and outbound transportation's share of cost increases. Even with high-value products, expenditures for transportation are important although the percentage of selling price may

be low, primarily because the total cost of transportation in absolute terms is significant. (Grant et al, 2006)

According to Russell et al (2003), in a supply chain, transportation refers to the movement of a product form one location to another as it makes it way to the end –user. Although supply chain experts agree that transportation tends to fall through the supply chain cracks, receiving less attention than it should, it can be a significant supply chain cost. Russell et al (2007) continues that for some manufacturing firms, transportation costs can be as much as 20 percent of total production costs and run as high as 6 percent of revenue.

2.2.1 Factors affecting transportation costs and pricing

Grant et al (2006) postulate that factors influencing transportation costs/pricing can be generally grouped into two major categories: product-related factors and market-related factors.

2.2.1.1 Product-related factors

Many factors related to a product's characteristics influence the cost/pricing of transportation. They can be grouped into the following categories:

- Density

Density refers to a product's weight- to- volume ratio. In general, low - density products – those with low weight-to-volume ratios- tend to cost more to transport on a per-pound (or kilo) basis than high - density products. Grant et al (2006)

- Stowability

This is the degree to which a product can fill the available space in a transport vehicle. For example, grain, ore and petroleum products in bulk have excellent stowability because they can completely fill the container (e.g. railcar, tank truck, pipeline) in which they are transported. Other items such as automobiles, machinery, livestock and people, do not have good stowability, or cube utilization.

- Ease or difficulty of handling

Related to stowability is the ease or difficulty of handling the product. Difficult-to-handle ite ams are more costly to transport. Products that are uniform in their physical characteristics (e.g. raw materials or items in cartons, cans or drums) or that can be manipulated with materials- handling equipment require less handling expense and are therefore less costly to transport. The reverse is also true.

- Liability

This is an important concern. Goods that have high value-to-weight ratios are easily damaged, they are subject to higher rates of theft or pilferage, and cost more to transport. Where the transportation carrier assumes greater liability, a higher price will be charged to transport the product.

Other factors which vary in importance depending on the product category are the product's hazardous characteristics and the need for strong and rigid protective packaging. These factors are particularly important in the chemical and plastics industries. (Grant et al, 2006).

2.2.1.2 Market-related factors

In addition to product characteristics, important market-related factors affect transportation costs/ pricing. The most significant are:

- Degree of intramode and intermode competition
- Location of markets, which determines the distance goods must be transported
- Nature and extent of government regulation of transportation carriers
- Balance or imbalance of freight traffic into and out of a market
- Seasonality of product movements
- Whether the product is transported domestically or internationally.

Grant et al (2006) further suggest that customer service is a vital component of logistics management. While each activity contributes to the level of service a company provides to its customers, the impact of transportation on customer service is one of the most significant. The most important transportation service characteristics affecting customer service levels are:

- Dependability – consistency of service
- Time- in- transit
- Market coverage - the ability to provide door-to-door service

- Flexibility – handling a variety of products and meeting the special need of shippers
- Loss and damage performance
- Ability of a carrier to provide more than basic transportation service (i.e. to become part of a shipper's overall marketing and logistics programme.

2.2.2 Modes of Transport

2.2.2.1 Air

Russell et al (2003) point out that airfreight is the most expensive and fastest mode of transportation; it is also the fastest – growing segment of the airline industry. For companies that use airfreight, service is more important than price. The type of products shipped by airfreight tends to be lightweight or small usually less than 500 lb, which require fast delivery. Air carriers generally handle high-value products. They are also used for perishable products like flowers and medical supplies. They also provide frequent and reliable service and rapid time-in-transit but terminal and delivery delays and congestion may appreciably reduce some of this advantage. Grant et al (2006) identifies that despite the limitations of air carriers, the volume of airfreight has grown slightly over the years.

2.2.2.2 Water

Grant et al (2006) suggest that water transportation can be broken down into several distinct categories:

- Inland waterways such as rivers and canals
- Coastal and intercoastal oceans and
- International deep sea

Other than in ocean transport, water carriers are limited in their movement by the availability of rivers, canals or intercoastal waterways. Reliance on water carriage depends to a greater or lesser degree on the geography of the particular location. Water carriage is perhaps the most inexpensive method of shipping high-bulk, low value commodities. Russell et al (2003) also identifies that water transport is still a significant means for transporting certain types of products between specific locations, although it is less visible and publicized than other modes of transport. Russell et al (2003) further identifies that water transport is a low – cost form shipping and also slow. It is limited to heavy, bulk items such as raw materials, minerals, ores, grains, chemicals and petroleum products. If delivery speed is not a factor, water transport is cost competitive with railroads for shipping these kinds of bulk products. Water transport is the only means of international shipping between countries separated by oceans for most products, since air transport is limited to a very narrow range of freight items. Transoceanic shipping companies have been effective in developing intermodal transport systems using container systems and container ships. Standardised containers that fit on rail flat cars and can be reloaded onto truck trailers are an effective and economical means of transporting products across long distances that encompass land and water. Russell et al (2003).

2.2.2.3 Rail

Railroads are particularly good for transporting low-value, high-density, bulk products such as raw materials over long distances between major distribution centers. Such products generally require little sorting or classification. Grant et al (2006) opine that rail transport lack the versatility and flexibility of motor carriers because it is limited to fixed track facilities. They also think that do not compare favourably to other modes in terms of loss and damage ratios and late deliveries. Russell et al (2003) also opine that railroads are not as economical for shipping small loads over short distances because of the high cost of terminal handling and the inflexibility of rail lines. Railroads also operate on less flexible schedules than trucks, and they usually cannot go directly from one business location or plant to another as trucks can; trains operate from railyard to railyard.

2.2.2.4 Truck or Road

Trucks provide flexible point-to-point service, delivering small loads over short and long distances over widely dispersed geographic areas. (Russell et al, 2003). Motor carriage offers fast, reliable service with damage or loss in transit. Trucks are very flexible and versatile because they can transport products of varying sizes and weights over any distance. Virtually any product can be transported by trucks, including some that require equipment modifications. (Grant et al, 2006). The literature agrees on two forms of trucking – full-truckload (TL) and less-than-truckload (LTL). TL carriers charge for the truck regardless of the quantity shipped, and rates vary with distance. LTL carriers charge rates depending on the amount carried and the distance travelled. As a result, TL shipping is more economical for large shipments while LTL is cheaper for small shipments. A key

to cost-effective LTL shipping is to consolidate loads from different customers in order to travel with full or nearly full loads. In order to accomplish this, LTL companies use regional consolidation centers, where trucks come together to build full truckloads. (Russell et al, 2003). However, the use of consolidation centers, and the fact that LTL carriers must make numerous pick-up and delivery stops, tends to increase delivery time. The literature also agrees on the fact that for truck or road transport to be effective there must be a good and effective road network system.

2.2.2.5 Pipelines

Pipelines are able to transport only a limited number of products, including natural gas, crude oil, petroleum products, water, chemicals and slurry products. Natural gas and crude oil account for the majority of pipeline traffic. Pipelines offer the shipper an extremely high level of service dependability at a relatively low cost. They are able to deliver their product on time because of the following factors.

- The flows of product within the pipeline are monitored and controlled by computer.
- Losses and damage due to pipeline leaks or breaks are extremely rare.
- Climatic conditions have minimal effects on products moving in pipelines.
- Pipelines are not labour-intensive; therefore, strikes or employee absences have little effect on their operations (Grant et al, 2006).

Pipelines, called slurry lines, carry other products that have been pulverized or transformed into liquid form, like coal or kaolin. Once the product arrives at its destination, the water is removed, leaving the solid material. Although pipelines require a high initial capital investment to construct, they are economical because they can carry materials over terrain that would be difficult for trucks or trains to travel across, e.g. the Trans-Alaska pipeline. Once in place, pipelines have a long life and are low-cost in terms of operation maintenance and labour. (Russell et al, 2003).

2.2.3 Transport in Ghana

Transport in Ghana is accomplished by road, rail, air and water. Ghana's transportation and communications networks are centered in the southern regions, especially the areas in which gold, cocoa, and timber are produced. The northern and central areas are connected through a major road system; some areas, however, remain relatively isolated (www.wikipedia.com).

The deterioration of the country's transportation and communications networks has been blamed for impeding the distribution of economic inputs and food as well as the transport of crucial exports. Consequently, the first priority of the Economic Recovery Programme was to repair physical infrastructure. Under the program's first phase (1983-86), the government allocated US$1.5 billion, or 36 percent of total investment, for that purpose and an additional US$222 million in 1987 for road and rail rehabilitation. In 1991 the Ghanaian government allocated 27 percent of its budget for various road schemes (www.wikipedia.com).

Foreign donor support helped to increase the number of new vehicle registrations from eight thousand (8,000) in 1984 to almost twenty thousand (20,000) in 1989. The distribution of vehicles was skewed, however, because, by 1988, more than half of all vehicles were in Accra, which contained approximately seven (7) percent of the country's population. Furthermore, most new vehicles are intended for private use rather than for hauling goods and people, a reflection of income disparities. Transportation is especially difficult in eastern regions, near the coast, and in the vast, underdeveloped northern regions, where vehicles are scarce (Wikipedia, 2009).

2.2.3.1 Railway system in Ghana

The railway system in Ghana has historically been confined to the plains south of the barrier range on mountains north of the city of Kumasi. However, the 1,067 mm (3 ft 6 in) narrow gauge railway, totaling nine hundred and thirty-five (935) kilometres, is presently undergoing major rehabilitation and inroads to the interior are now being made. In Ghana, most of the lines are single tracked, and in 1997 it was estimated that thirty-two (32) kilometres were double tracked. There have, however, been initiatives to expand rail facilities in Ghana.

These projects, however, are yet to be completed since according to the Minister of Transport on a TV 3 news item on Friday, 10th July, 2009, rail transport in Ghana is seriously challenged and in need immediate help in order to salvage it. He made this statement when he visited Kwame Nkrumah Circle in Accra where a train had derailed.

2.2.3.2 Road transport

In 1997, it was estimated that there was a total of thirty-nine thousand, four hundred and nine (39,409) kilometres of highways in Ghana of which eleven thousand, six hundred and fifty-three (11,653) kilometres are paved (including 30 km of expressways). The remaining twenty-seven thousand, seven hundred and fifty-six (27,756) kilometres were unpaved.

2.2.3.3 International highways

The Trans-West African Coastal Highway, part of the Trans-African Highway network crosses Ghana, connecting it to Abidjan, (Côte d'Ivoire), Lomé, (Togo) as well as Benin and Nigeria. Eventually the highway will connect to another seven ECOWAS nations to the west. A paved highway also connects Ghana north to landlocked Burkina Faso, where it joins another highway in the Trans-African network, the Trans-Sahelian Highway.

2.2.3.4 Ferries and waterways

The Volta, Ankobra, and Tano rivers provide 168 km of perennial navigation for launches and lighters; Lake Volta provides 1,125 kilometres of arterial and feeder waterway. There are ferries on Lake Volta at Yeji and Kwadjokrom.

2.2.3.5 Marine transport

Seaports and harbours

There are ports on the Atlantic Ocean at Takoradi and Tema.

Merchant marine

There are six ships (with a volume of 1,000 gross register tons (GRT) or over) totaling 13,484 GRT/18,583 metric tons deadweight (DWT). This includes two petroleum tankers and four refrigerated cargo vessels (1999 estimates).

2.2.3.6 Aviation

Ghana has twelve airports, six with hard surfaced runways. The most important are Kotoka International Airport at Accra and airports at Sekondi-Takoradi, Kumasi, and Tamale that serve domestic air traffic. In 1990, the government spent US$12 million to improve Accra's facilities. (Wikipedia)

Of the various modes of transport in Ghana, road transport is the most developed and widely available in oil palm growing areas. Water, air and pipeline transportation are virtually non-existent in these areas. However, major challenges such as poor road infrastructure, poor road network and inaccessibility still plague even these areas where the so-called roads are developed.

2.3 Optimization

Simply put, optimization is the process of choosing the actions that result in the best outcome. With this definition, it's clear that every living thing—and every enterprise—on the planet is, in some sense, involved in optimization. Whether the goal is survival of the species through propagation, maximization of profits through production decisions, or minimization of risk with purchasing strategies, we're all striving to optimize something— or, more likely, several things (www.2.sas.com).

Optimization refers to a collection of mathematical principles and methods used for solving quantitative problems in many disciplines, including physics, biology, engineering, economics, and business. The subject grew from a realization that quantitative problems in manifestly different disciplines have important mathematical elements in common. Because of this commonality, many problems can be formulated and solved by using the unified set of ideas and methods that make up the field of optimization (Encyclopedia Britannica). Optimization means "the action of finding the best solution". Mathematical Programming, or optimization modeling, is a branch of mathematical modeling which is concerned with finding the best solution to a problem (Eudoxus system 2003).

The historic term mathematical programming, broadly synonymous with optimization, was coined in the 1940s before programming became equated with computer programming. Mathematical programming includes the study of the mathematical structure of optimization problems, the invention of methods for solving these problems, the study of the mathematical properties of these methods, and the implementation of these methods on computers. Faster computers have greatly expanded the size and complexity of optimization problems that can be solved. The development of optimization techniques has paralleled advances not only in computer science but also in operations research, numerical analysis, game theory, mathematical economics, control theory, and combinatoric (EncyclopdediaBritannica).

2.3.1 Reducing fuel consumption

Going by the definition of optimization as the process of choosing the actions that result in the best outcome, one can conveniently say that transportation costs can be optimized or reduced by choosing certain actions that would improve fuel economy; hence reducing fuel consumption, thereby reducing the amount spent on fuel. Fuel costs are a considerable part of transportation costs. Therefore, their reduction can lead to an appreciable reduction in transportation costs.

2.3.1.1 The Role of the Driver

The driver's behaviour can play a significant role in achieving fuel efficiency that will translate into a reduced growth in fuel consumption. Jones and Collings (1999) argue that the driver's right foot is a significant factor that must be considered if fuel efficiency is to be improved. According to them, trials on test tracks have shown that a skilled driver can achieve up to 25% better mpg without significantly increasing journey times.

An Energy Efficiency Best Practice Programme (EEBPP) case study, Energy Savings Through Improved Driver Training, shows that a driver training scheme implemented by a freight operator proved to be highly cost effective in achieving fuel savings of 8% in the first year, while significantly reducing maintenance costs and almost halving the cost of accidents, in addition to cutting annual carbon emissions by an estimated two hundred and ten (210) tonnes in the UK.

After a vehicle has been designed, engineered and manufactured the driver can have the greatest influence on its fuel economy. Different driving styles are a major reason why

the fuel economy label indicates that mileages can vary. What little research there is on the subject indicates that typical drivers can increase their miles per gallon by about 10% by diligently adopting good driving practices (www.cta.ornl.gov).

Driver behavior such as minimizing unnecessary braking, observing the speed limit, and avoiding excessively rapid acceleration can improve fuel economy by a few percent over normal driving behavior (www.cleanairnet.com).

Curbing aggressive driving could bring about a five (5) percent improvement in city driving and even more on the highway. Observing speed limits could also result in a 7-8% fuel economy benefit for every five (5) mph slower at highway speeds. Car "housecleaning", that is, removing unnecessary weight from the cargo compartment, as well as car top carriers when not in use could also bring about a two (2) percent improvement for each one hundred (100) lbs unloaded. Avoiding unnecessary idling could also increase fuel economy. Drivers must always shut down the engine and restart instead of idling even for a few seconds (www.cta.ornl.gov).

2.3.1.2 Vehicle Maintenance

Proper vehicle maintenance can also improve fuel economy. Keeping tyres inflated to manufacturer's recommended pressure, keeping wheels properly aligned and balanced, oil changes on manufacturers' recommended intervals with the recommended grade of fuel saving oil; replacing dirty air filters and keeping you engine in proper tune can all help maximize miles per gallon (www.cta.ornl.gov).

Poor vehicle maintenance and certain operational practices—such as overly retarded injection timing, not correctly inflating tyres, or driving behavior characterized by sudden

acceleration and deceleration lower fuel economy. Retarded injection timing increases fuel consumption under all circumstances. Low tyre pressure increases vehicle rolling resistance causing higher engine power levels and increased fuel consumption by 5–10 percent. Some studies have reported fuel consumption differences of as much as fifteen (15) percent. It is possible to increase fuel economy by another few percent via optimal vehicle maintenance. However, poorly maintained roads make it difficult for drivers to maintain a steady speed and lower fuel economy markedly (www.cleanairnet.com).

2.3.1.3 Speed Limits

Reducing speed limits can save fuel, but at a cost of increased travel time. For each 5 mph above 55 mph, fuel economy decreases by about 7%. A retrospective study of the 55 mph speed limit by the National Academy of Sciences (NAS) found that it saved 1-3% of highway fuel use and also improved highway safety (NAS, 1984) (www.cta.ornl.gov). Everything else remaining the same, lowering the vehicle weight (and hence decreasing the vehicle size) and power increases fuel economy (www.cleanairnet.org).

2.3.2 Dijkstra's Algorithm

Dijkstra's algorithm, conceived by Dutch computer scientist Edsger Dijkstra in 1959, is a graph search algorithm that solves the single-source shortest path problem for a graph with nonnegative edge path costs, producing a shortest path tree. This algorithm is often used in routing.

For a given source vertex (node) in the graph, the algorithm finds the path with lowest cost (i.e. the shortest path) between that vertex and every other vertex. It can also be used

for finding costs of shortest paths from a single vertex to a single destination vertex by stopping the algorithm once the shortest path to the destination vertex has been determined. For example, if the vertices of the graph represent towns or cities and edge path costs represent driving distances between pairs of towns or cities connected by a direct road, Dijkstra's algorithm can be used to find the shortest route between one city and all other cities. As a result, the shortest path theory is widely used in routing protocols (Wikipedia, 2009).

Algorithm

Let's call the node we are starting with an initial node. Let a distance of a node Y be the distance from the initial node to it. Dijkstra's algorithm will assign some initial distance values and will try to improve them step-by-step.

1. Assign to every node a distance value. Set it to zero for our initial node and to infinity for all other nodes.

2. Mark all nodes as unvisited. Set initial node as current.

3. For current node, consider all its unvisited neighbours and calculate their distance (from the initial node). For example, if current node (A) has distance of 6, and an edge connecting it with another node (B) is 2, the distance to B through A will be 6+2=8. If this distance is less than the previously recorded distance (infinity in the beginning, zero for the initial node), overwrite the distance.

4. When we are done considering all neighbours of the current node, mark it as visited. A visited node will not be checked ever again; its distance recorded now is final and minimal.

5. Set the unvisited node with the smallest distance (from the initial node) as the next "current node" and continue from step 3.

2.4 Oil Palm

There are two schools of thought as to whether the oil palm is indigenous to West Africa or not. One school of thought led by Chevalier (1934) holds that it is: whilst the other, held mainly by American scientists and championed by O. F. Cook (1901, 1910, 1940, and 1942), claims that the oil palm has been introduced within historical time from Brazil. The truth is that the oil palm is now so well established in West Africa, and especially in parts of Ghana, as to appear indigenous. (La Anyane, 1963)

The oil palm (Elaeis guineensis) is a native of West Africa. It flourishes in the humid tropics in groves of varying density, mainly in the coastal belt between 10 degrees north latitude and 10 degrees south latitude. It is also found up to 20 degrees south latitude in Central and East Africa and Madagascar in isolated localities with a suitable rainfall. It grows on relatively open ground and, therefore, originally spread along the banks of rivers and later on land cleared by humans for long-fallow cultivation (Hartley 1988: 5—7).

The palm fruit develops in dense bunches weighing 10 kilograms (kg) or more and containing more than a thousand individual fruits similar in size to a small plum. Palm oil

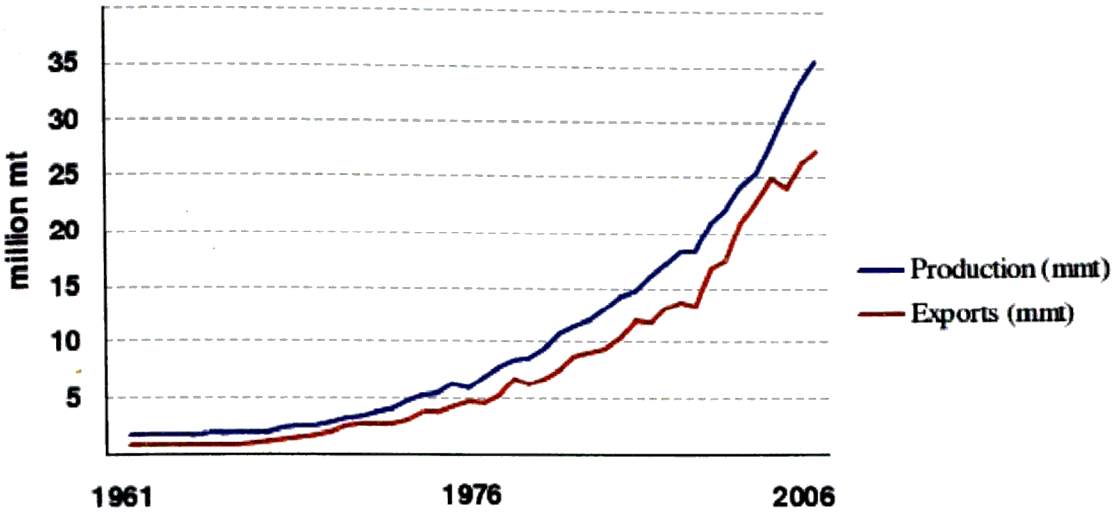
is obtained from the flesh of the fruit and probably formed part of the food supply of the indigenous populations long before recorded history. It may also have been traded overland, since archaeological evidence indicates that palm oil was most likely available in ancient Egypt. The excavation of an early tomb at Abydos, dated to 3000 B.C., yielded "a mass of several Kilograms still in the shape of the vessel which contained it" (Friedel 1897).

In West Africa, local populations have used it to make foodstuffs, medicines, woven material and wine over centuries. Today's large-scale plantations are mostly aimed at the production of oil which is extracted from the fleshy part of the palm fruit and kernel oil, which is obtained from the nut. Palm oil is an edible vegetable oil produced from the fruits of oil palms. Oil palm plantations, composed of specially selected and cloned varieties of palm trees, start to produce fruit after four to five years and reach maturity and the highest rate of productivity when the trees are 20 to 30 years old. Oil palms can grow 20 meters tall with leaves up to 5 meters long. They bear clusters of fruit all year long, with each fully matured cluster weighing up to 25 kilograms. The fruit bunches, each weighing between 15 and 25 kilograms, are made up of between 1000 and 4000 oval-shaped fruits, measuring some three to five centimeters long. The fruits contain about 50 percent oil. Oil palms are highly efficient oil producers, requiring up to ten times less land than other oil-producing crops. Once harvested, the fleshy part of the fruit is converted into oil through a series of processes, while the palm kernel oil is extracted from the nut itself. The processing of the crude oil gives rise to two different products: 1) palm stearin and 2) palm olein. The stearin, which is solid at room temperature, is used almost entirely for industrial purposes such as cosmetics, soaps, detergents, candles,

lubricating oils, while the olein, liquid at room temperature, is used exclusively in foodstuffs cooking oil, margarines, creams, cakes and pastries.

2.4.1 The Global Expansion of the Palm Oil Sector

Worldwide, the palm oil sector has grown remarkably during the past decades. The production level of palm oil has reached that of soybean oil and surpassed other vegetable oils (Table 1). There are several reasons for this growth. Out of all the vegetable oil crops, the palm oil produces the highest yields (about 5000 kg oil/ha). This high performance is not only due to high yields, but also to the low production costs in comparison to other oil crops. Soy oil is estimated to have 20% higher costs; followed by sunflower oil, coconut oil and finally rapeseed oil. It is also worth mentioning that governance structure of this chain in developing countries has facilitated the expansion and modernization of production and trade, as the lead firms have been able to upgrade technologically in order to maintain a competitive position. There a few producing countries and a limited number of players in each country. Finally, this industry has benefited from a policy environment. In most countries, including large producers such as Malaysia and Indonesia, the government has had a strong presence, being the key promoter of the industry. Foreign direct investment has been attracted and high investments in R&D, infrastructure, processing, and marketing and trade promotion programs have been supported by government policies, creating an ideal environment for the expansion of the industry.



Source: FAO, 2006

Figure 2.2 Global Palm Oil Production and Trade

World palm oil production doubled from 5 million to 11 million tons from 1980 to 1990. Production doubled to 21.8 million tons by the year 2000. World production of oilseeds and palm oil is forecast to expand. World consumption for oilseeds is forecast to increase by 7 percent, and palm oil consumption to increase by 3 percent. Biodiesel is one factor of the increasing demand. This industry converts approximately one ton of vegetable oil into one ton of biodiesel. World interest in biodiesel production is expanding rapidly because of the current high world price for crude oil, making biodiesel production more attractive. In the case of Brazil, the world's largest biodiesel producer, a mere 5% mixture of biodiesel with fossil fuels would be enough to reduce Brazil's imports of petroleum by 2 billion liters per year; of the 40 billion they presently import (USDA, 2004).

2.4.2 The Palm Industry in Ghana

By 1820, trade in palm oil had begun, but existed only to a small extent. The Government under George Maclean imparted great impetus to the processing and export of palm. It became the principal agricultural item of trade in the country from 1850 onwards. Oil palm production for export reached a peak in 1884 when some 20,000 tons of palm oil and 40,000 tons of palm kernel were exported. (La Anyane, 1963)

The palm oil industry in Ghana has expanded over the past twenty years, creating employment opportunities in rural areas, as well as forward and backward linkages to complementary industries. Ghana produced 42,000 tons of palm oil in 1985. This increased to a whopping 117,000 tons in 2005. (FAOSTAT, 2007) The palm oil industry is by now well-established and has generated employment and a source of income in the areas where it is grown.

However, it still has its fair share of problems. It is estimated that 80% of the producers nationwide have no access to transportation and are forced to sell to intermediaries who collect the fruit directly at the plantation. Buying or renting trucks is not an option for them because of the high costs. JOPOCOS, one of the leading palm producers' associations in Ghana, has tried to bring producers together so they establish collection centers for transportation services to pick up the fruit. Another hurdle producers have is the deficient roads. Most of the roads used are unpaved and during the rainy season, these roads are sometimes almost completely destroyed. (JOPOCOS)

It is expected that 200,000 hectares of oil palm will be planted. This is more than double the amount of land cultivated at the moment and the expansion of plantation area has

several economic and environmental implications. Although incentives are offered to producers in the form of inputs such as seedlings and fertilizers as a result of the President's Special Initiatives, many small-scale producers lack capital to start operations in the plantations. The initial work is capital and labor-intensive.

2.4.3 Uses of palm oil

Because of its distinct properties, palm oil is perfectly suited for application in a wide range of food and non-food products. For example, palm oil is used to make shampoos, soap and other cosmetics more 'creamy'. The oil can also be used as an ingredient to margarine, chocolate, ice cream and many other food products. In fact, palm oil is used in about half of all packaged food products in supermarkets today. More recently, palm oil has also been used to make fuels for transportation and power plants.

Palm oil exports also support the economies of developing countries. Thanks to palm oil's versatility, world production has grown steadily in recent years. In 2007, palm oil accounted for a third of the 130 million tonnes of vegetable oil produced worldwide. Palm oil has recently surpassed soy oil as the world's most popular vegetable oil.

Malaysia and Indonesia together produce about 85 percent of the world's palm oil; they are also by far the biggest exporters. Other exporters include Nigeria, Thailand, Colombia, Ecuador, Papua New Guinea, Ivory Coast and Brazil. All are developing countries where palm oil trade has the potential to contribute significantly to local economic growth and poverty reduction. Palm oil production employs and supports more than seven million plantation workers, smallholders and their families. Of the estimated

29.4 million tonnes of palm oil exported in 2007, 56 percent went to Asia, 16 percent went to the European Union, and 12 percent went to Africa.

2.5 Summary

This chapter reviewed relevant literature on supply chains, transportation, transportation in Ghana, oil palm and the Dijkstra's Algorithm. The next chapter would examine the research methodology and give a brief organizational profile of JOML.

CHAPTER THREE

RESEARCH METHODOLOGY AND ORGANIZATIONAL PROFILE

3.0 Introduction

This chapter contains the research methodology and the organizational profile of Juaben Oil Mills Ltd.

3.1 Research Methodology

3.1.1 Research Design

The descriptive survey is the design that was used in this study. It was used because of several reasons advanced by authorities in research methodology. Descriptive research involves collecting data in order to address research questions concerning the current status of the subject of study. It also determines and reports the way things are (Gay, 1987). The descriptive design is towards determining the nature of a situation as it exists at the time of the study.

3.1.2 Scope of Study

The case study of Juaben Oil Mills was aimed at investigating the current transportation efficiency and the challenges associated with the transportation system. This study will thus aim at finding immediate solutions to the study and make necessary recommendations to be applied in the future.

3.1.3 Population

The case study organization (JOML) has about three hundred (300) permanent staff in different departments. The various departments are the, Accounts and Administrative

Department, Technical and Maintenance Department, Out grower Department, Transport and Supply Chain Department, Quality Assurance Department and the Stores Department.

The Chief Executive Officer, Transport Officer and all twenty - four drivers at the Juaben Oil Mills were interviewed. In all, twenty – six people were interviewed,

3.1.4 Method of Data Collection

i) Sampling Technique

Purposive sampling, a non-probability sampling technique was used to target the drivers, transport officer and the Chief Executive Officer. This is because they possessed the answers the researcher required for the study. A well-designed questionnaire was used for achieving the objectives of this study. Questionnaires were handed over personally by the researcher to the CEO, Transport Officer and the drivers.

This allowed the researcher the opportunity of establishing rapport, to explain the purpose of the study and also the meaning of the items that were not clear.

ii) Data Collection

Primary data was obtained using questionnaires, personal observations, formal and informal interviews with departmental heads and assistants, and sampled workers. As defined by Saunders et al., (2007) primary data 'is data that has been collected specifically for the research project being undertaken. Questionnaires were used to collect this primary data on specific questions, but there was room for open discussion so that the interviewees could share complementary information on various issues.

Secondary data was obtained from relevant published and unpublished reports written on JOML's operations and other related materials. This provided relevant background information on the actual research survey.

iii) Measurement Variables

The researcher used a detailed questionnaire made up of closed and open ended questions to collect the data. With the closed ended questions (items), respondents were required to answer either 'yes' or 'no' or to choose from alternative answers provided. To the open ended questions, respondents were requested to give their views on issues raised.

3.1.5 Data Analysis

A computer software, Statistical Package for Social Sciences (SPSS), was used to determine the degree of assertion in the perceptual data collected.

3.1.6 Research Constraints and Problems

As much as the subject matter was found to be interesting and of much importance to the firm it focused on, the limited time available for the study did not allow for a more detailed research, both field and secondary.

Moreover, interviewees were sometimes dishonest on questions for fear that the Company would be disgraced of her shortcomings.

3.2 ORGANIZATION PROFILE OF JUABEN OIL MILLS LTD (JOML)

3.2.1 Historical background

Juaben Oil Mills (JOML) is a private, wholly Ghanaian-owned Company with the paramount chief of the Juaben Traditional area, Nana Otuo Siriboe II, being the Executive Chairman. It is located at the Juaben Traditional area, within the Ejisu/Juaben District in the Ashanti Region of Ghana and about thirty-two (32) kilometers east of Kumasi. According to 1990 census figures the total population of Juaben was seventeen thousand (17,000). The people are mainly farmers, who cultivate food crops and vegetables. Oil Palm is cultivated mainly as a cash crop.

3.2.2 Legislation/Establishment

JOML was incorporated in 1981 under the Companies Code, 1963 (Act 179) with its liability limited by members. JOML, however, commenced operations as a processor of palm fruit in 1984. Juaben Oil Mills is complying with safety and health regulations at work places, prescribed under the 1963 factory ordinance; which covers the provision of protective clothes, safety boots, and ear/nose guards for noise and dust control respectively. Health status of workforce is also maintained by periodic medical check-ups and payment of hospital expenses for both staff and dependants.

3.2.3 Economic Activities.

Juaben Oil Mills Ltd is a major and leading Agro-Industry concern in the town and within the Traditional area. It employs three hundred (300) people and, with the Juaben Farm Nucleus and Outgrower Plantations, about one thousand, five hundred (1,500)

people and their dependents are employed. Juaben is linked to the sea- port by fairly good road net-work which is about 3-4 hours drive. The inland port under construction at Boankra is just some fifteen (15) kilometres away and would therefore facilitate the movement of finished products for export.

3.2.4 Juaben Farms Limited

Incorporated in August 1995, the Juaben Farms Limited has shareholders with Juaben Oil Mills being a major shareholder. The Company owns five hundred and nineteen (519) hectares (about 2,076 acres) of farm land which has been cultivated with Oil-Palm.

3.2.5 Juaben Outgrower Scheme

JOML has within the past sixteen (16) years as part of its backward integration and raw material security programs encouraged and assisted about two hundred (200) farmers to cultivate about four hundred (400) hectares (about 1,600 acres) of oil-palm plantation. JOML provided them with cash advances, seedlings and other inputs with the arrangement that fruits would be supplied to the Mill. The Juaben Farm Nucleus and Outgrower Plantations, have employed about one thousand, five hundred (1,500) people and it is a source of livelihood for them and their dependents.

3.2.6 Presidential Special Initiative (PSI)

The company has been one of the pillars of the Presidential Special Initiative (PSI) on oil palm, as a result of which some three thousand, five hundred and ninety-four (3,594) hectares of oil palm farms have been developed for about one thousand, five hundred (1,500) farming families in the Company's catchment's area since 2004. It is envisaged

that an extra two thousand, five hundred (2,500) hectares of farms will be developed in the next two years.

3.2.7 The Organization (JOML)

Juaben Oil Mills is a private/wholly Ghanaian-owned firm that has made significant strides in the vegetable oil seed processing industry since its inception in 1981.

The main objective of JOML is the processing of crude vegetable oil seed and further value-adding by refining, bleaching, deodorizing and fractionating of crude vegetable oil. JOML in that quest is currently in the processing of Crude Palm Oil, Crude Palm Kernel Oil, Crude Shea Butter and refined vegetable cooking oil.

From a humble beginning with a 3-Mt.per hour capacity Oil Palm fresh fruit bunch (FFB) mill the firm has in the last four years undertaken significant expansion, modernization and up-dating programs to improve the overall competitiveness and now poised to take the leadership in the small/medium-scale oil seed processing industry in Ghana.

The firm can now boast of a milling capacity of fifteen (15) Mt. /h FFB for Oil palm, about one thousand (1,000) Mt per month input for shea nuts, nine (9) Mt. per day for palm kernel and about fifty (50) Mt/day for refined, bleached and deodorised and fractionated palm olein.

The organization's source of palm fruits is mainly from the Juaben Farms Ltd which contributes about six (6) percent of the raw material base. The Juaben Outgrower scheme contributes about twenty-two (22) percent of the raw material base. Finally palm fruits

are bought from private farmers in the region and beyond which contributes to about seventy-two (72) percent of the raw material base.

Shea nut is also available but seasonal. It is a relatively stable product and sourced from the North. It is seasonal but purchases are made to stock in the peak season for processing during the lean season to meet demand.

JOML has three main water pumping stations around which is able to feed the Company's water consumption of about six hundred (600) cubic meters and further supply water into the main town water supply.

JOML over the years has been exploring all means to eliminate or minimize environmental problems and, in 1992, it acquired a specially designed state of the art ten (10) Mt. per hour steam Boiler which uses as fuel, the waste products – empty bunches, fibre, and kernel shells, from Messrs. Vyncke N.V Horlelbeke Belgium. The technology for the design of the Boiler –viz-Underfeeding Stoking and the independent control of the use of primary and secondary air and fuel result in the virtual absence of smoke from the combustion process.

Due to the erratic nature of the main power supply from Kumasi, JOML has secured a five hundred and thirty (530) KVA Stem turbine generator coupled to the 10 Mt. per hour steam Boiler. This has secured its energy and power needs and as part of its social responsibility supplies free power to the Government Hospital.

JOML can also boost of good, experienced, technical qualified and skilled personnel. They hold MBA, ACCA, MSc, BSc, HND, technicians' trade certificates among others

in craftsmanship. Others have had various on-the job apprenticeship training and tutelage in their chosen vocations with master and experience skilled persons in various private workshops and followed up with long periods of on-the-job experience in other establishments.

Juaben Oil Mills also provides a forward and integrated linkage to both existing and potential small-scale oil palm processing mills as well as women groups engaged in traditional shea butter processing in the North who sells their crude and poor quality palm oil and shea butter products to Juaben for further value-addition and marketing.

3.3 Summary

In this chapter, the research methodology was discussed and the organizational profile of Juaben Oil Mills Ltd was given.

In the next chapter, a detailed analysis of the questionnaires administered would be discussed using the software, Statistical Package for Social Sciences, Version 16.0.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter analyses and discusses the responses obtained from the questionnaires administered.

Questionnaires were administered to all twenty-four (24) drivers, the Transport Officer and the Chief Executive Officer. In all 26 people were given questionnaires and a 99 percent response rate was obtained.

4.2 Investigating the current transport efficiency of Juaben Oil Mills Ltd.

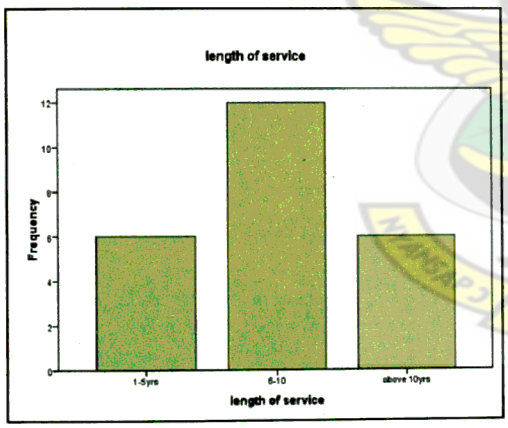


Fig.4.1 How long have you been working with this organization?

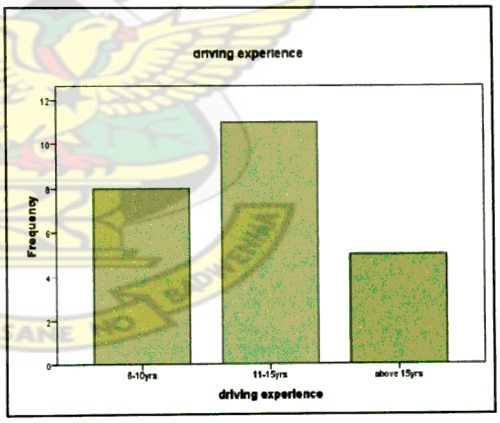


Fig.4.2 How many years of driving experience do you have?

Source: Author's field study

Out of twenty-four (24) drivers, six (6) representing twenty-five (25) percent have worked between 1- 5 years with the organization. Twelve (12) of them representing fifty (50) percent have worked between 6 – 10 years and another six (6) representing twenty-

five (25) percent have worked more than ten (10) years with the organization. Moreover, eleven (11) and five (5) of them have worked between 11 -15 years and more than fifteen (15) years experience respectively as shown in Fig. 4.2. From this statistics, there is every indication that they have had a considerable level of experience and their skills have improved over the years. This is because driver skill as any complex motor skill improves with practice. It can also be noted that they are more familiar with the routes that they plow and are more conversant with the culture and values of the organization with respect to their jobs. It can also be confirmed that their transport efficiency with respect to driver skill and experience has also improved. This means that lesser amount of fuel would be used to achieve the same level of output which otherwise would have been achieved by relatively more fuel. The resultant cost savings would translate into a reduced transportation costs. According to Jones and Colling (1999), trials on test tracks have shown that a skilled driver can achieve up to twenty –five (25) percent better miles per gallon without significantly increasing journey times.

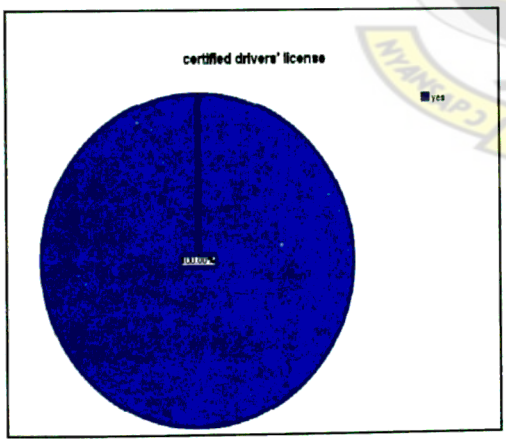


Fig.4.3 Do you have a drivers' license?

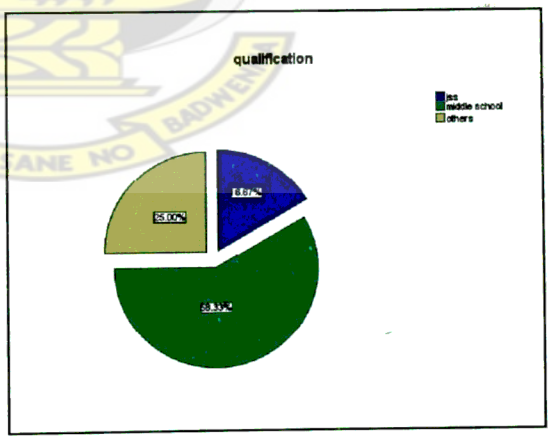


Fig. 4.4 What qualification do you hold?

All twenty-four (24) drivers were duly licensed by the Driver and Vehicle Licensing Authority as indicated by the responses given. One hundred (100) percent of them had

the appropriate grade of license to enable them operate the trucks they use. It can be concluded that if the preliminary test on which the issuance of the license was based was efficiently done, all things being equal, drivers have the basic knowledge of driving, traffic regulations and interpretation of road signs. These go to enhance their skills and make them more efficient. It also follows that they have acquired knowledge of prudent driving practices that improves miles per gallon and thus enhance fuel efficiency which has a greater ability to optimize transportation costs. It was evident that the educational background of drivers was low. Drivers' educational background ranged from Primary education through Junior Secondary School to Middle School. Fourteen (14) drivers representing 58.33 percent had Middle School Leavers' Certificate. Six (6) of them representing twenty-five (25) percent had formal education below Junior Secondary School or Middle School and four (4) representing 16.67 percent had education up to Junior Secondary School level. As one progresses along the education ladder, his intellect is enhanced and that enables him to be creative, more critical and versatile. Driving is a profession and there must be an acceptable minimum level of education so as to ensure that individuals have the intellectual ability to drive. Driving is a very complex activity that involves the use of the brain, eyes, hands and legs all at the same time. It requires a high ability to promptly and accurately assess situations and act. Drivers at JOML have low educational backgrounds. Their intellect can therefore be said to be low and they may falter when difficult situations arise in their line of duty. Mistakes they may commit may cost the organisation some financial resources. This may increase transportation costs.

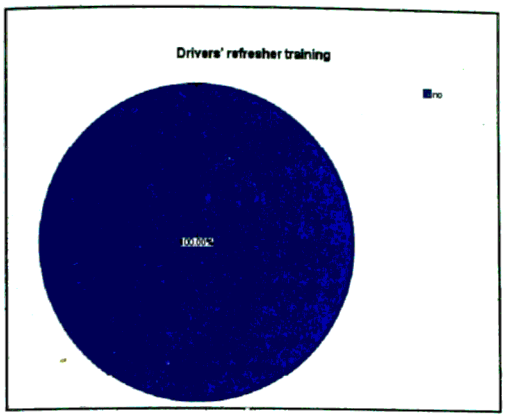


Fig. 4.5 Do you undergo any internal training on road safety?

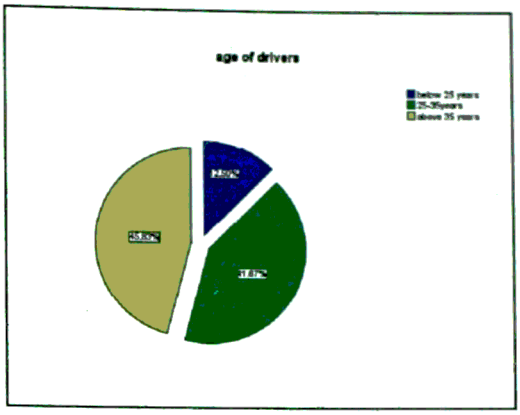


Fig. 4.6 How old are you?

Source: Author's field study

All twenty-four (24) drivers representing one hundred (100) percent answered negative to the question of on-the-job training for drivers. This was also corroborated by the response given by the Transport Officer to the same question. Thus, drivers have to rely on their experience and outdated knowledge to carry out their duties in the face of new challenges. This lack of refresher training is causing the organization some good savings they could have made on fuel. An Energy Efficiency Best Practice Programme (EEBPP) case study, Energy Savings Through Improved Driver Training, shows that a driver training scheme implemented by a freight operator proved to be highly cost effective in achieving fuel savings of 8% in the first year, while significantly reducing maintenance costs and almost halving the cost of accidents, in addition to cutting annual carbon emissions by an estimated two hundred and ten (210) tonnes in the UK (Jones and Colling, 1999).

Three (3) drivers representing 12.5 percent were aged below twenty-five (25) years. Ten (10) of them representing 41.7 percent were aged between twenty-five (25) and thirty-

five (35) years, while eleven (11) representing 45.8 percent were above thirty-five (35) years old. Most of the drivers are aged above thirty-five (35) years old and thus could be said to be elderly, more experienced and would exhibit more caution when driving. This can also account for the low accident rate recorded by the organization. On the other hand, as people age they become less productive. Their work output is relatively lower than that of their younger counterparts. This may mean more resources spent to obtain the same level of output. This may increase transport-related costs to the organization.

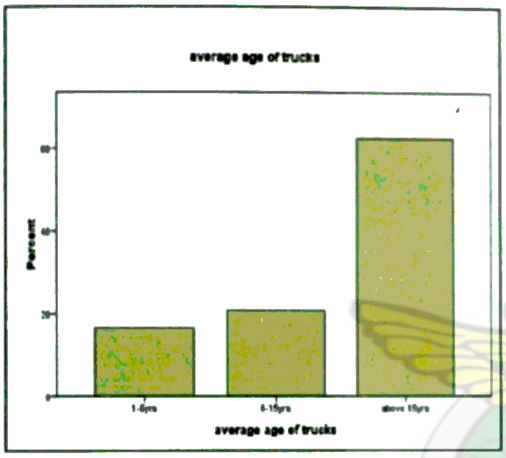


Fig. 4.7 What is the average age of your truck?

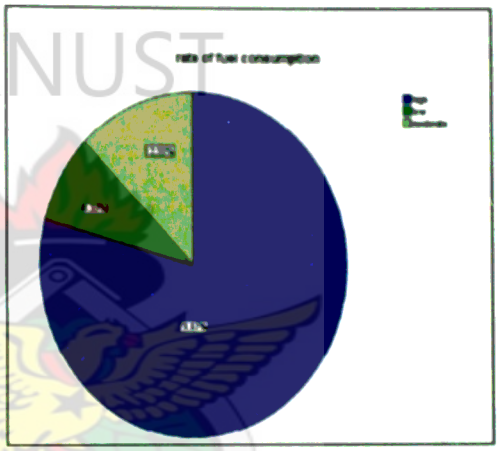


Fig. 4.8 How do you describe this rate of fuel consumption?

Four (4) of the trucks representing 16.7 percent are aged between 1-5 years, five (5) representing 20.8 percent are aged between 6 -15 years and the majority of fifteen (15) trucks representing 62.5 percent are aged above fifteen (15) years. Naturally, as a truck ages even with the best of maintenance practices its fuel efficiency decreases. It is therefore no wonder that respondents were of the views that the rate of the trucks' fuel consumption was high as was evidenced by a 79.17 percent response in that wise as shown in Fig. 4.8. Three (3) respondents representing 12.5 percent were of the view the

rate of fuel consumption was moderate, whilst two (2) respondents representing 8.3 percent were of the view that it was low. A high rate of fuel consumption indicates that more money is spent on fuel which leads to higher transportation costs. These costs can, therefore, be reduced when fuel consumption is reduced.

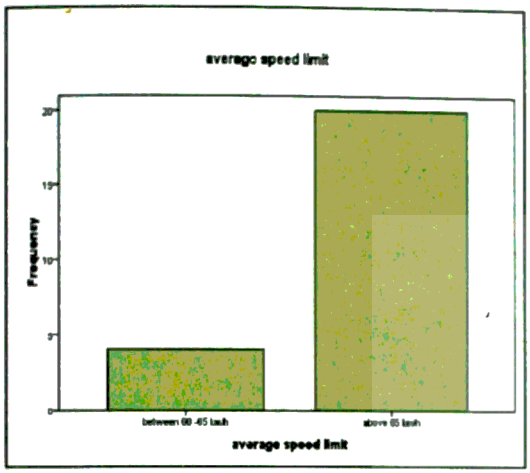


Fig. 4.9 What is the average speed at which you travel?

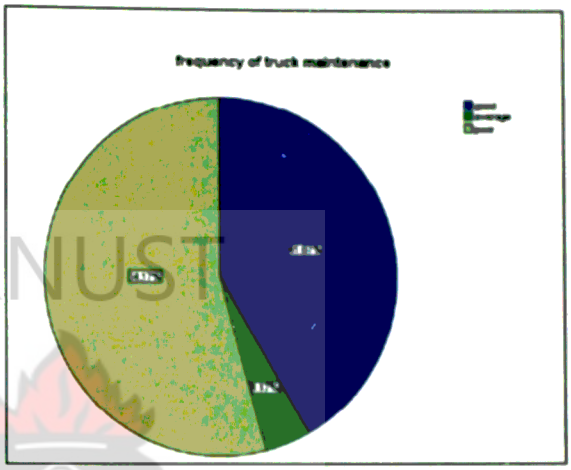


Fig. 4.10 How do you rate the frequency at which trucks are maintained?

Source: Author's field study

Twenty (20) drivers representing 83.3 percent drives above sixty-five (65) kilometres per hour while four (4) representing 16.7 percent drives between 60 – 65 kilometres per hour. None of the drivers drove below sixty (60) kilometres per hour. According to Greene (2008), for each 5 miles per hour (mph) above 55 mph, fuel economy decreases by about 7%. A retrospective study of the 55 mph speed limit by the National Academy of Sciences (NAS) found that it saved 1-3% of highway fuel use and also improved highway safety (NAS, 1984). The researcher therefore concludes that fuel is less efficiently used by the drivers in the organization. This also means that speed limits of 50 km/h set by

legislation when driving through towns is disregarded by these drivers, thus further exposing them to more hazards on the road, to themselves and to other road users. Accidents that may occur as a result of disregard for speed limits and other traffic regulation may also cost the organization some money which could translate into increased transportation costs.

Ten (10) drivers representing 41.67 percent were of the view that the frequency of truck maintenance was good. One (1) driver thought it was average whilst thirteen (13) of them representing 54.17 percent thought the frequency of truck maintenance was poor. This was corroborated by the Transport Officer who said there was no scheduled maintenance plans for the vehicles. Maintenance was only carried out on any of them when a problem was reported by the driver. This leaves the decision of maintenance in the hand of drivers. In the case where a driver failed to detect a problem, or in the case where he underestimates the seriousness of a problem, this could lead to a major problem which could even stall the activities of the organization due to total breakdown of the vehicle. Proper vehicle maintenance can also improve fuel economy. Keeping tyres inflated to the manufacturer's recommended pressure, keeping wheels properly aligned and balanced, oil changes on manufacturers' recommended intervals with the recommended grade of fuel saving oil; replacing dirty air filters and keeping vehicle engines in proper tune can all help maximize miles per gallon thereby enhancing fuel efficiency and reducing transportation costs. (www.cta.ornl.gov)

4.3 Identifying the challenges with the current transportation system

4.3.1 Fuel efficiency and cost of fuel

The first challenge identified was the quantity of fuel used and its associated costs. Due to the fact that most of the trucks are old, i.e. above ten years, their fuel efficiency have reduced and twice as much fuel that a newer truck of the same make and specification will use is used by these trucks. Again, regular diesel is used as fuel by these trucks at Juaben Oil Mills Ltd. Recent technological advancements and research have led to improvements in fuel to enhance its efficiency. These new brands include Diesel Extra by Shell and Effimax by Total. According to John Taylor, Guinness World Record holder on fuel economy, in a TV3 newscast on 16th July, 2009, these improved diesel brands, for example, Diesel Extra is more efficient for engines than regular diesel.

4.3.2 Loading capacity of trucks and actual weight of palm fruits carried

The actual weight of palm fruits carried by a truck is below the loading capacity of the truck. This is due to the fact that most of the trucks are old and thus, cannot the bear the required load. This is illustrated by the figures below. Eleven (11) of the trucks representing 45.83 percent have a loading capacity of between five (5) and seven (7) tons

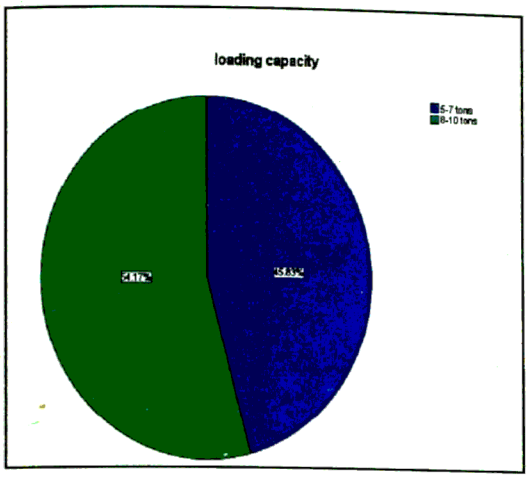


Fig. 4.11 What is the average loading capacity of your truck?

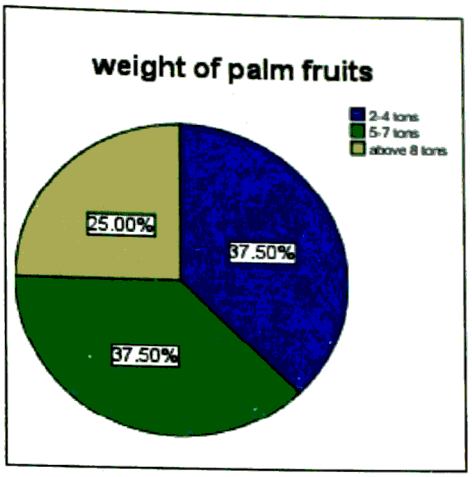


Fig. 4.12 What is the average weight of palm fruits carried by your truck?

Source: Author's field study

whilst thirteen (13) of them representing 54.17 percent have a loading capacity of between eight (8) and ten (10) tons. However, only six (6) trucks representing twenty-five (25) percent actually carry loads above eight (8) tons. Nine (9) of them representing 37.5 percent carry loads of between two (2) and four (4) tons whilst another nine (9) also representing 37.5 percent also carry loads between five (5) and seven (7) tons as shown in Fig. 4.12. This is an indication that vehicles are underutilized. This means that the organization incurs extra expenditure in hauling palm fruits from their sources to the mills. This is because, averagely a truck hauls half the load it is required to haul. This requires extra trips to be made by trucks resulting in extra risks, extra fuel and labour costs which eventually lead to increased transportation costs.

4.3.3 Condition of the roads

Interview with drivers indicated that conditions of the road on which their trucks plow was poor, particularly those linking the farms with the organization. They emphasised that the roads were narrow and pot-holes-ridden and mostly undulating. They also indicated that the roads were inaccessible during the rainy season and posed a serious threat to them. They also attributed the frequent breakdown of vehicles and wearing out of vehicle parts to the bad nature of the roads. The deterioration of the country's transportation and communications networks has been blamed for impeding the distribution of economic inputs and food as well as the transport of crucial exports. In 1997, it was estimated that there was a total of 39,409 kilometres of highways in Ghana of which 11,653 kilometres are paved (including 30 km of expressways). The remaining 27,756 kilometres were unpaved (www.wikipedia.com, 2009).

4.4 Using the Dijkstra's Algorithm to determine the shortest path from each source to the Mill

Juaben Oil Mills has a monthly demand of three thousand (3,000) MT and an average monthly supply of about two thousand (2,000) MT. This means that the purchasing department has to scout for the palm fruits from every available farm. As a result, the Dijkstra's Algorithm was used to find the shortest paths from each of the farms to the mill. A list of the areas that the palm fruits were sourced from was obtained from the mill and the shortest paths were traced. These areas include: Juaben, Apemso, Atia, Kubease, Boamadumase, Duampompo, Boankra, New Koforidua, Nobewam, Bomfa, Adumasa,

Boamadumase, Duampompo, Boankra, New Koforidua, Nobewam, Bomfa, Adumasa, Abetenim, Ofoase, Odoyefe, Kokodie and Nkyerepoaso.

A map of the Ejisu – Juaben District was also obtained from the Town and Country Planning Department at Ejisu. The shortest paths from each of these areas to Juaben where the Oil Mill is situated were traced on the map.

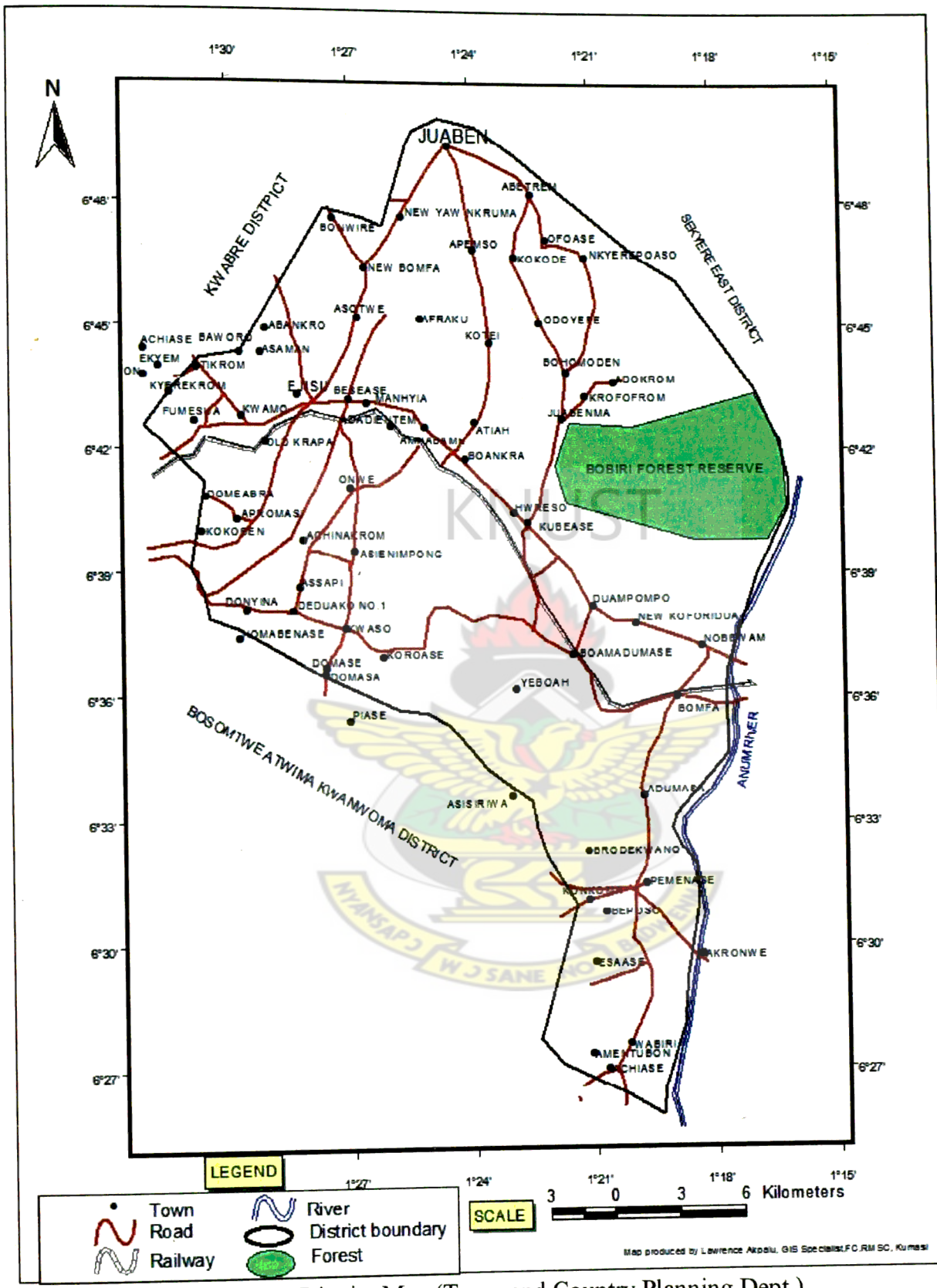


Figure 4.13 Ejisu – Juaben District Map (Town and Country Planning Dept.)

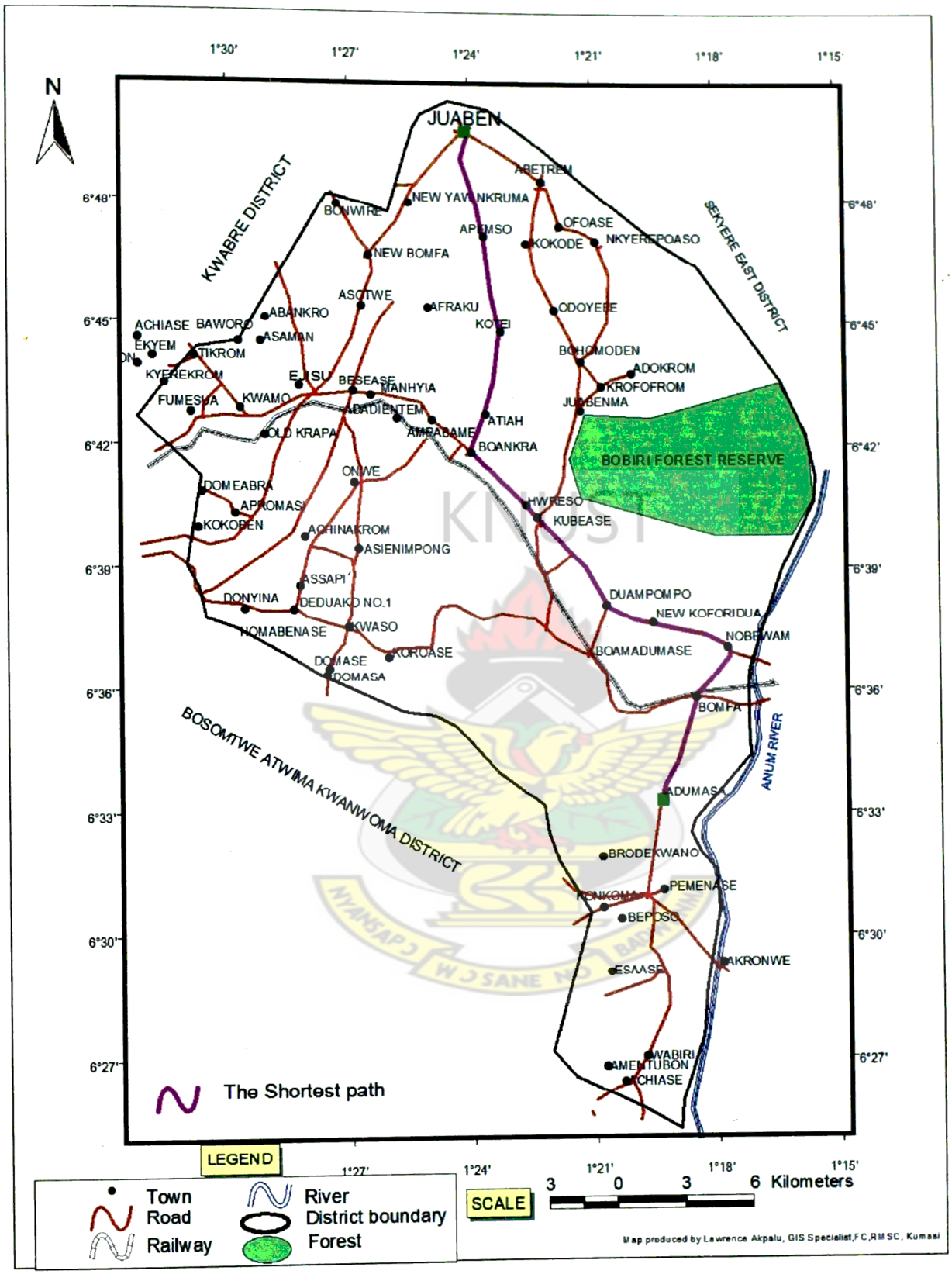


Figure 4.14: Shortest path from Adumasa to Juaben

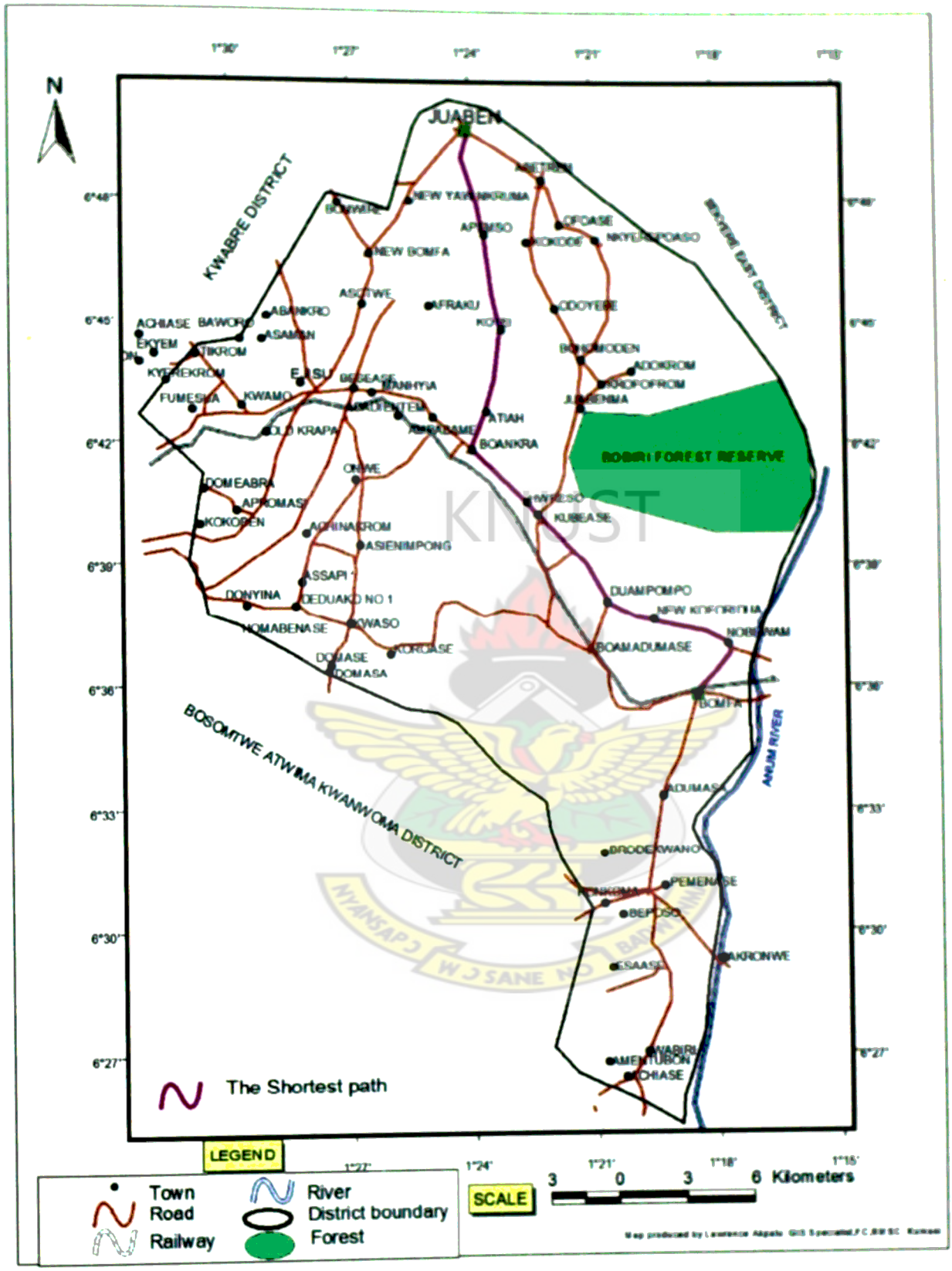


Figure 4.15: Shortest path from Bomfa to Juaben

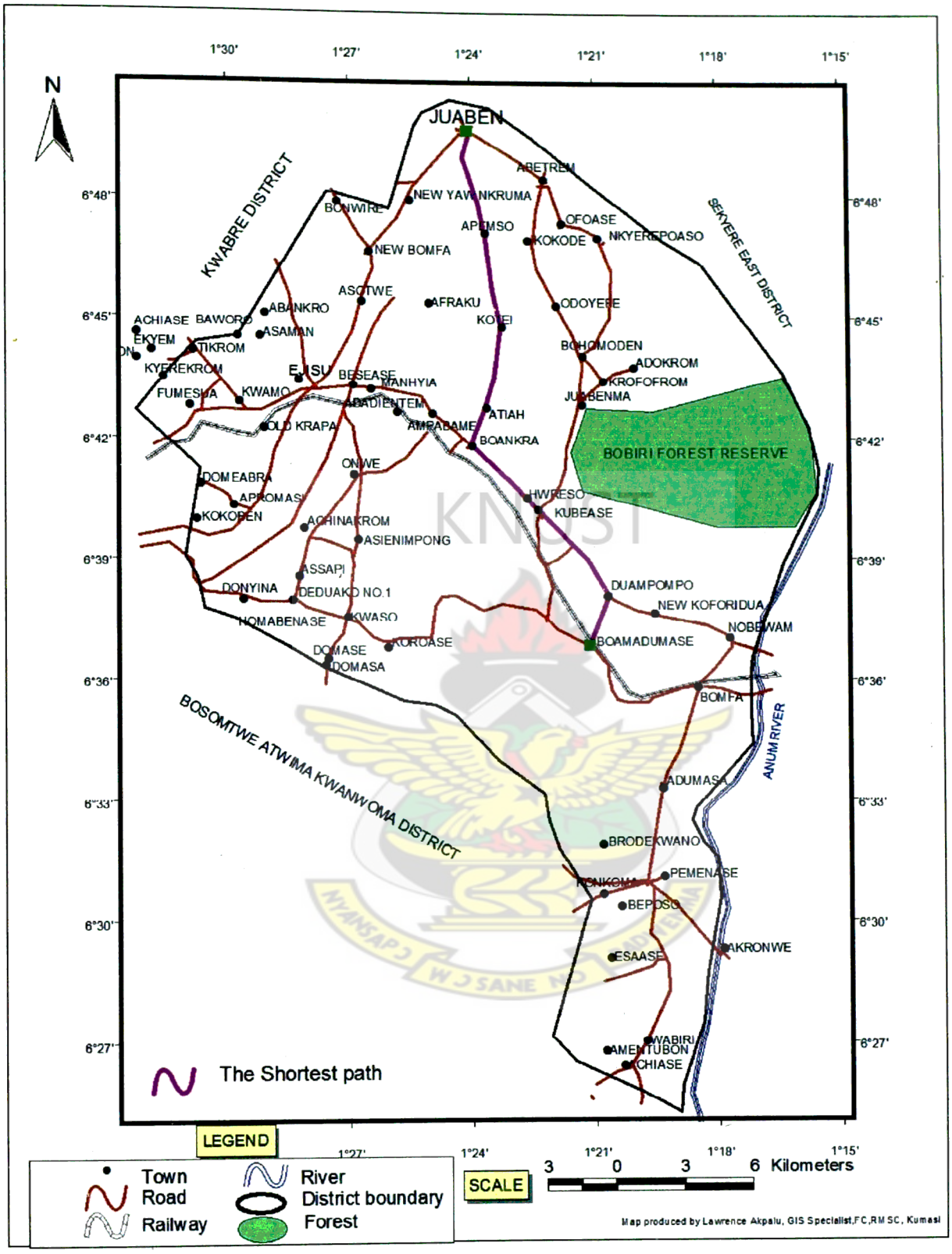


Figure 4.16: Shortest path from Boamadumase to Juaben

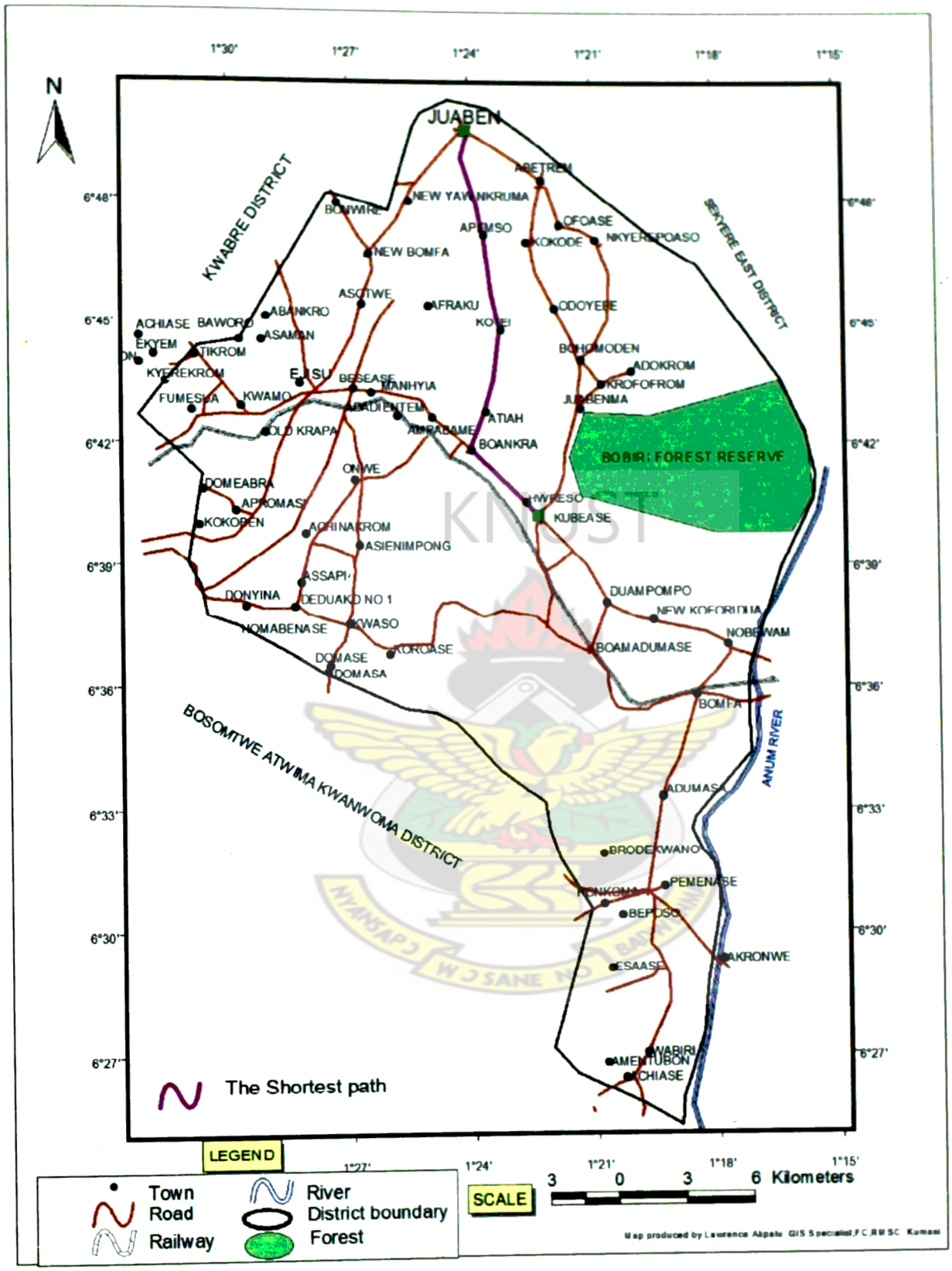


Figure 4.17: Shortest path from Kubease to Juaben

4.5 Summary

This chapter analysed and discussed the responses obtained from the questionnaires. The next chapter would conclude the study with the findings and recommendations.

CHAPTER FIVE

FINDINGS, RECOMMENDATIONS AND CONCLUSION

5.0 Introduction

The general objective of this thesis was to optimize inbound transportation costs for Juaben Oil Mills Ltd. The specific objectives sought to identify the current transportation efficiency of the organization; to identify the challenges with the transportation system and to use the Dijkstra's Algorithm to determine the shortest paths from the farms to the mills to reduce transportation costs. A list of the farms from which the palm fruits are sourced was obtained from the organization and their locations ascertained to facilitate the use of the Dijkstra's Algorithm. The research was guided by key research questions such as:

(i) Where are the sources of palm fruits to the Juaben Oil Mills Ltd.?

(ii) How are palm fruits transported from the farms to the Juaben Oil Mills Ltd.?

(iii) What are the challenges associated with the current transportation system in Juaben Oil Mills.?

(iv) How can transportation costs be optimized at Juaben Oil Mills Ltd.?

It was found out that road transport was used by the organization in hauling palm fruits from the farms to the Oil Mill. This is mainly because the farms, where the palm fruits are obtained, are only accessible by roads. Therefore, vehicles and drivers play a very crucial role in the transportation system of the organization.

5.1 Findings

5.1.1 Drivers

It came to light that most of the drivers were old, i. e. above thirty-five (35) years. Educational background of the drivers was also low with majority of them holding the Middle School Leaving Certificate with a few being Junior Secondary School graduates. It was also realized that all the drivers, who are permanent employees of the organization, have been at the wheel for some time thus, giving them reasonable experience the least of which was six (6) years. However, the gain the company makes from their experience was offset by the loss obtained from the absence of a training and development programme. It was evident that there were no planned training programmes for drivers. It was also found out that there was no system in place to monitor drivers when they were on the road. Drivers could idle around or drive well above the fuel-efficient speed limits which led to lower fuel efficiency which, in turn, increased fuel consumption and consequently, transportation costs. It also came to light that drivers' remuneration was also low. This served as a disincentive to work since substantial evidence exists to show a positive relationship between motivation, leading to employee satisfaction, and productivity. It was also evident that few accidents sometimes occurred which was mostly attributed to obstruction from other vehicles, with some of them being as a result of driving under the influence of alcohol. Other reasons included speeding and disregard for road signs.

5.1.2 Vehicles

It was evident that most of the vehicles were old, i. e. fifteen (15) of them were aged above fifteen (15) years. A few of them, however, were aged between one (1) and five (5) years. As a result of their ages, fuel economy had reduced thus, increasing fuel consumption which led to increased transportation costs. It was also realized that most of the trucks were underutilized. This means that the organization incurs extra expenditure in hauling palm fruits from their sources to the mills. This is because, averagely a truck hauls half the load it is required to haul. This requires extra trips to be made by trucks resulting in extra risks, extra fuel and labour costs which eventually lead to increased transportation costs. It was established that there was no routine maintenance schedules for vehicles. There were no regular checks to ensure that vehicles were in the right shape for their operation. Maintenance was only carried out on any of them when a problem was reported by the driver. In the case where a driver failed to detect a problem, or in the case where he underestimates the seriousness of a problem, this could lead to a major problem which could even stall the activities of the organization due to total breakdown of the vehicle. Lack of maintenance also reduces fuel economy thus increasing fuel consumption and transportation costs. Again, it was revealed that regular diesel is used as fuel by the vehicles at Juaben Oil Mills Ltd. Recent technological advancements and research have led to improvements in fuel to enhance its efficiency. These new brands include Diesel Extra by Shell and Effimax by Total. According to John Taylor, Guinness World Record holder on fuel economy, in a TV3 newscast on 16th July, 2009, these improved diesel brands, for example, Diesel Extra is more efficient for engines than regular diesel.

5.2 Recommendations

The researcher recommends the following as a measure to improve fuel efficiency, reduce fuel consumption and thereby optimize transportation costs.

(i) Drivers

(a) Training and Development Programmes

It is recommended that regular comprehensive training programmes be instituted by the organization for all its drivers to enhance their skills and also to train them on fuel-efficient driving behavior which, when correctly done, also contributes to safe driving. Drivers should also be trained to observe posted speed limits, avoid aggressive driving behaviours, anticipate traffic situations and avoid tailgating, all with the aim to improve fuel economy and traffic safety. This would help reduce fuel consumption thereby, translating into reduced transportation costs. Resource persons can be drawn from the Driver, Vehicle and Licensing Authority. It is also recommended that the Transport Officer be further trained on modern transportation models and routing.

(b) Motivation

It is also recommended that drivers should be adequately motivated in order to generate employee satisfaction that would help to keep them in the organization. A high turnover

rate of drivers would imply that there would be constant recruiting and training of new drivers which increases overhead costs for the organization.

(ii) Vehicles

(a) Maintenance

It is recommended that the organization pays serious attention to the maintenance of all its vehicles. The maintenance department should be equipped resourcefully, in terms of human resource and equipment, to be able to handle the maintenance of all vehicles. There should also be planned, periodic maintenance schedules for all vehicles of the organization. A well-maintained vehicle is a more fuel efficient and safer vehicle. Keeping tyres inflated to the manufacturer's recommended pressure, keeping wheels properly aligned and balanced, oil changes on manufacturers' recommended intervals with the recommended grade of fuel saving oil; replacing dirty air filters and keeping vehicle engines in proper tune can all help maximize miles per gallon thereby enhancing fuel efficiency and reducing transportation costs.

(b) Vehicle capacity utilization

It is also recommended that proper utilization be made of all vehicles. Loads should be arranged well so that vehicles can carry more. This would reduce the number of trips

vehicles make. Fuel would, in turn, be reduced translating into reduced transportation costs.

(c) Fuel

The organization stocks its own fuel supplies. However, instead of stocking regular diesel, it is hereby recommended that an improved fuel as Diesel Extra be used to optimize fuel efficiency i.e. reduce fuel consumption, improve performance of vehicles and reduce wear, thus translating into reduced transportation costs. It is also recommended that for short trips, fuel just enough for the trip is put in the vehicles and not fill the whole tank as a way of checking drivers unnecessary idling and wasting fuel. This will go a long way in reducing fuel consumption and thus reduce transportation costs.

(d) Tracking and monitoring of vehicles

In the short term, it is recommended that telephone numbers be provided on vehicles to afford individuals to call into the organization to report of any unsafe driving practices that drivers may engage in when on trips. This may check aggressive driving practices and improve fuel efficiency and also reduce transportation and transport – related costs that may come about as a result of road accidents or destruction of property. In the long term, it is also recommended that Global Positioning Systems or tracking devices that can give the location of vehicles at all times be installed on all vehicles to check drivers' activities at any time. These tracking devices would help the organization to monitor time spent at a job for accurate billing and reduce excessive overtime and paperwork with

automated time sheets. They also eliminate unauthorized vehicle use and monitor excessive idle times. They also increase route efficiencies with live tracking and mapping and give an alert when drivers speed – a huge source of wasted fuel. Finally, they increase employee productivity, reduce fuel costs and encourage safe driving techniques.

(e) Adaptation of the Dijkstra's Algorithm

The use of the shortest path algorithm suggests that from the farthest point, i.e. Adumasa to Juaben, one has to pass through Bomfa, through Nobewam, through Kubease, through Kotei and Apemso to Juaben. This is the shortest motorable path. It has a distance of 36.86 km as compared to passing through Kubease, through Odoyefe which has a distance of 38.29 km and also 40.47 km through Kubease through Juabenmma and Odoyefe. The study suggested that going to Juaben from each of the farthest points through Kubease through Kotei and Apemso is shorter than any of the other alternatives. The road is also motorable and free of vehicular traffic. This presupposes that going from each of the other areas such as Nobewam, Duampompo, New Koforidua, Bomfa, etc, one has to use the same Kubease through Kotei and Apemso route as the shortest path between that area and Juaben. Other areas such as Odoyefe, Ofoase, Abetenim, Nkyerepoaso and Kokode have straight routes linking Juaben. These routes are the shortest since any alternative routes are longer.

5.3 Suggestions for further study

It is hereby, suggested that this study be replicated in other organizations in which transportation plays a central role. A research on the optimization of outbound transportation costs can also be carried out for Juaben Oil Mills Ltd.

5.4 Conclusion

Freight transportation in particular, is a very crucial part of every business. Industries will never be able to prosper as much as they want to without these hardy machines delivering goods, products and services to different places on time. Transportation maintains the flow of production and consumption regularly, thus causing nations to develop and improve. It also helps in heightening the security and protection of goods against loss or damage. That is why it is the most crucial link in the entire supply chain. Since it helps businesses in being as efficient as possible, proper guidance should be given to managers in ensuring faster and more flawless flow. The efficient movement of goods through effective transportation management offers the greatest opportunity to reduce costs and improve customer satisfaction. Success, however, comes by developing and using a systematic and measurable approach. This study has outlined some of the ways in which drivers and vehicles (resources of the organization) can be managed to ensure fuel efficiency and economy in order to reduce transportation costs, thereby optimizing transportation costs.

REFERENCES

Christopher, M. and Lee, H. (2004), "Mitigating supply chain Risk through improved confidence", *Commonwealth of Australia (2204) Humanitarian Action Policy*, Printed by Pinion, Canberra [http://www.Dalta.Gov.an/cca.data] (accessed on 26/04/09.)

Deloitte (2004) "Supply Chain Risk Management" [www.deloitte.com/.../nl_eng_brochure_**supply_chain_risk**_management_070704x(1).pdf] (Accessed on 16/6/09)

Encyclopedia Britannica Australia Ltd. (2006) [www.britannica.com.au/britannica_browse/o/o37.html] (Accessed on 7/6/09)
Eudoxus Systems Ltd. (2003) "What is optimization". [www.eudoxus.com/what.html] (Accessed on 6/6/09)

Friedel, M. C.(1897), *Sur des matières grasses trouvées dans des tombes égyptiennes d'Abydos,* Comptes Rendu 24: 648—51.

Gadde, L. E., & Mattsson, L. G. (1987), "Stability and Change in Network Relationships", *InternationalJournal of Research in Marketing*, 4(1), 29-41.

Gay, L. R. (1987), *Educational research competencies to analysis and application*, Second edition, Ohio, Perril Publication Company.

Grant, D. B., Douglas, M. L., Stock, J. R. and Ellram, M. L.(2006), *Fundamentals of Logistics Management,* European Edn., McGraw Hill.

Greene, David L. (2008), "Near Term Options to Increase Fuel Economy and Decrease Petroleum Demand".
[*www-cta.ornl.gov/.../Testimony_**NearTermOptionsforFuelEconomy**_Greene%20.pd]f* (accessed on 10/07/09).

Hartley, C. W. S. (1988), *The oil palm (Elaeis guineensis Jacq.)*, Third edition. London.
Ho, D. C. K., Au, K. F. and Newton, E. (2002) "Empirical research on supply chain management: a critical review and recommendations", *International Journal of Production Research,* Vol. 40 No. 17, pp. 4415-30.

Hughes, E. P., & Kearney, T.D.(2002). "Optimization with the SAS System: What It Is, What's new and why you should be using it". [www2.sas.com/proceedings/sugi28/276-28.pdf] (Accessed on 3/6/09).

Jones, Marcus and Collings, Simon (1999), "Can efficient logistics reduce transport energy demands?"Kogan Page Ltd, 120 Pentonville Road, London N1 9JN, UK.

Klappich, C. D. (2006), "Higher Freight costs increase need for Transportation Management solutions".
[www.scdigest.com/.../**Transportation**_Mngt_and_the_Adaptive_Supply_Chain.pdf?...] (accessed on 24/ 5/ 09)

La Anyane, S. (1963), *Ghana Agriculture*, Oxford University Press, Amen House, London, EC 4.

Lummus et al. (1999), "The relationship of logistics to supply chain management: Developing a common industry definition, in Industrial Management & data systems", [http://www.emarold-library.com] (Accessed on 14/09 /08)

Lysons Kenneth and Farrington Brian, *Purchasing and Supply Chain Management*,(2006), 7th Edn., Pearsons Education Limited.

Russell, R. S., Taylor, B. W., *Operations Management*, (2003), 4th Edn., Pearson Education Inc., Upper Saddle River, New Jersey, 07458.

Saunders, M., Lewis, P., & Thornhill, A. (2007). *Research Methods for Business Students*, 4th edn., Edinburgh Gate: Pearson Education Limited.

Simchi-Levi, D., Kaminsky, P., & Simchi-Levi, E. (2004), *Managing The Supply Chain: The Definitive Guide For The Business Professional*, New York: McGraw-Hill.

Stank, T. P., Davis, B. R. and Fugate, B. S. (2005), "A strategic framework for supply chain oriented logistics", *Journal of Business Logistics*, Vol. 26 No. 2 pp. 27-45

"The Private Sector Foundation (PSF) of Uganda (2003)" in "Identify improvement opportunity and diagnosing prospects for Uganda's maize supply chains".
[www.foodnet.cgiar.org/.../**Maize**%20**Supply**%20**Chain**%20Analysis,%20PSF%2003.pdf] (Accessed on 14/5/09)

Tijskens, L.M.M., Koster, A.C., Jonker, J.M.E. "Concepts of chain management and chain optimization", *Food Process Modeling*, ed. L.M.M. Tijskens, Hertog, M.L.A.T.M., Nicolai, B.M. 2001: Woodhead.

Tuzkaya, K.U (2009), "A holonic approach based integration methodology for transportation and warehousing functions of the supply network", *Computer and Industrial Engineering*, Vol 6 Issue 2 pp 208-723.

USDA, 2004. "More Oilseed Production Going Toward Biodiesel", Production Estimates and Crop Assessment Division, Foreign Agricultural Service, Washington.

Vorst, J.G.A.J., van der (2000) *Effective food supply chain:Generating, modeling and evaluating supply chain scenarios.*., Wageningen University: Wageningen.

Wassenhove V.L.N (2006), *Humanitarian Aid Logistics: Supply Chain Management in high gear*, Journal of the Operational Research Society.
Wikipedia (2009), Transportation in Ghana www.wikipedia modified on 6/01/09

www.cleanairnet.org , "Reducing fuel consumption per unit of movement" [www.cleanairnet.org/cai/1403/articles-56396_chapter_4.pdf] (Accessed on 10/7/09)

www.SAP-AG.com, Driver Behaviour retrieved on 10/6/09

Zuurbier, P. J .P., Trienekens, J. H., Ziggers, G. W.,(1996) *Verticale Samenwerking*, Deventer: Kluwer Bedrijfswetenschappen

APPENDIX

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF BUSINESS

QUESTIONNAIRE

This questionnaire is part of a research set out to optimize transportation costs in your outfit. The results will be used for the preparation of a dissertation for presentation to School of Business, Kwame Nkrumah University of Science and Technology as partial fulfillment of requirement for the award of MBA Degree.

All answers would be kept strictly confidential. To this effect there are no questions asking you to disclose your identity.

Please tick the appropriate answer.

TRANSPORT OFFICER

1. How long have you been working with this organization?

   1-5 years [ ]

   5-10 years [ ]

   Above 10 years [ ]

2. What qualification do you hold?
   SSS [ ] Polytechnic [ ] Degree [ ] Postgraduate [ ]

3. Which mode(s) of transportation is/are used in shipping palm fruits to JOML?
   Road [ ]
   Rail [ ]
   Pipeline[ ]
   Air [ ]
   Water [ ]

4. What factors influence this choice?

Availability [ ] Distance [ ]
Convenience [ ] Accessibility [ ]
Cost [ ]
Other, please
specify.....
.....
.....

5. What fuel do your trucks use?
   Petrol [ ] Gas [ ] Diesel [ ]
6. What type of fuel in 4 above?

.....

7. What fuel purchasing strategy do you use?
   Buy enough for one trip [ ]
   Fill tank [ ]
   Other, please
   specify.....
   .....

8. What is your average fuel consumption for a journey?
   .....
   .....

9. How do you describe this rate of fuel consumption?
   High [ ] Low [ ] Moderate [ ]

   Comments.....
   .....

10. What qualification do drivers hold?
    JSS [ ]
    SSS [ ]
    Technical [ ]
    Middle School Leaving Certificate [ ]

11. What is the employment status of employees?

Permanent [ ]
Transitional [ ]
Other, please state.....

Comments.....
.....

12. How would you rate the working condition of drivers in your organisation?
Better [ ] Good [ ] Normal [ ] Poor [ ]

13. Do you hold training programmes for drivers?
Yes [ ] No [ ]

14. If yes, how often?
Once every three months [ ] Once every six months [ ] Once in a year [ ]

15. Is there any incidence of accidents occurring?
Yes [ ] No [ ]

16. If yes, what causes these accidents?
Speeding [ ]
Influence of alcohol [ ]
Disregard for road signs [ ]
Obstruction from other vehicles [ ]

17. How would you rate the occurrence of accidents in a year?
Low [ ] Medium [ ] High [ ] Very High [ ]

18. Do your trucks break down?
Yes [ ] No [ ]

19. How would you rate the frequency of truck break-down?
Low [ ] Medium [ ] High [ ] Very High [ ]

20. Do you have a routine maintenance programme for your trucks?
Yes [ ] No [ ]

21. How often do you maintain important parts of your trucks?

	Once in three months	Once in six months	Once in a year	When there is a problem
Tyres				
Fuel filters				
Lubricants and transmission fluids				
Alignment				

22. How are drivers monitored on the road?

.....

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CHIEF EXECUTIVE OFFICER

1. How long have you been working with this organization?

   1-2 years [ ]

   2-5 years [ ]

   Above 5 years [ ]

2. Please state the sources of palm fruits to your organization.

   .....

   .....

   .....

3. How far is the plant from each source?

   Source 1.....

   Source 2.....

   Source 3.....

4. What is the amount of palm fruits needed by your organization monthly?

   .....

5. What is the quantity of palm fruits obtained from each source monthly?

   Source 1.....

   Source 2.....

   Source 3.....

6. What is the unit cost of transporting palm fruits from each source?

   Source 1.....

   Source 2.....

   Source 3.....

7. How much does the company spend on transportation of palm fruits monthly?

.....

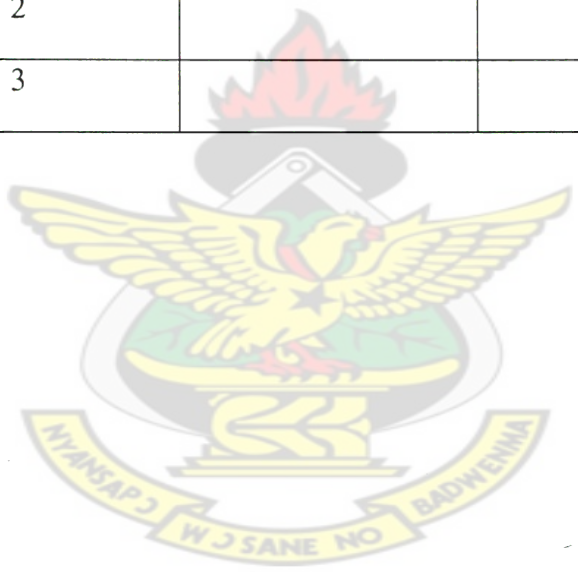
8. How much does the company spend on palm fruits monthly?

.....

9. Kindly give figures for the past six months.

MONTH	SOURCE	QUANTITY OF PALM FRUITS	AMOUNT SPENT ON TRANSPORTATION
MONTH 1	1		
	2		
	3		
MONTH 2	1		
	2		
	3		
MONTH 3	1		

	2		
	3		
MONTH 4	1		
	2		
	3		
MONTH 5	1		
	2		
	3		
MONTH 6	1		
	2		
	3		



KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF BUSINESS

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All answers would be kept strictly confidential. To this effect there are no questions asking you to disclose your identity.

Please tick the appropriate answer.

DRIVERS

1. How long have been working with this organization?

   1-5 years [ ]

   6-10 years [ ]

   Above 10 years [ ]

2. What qualification do you hold?
   JSS [ ]
   SSS [ ]
   Technical [ ]
   Middle School Leaving Certificate [ ]

3. How many years of driving experience do you have?

4. How old are you?

   Below 25 years [ ]

   Between 25 and 35 years [ ]

   Above 35 years [ ]

5. Do you undergo any internal training on road safety?

6. Do you have a certified drivers' license?

7. What is the average speed at which you travel?
   Below 60 km/h [ ]
   Between 60 - 65km/h [ ]
   Above 65km/h [ ]

8. What is the average weight of these trucks?
   .....

9. What is the average age of these trucks?
   .....

10. What is the average loading capacity of these trucks?
    .....

11. What is the average weight of palm fruits carried by each truck?
    .....

12. Do you encounter traffic congestions on your normal routes?

13. If yes, what factors causes this traffic?
    Broken down vehicles [ ]
    Poor road network [ ]
    Poor car condition [ ]
    Road check points [ ]

    Other, please specify.....

14. What is your average fuel consumption for a journey?
    .....
    .....

15. How do you describe this rate of fuel consumption?
    High [ ] Low [ ] Moderate [ ]

Comments.....

.....

16. How do you rate the condition of the roads on which your trucks plow?
Better [ ] Good [ ] Normal [ ] Poor [ ]

17. How do you rate the adequacy of road network infrastructure?
Better [ ] Good [ ] Normal [ ] Poor [ ]

18. How do you rate the frequency at which roads are maintained?
Better [ ] Good [ ] Normal [ ] Poor [ ]

19. Please state any other challenges you encounter with the transportation system.

.....

.....

.....

.....

20. How do you compare your working conditions to other drivers in similar organisations?
Better [ ] Normal [ ] Poor [ ]