

# Transportation Challenges in Fertilizer Supply Chain in Malawi.

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**Abstract**— The high cost of fertilizer continues to hinder small holder farmers from accessing fertilizer resulting in low agricultural production. To solve this problem, Malawi government introduced the Farm Input Subsidy Program (FISP) in 2004/2005 growing season which constitute about 60% of all fertilizer imports. However, besides the huge investment into this program, the country still faces food insecurity leaving many households depending on food handouts during lean season forcing policy makers explore options on how to exploit the benefits of FISP. This investigation therefore was conducted on transportation challenges in fertilizer supply chain, as late delivery was reported to be one of the problems in the distribution process. The research objectives were to investigate the fertilizer supply chain challenges in Malawi by determining transportation challenges in the distribution of FISP fertilizer and recommend solutions for effective fertilizer distribution. To achieve this, a pragmatic philosophy was adopted by employing both qualitative as well as quantitative research methods in data collection. A snowball sampling method was used with the assistance of Road Transport Operators Association (RTOA) in Malawi. Three managers from both public as well as private fertilizer companies were interviewed while 38 questionnaires were administered to transporters that had been involved in subsidy fertilizer distribution. The findings of the research had revealed logistical problems in awarding contracts to fertilizer importers and transporters, beneficiary identification. High transportation costs, underutilization of ICT (ITS) and lack of Research and Development were the other challenges. And this research therefore proposed “group fertilizer procurement” in future fertilizer procurement policies, offering unbiased contract awards, conducting Research and Development and embracing ICT (ITS) in solving transportation problems. To do this, a Roadmap to Fertilizer Supply Chain as a reference material for future fertilizer supply chain studies had been provided.

**Keywords**— *Farm Input Subsidy Program (FISP), Transportation challenges, Fertilizer distribution, Fertilizer Supply Chain.*

## 1. Introduction

The main objective of this project was to investigate the supply chain of fertilizer in Malawi, from the source to the end user (the farmer), with an intention of identifying performance gaps in transportation that result into delayed fertilizer deliveries affecting agricultural productivity. The Malawi Agricultural Input Subsidy Program 2005/6 to 2008/9 Report highlighted challenges within the fertilizer supply chain as one factor contributing to late delivery of fertilizer and seed [1]. The report also emphasised on improving the efficiency in fertilizer supply or the reduction in transportation costs during importation and distribution of fertilizer as some of the ways of achieving profitability in fertilizer use in maize production. And it is from that background that this investigation was conducted in the fertilizer supply chain, in order to understand the transportation challenges that impede productivity.

### 1.1 Farm Input Subsidy Program

Farm input subsidy program is a government initiative aimed at improving fertilizer and hybrid seed use in maize production as a result of food insecurity particularly after poor 2004/5 production season coupled with political manifesto [2]. Since its inception, the main objective of the program was increased access to cheap fertilizer and hybrid seed by poor smallholder farmers. However, it was asserted that the profitability of fertilizer use in maize production could be achieved by either improving the efficiency in fertilizer supply or reducing the cost of transport during importation and distribution of the commodity [1].

Over the years, FISP program had gained popularity [1] due to increased maize production from 1480kg/ha to 2100kg/ha in 2013 and decreased undernourishment from 27% to 20.8% [3]. However, with hunger still affecting some households, the debate continued at the national level on whether FISP had been fully exploited with the policy makers exploring options to improve the effectiveness of the program further [3].

## 2 Literature Review

Supply chain is the combination of processes, functions, activities, relationships, and pathways where products, services, information and financial transactions are transferred between enterprises [4]. This encompasses the involvement partly or complete product movements or information flow from an original producer to the ultimate end user [4]. In Malawi, fertilizer supply chain involves the Ministry of Agriculture and Water development, Ministry of Industry, Trade and Commerce, several statutory bodies that deal with Business and fertilizer registrations, Licensing, regulation and enforcement.

The fertilizer Trade Association of Malawi (MFTA), the public-private partnership of Agricultural companies was formed in 2007 to provide advice and update the government on the status of fertilizer supply in the local markets [5]. It is a grouping of importers, manufacturers and distributors of Farm inputs in Malawi. Other players in fertilizer supply chain in Malawi include Financial Institutions, Fertilizer Manufacturers from Ukraine, Russia, European countries and Persian Gulf countries [6], International shippers, foreign ports, e.g. port of Beira (807km) and Nacala (649km) in Mozambique, Durban (3500km) in South Africa and Dar es Salaam (1979km) in Tanzania [5], from where, road freight transportation of fertilizer is involved to ferry the

loads by trucks to Malawi.

### 2.1 Road Freight Transportation

In Malawi, road freight is the dominant mode of transportation because of cheaper investment funds, high accessibility, high mobility, and availability. Road freight plays a major role in Malawi's domestic and international trade accounting to more than 70% of the internal freight and over 90% of the country's international freight traffic [7]. However, road freight transport, which is provided by the private sector, had not provided a seamless service in Malawi because of lacking essential telecommunication infrastructure in ITS part of which was supposed to be provided by the government [8]. The cost of Farm inputs is three times higher in Sub Saharan Africa than in developed countries, mainly due to high road freight costs which negatively affect agricultural productivity [9].

This is a worrisome situation considering that development of every nation hinges on transportation. For example, transportation has been the driving force and central to the development of US, linking regions and the world as a whole [10]. In agriculture, transportation is a strategic factor in rural development and social change dynamics [11]. This had been the case because trucks transported food supplies for more than 80% of US cities and communities [12]. An efficient transportation system plays a big role in boosting agricultural productivity [13], [14]. A good transport system in logistics activities provide better logistics efficiency, reduce operation cost, and promote service quality [15]. Access to efficient transport logistics in modern supply chains could increase farmer's income by 10 to 100% [16].

### 2.2 Transportation Challenges affecting Agricultural Productivity

One of the challenges attached to agricultural productivity is the transportation of farm inputs and agricultural produce. Reliable transportation system is crucial to the development of agriculture in order to reduce farmer's poverty [14]. The researchers asserted that transportation challenges were major contributing factors to high cost of agricultural inputs. It was highlighted that about one-third of the price of agricultural inputs in some Sub Saharan countries was as a result of transportation cost [16], [17]. This had been as a result of importing and then transporting the agricultural inputs by road.

The High marketing costs had hampered farmers from commercializing their production [16]. The transportation challenges affecting agricultural productivity derived from the literature search were as follows:

*a) Disregarding Transportation as an important problem.*

The Research Board on transportation in the US affirmed that transportation impacts heavily on agricultural production but whose existence in planning is usually underestimated [10]. The board noted that even in mature economies, transportation was very essential because the majority of domestic agricultural freight was transported by road, and agriculture, had benefited a lot from freight transportation [18]. However, even the US citizenry had not regarded transportation as a challenge, after being asked on the “Most Important Problems of America”. By not recognizing transportation as the most important problem, the price of road transportation in different regions of Africa had remained considerably higher than other regions of the world [19], [20], which had negatively affected agricultural productivity [21], [22].

*b) Lack of adequate research and development (R & D).*

It is through operational research that brought successes in solving some of the transportation challenges that assisted for a very long time [23]. However inadequate investment in R & D had hindered progress in transportation. In the US, for example, federal investment in health care research would at times, be more than 10 times greater than in transportation research investment, because transportation was not viewed as a leading edge of research [10]. This, therefore, means that there is urgent need to investment more in transport research and development studies.

*c) Poor or not utilizing the benefits of Information and Communication Technology (ICT) and Intelligent Transportation Systems (ITS).*

It is interesting to note that the little investments allocated to transportation research, produced commendable results which included innovations in integrated technologies through Intelligent Transport Systems [8]. ITS assist in traffic management, public transport management, emergency management, traveller information, advanced vehicle control and safety, commercial

vehicle operations, weather information, electronic payment, e- collision, congestion management, advanced driver’s assistance system and rail road grade crossing safety, Geographical Positioning Systems (GPS), real time traveller information, goods and vehicle tracking systems, e- tolling, inter modal coordination and many more. The availability of ITS had improved transportation efficiency such that institutions that do not utilize this modern technology can not realize efficient transportation from existing physical infrastructure without investment in technology [8]. ITS and ICT had increased speed, reliability, storage capacity, transparency, and reduced overall transportation costs [8], [10], [23], [24] and [25]. However, an indicator is needed to assess the effectiveness of these digital technologies [48].

*d) Poor Logistics.*

Transportation and logistics systems have interdependent relationships because logistics management needs transportation to perform its activities and successful logistics help to improve traffic environment and transportation development [15]. The success of logistics lies on customized, well-coordinated flow of goods and cooperation of several functions. This could only be achieved by harnessing new technologies provided by Intelligent Transportation Systems and Information and Communication Technology.

*e) Underutilization of rail transportation.*

The importance of rail transportation cannot be overemphasized. About 40% of intercity freight shipment in rural communities in America still use rail transportation, which was abandoned in the 70s [26]. In fact, one of the White Paper goals had pushed for about 30% of road freight over 300km be conveyed through other modes of transport such as rail, by 2030 and 50% by 2050 [27]. Some of the benefits of utilizing rail transportation including high carrying capacity, lower disruptions by weather conditions, lower energy consumption and lower transportation cost and it is widely accepted by market players including trucking companies that the presence of a more efficient rail system would significantly reduce the prices of transport services [28]. These benefits are achievable, especially for bulk goods such as coal, fertilizer, oil, and maize. For instance, a single train is able to carry approximately 1400 tons of cargo which is equivalent to almost fifty, 30-ton trucks, meaning

that there is a lower rate per ton due to scale and distance economies [28]. The introduction of the electric train system has now been the main trend of railway development around the world which is characterised by lower energy consumption and less pollution as compared to other transport modes [25].

In Malawi, rail transportation had been the main mode for international freight transport, connecting Malawi to its southern neighbours of Mozambique, Zimbabwe and South Africa [7]. Being a landlocked country, Malawi's two major railway links to the sea are the links that stretches from Lilongwe eastward to Salima on the Lake Malawi shore and southwards through Blantyre to the port of Beira on the Mozambican coast, and another railroad that joins the Salima-Blantyre line at Nkaya junction to the south of Balaka which stretches through the east to link with the Mozambican railway system at Cuamba, Mozambique, from where it continued to the port of Nacala. Both of these routes were paralyzed by the Mozambican civil war, forcing Malawi to seek alternative routes to the sea which led to the decline in Malawi's international freight movements [28].

*f) Lack or reluctance to abide by Road Transport Policies*

Decisions affecting freight transportation demands have usually been adopted without any reference to policy directions which many governments formulate in order to reduce transport intensity of their economies by addressing transport demand [8]. Instead of the policies providing direction in such areas as national or regional planning, fiscal planning, labour, environmental and many other areas of concern, many countries do not consider freight transport demand as paramount to implementing transport development plans because decisions had been influenced by political mileage resulting in roads being constructed where there is little or no freight transport demand [8].

*g) Overreliance on road freight transport*

As compared to other modes of transport, road freight transport had become the preferred choice because of its cheaper investment funds, high accessibility, high mobility, and availability. Road freight had played a major role in Malawi's domestic and international trade accounting to more than 70% of the internal freight and over 90%

of the country's international freight traffic [7]. However, road freight transport, which had been provided by the private sector, had not provided a seamless service in Malawi because of lacking essential telecommunication infrastructure in ITS some of which were supposed to be provided by the government [8]. The effects of road accidents had been a major challenge in road freight transportation which include damage to infrastructure and injury or death of productive citizens which retards world economic growth. About 1.35 million people die on the worlds' roads with millions more sustaining serious injuries and living with long-term adverse health consequences [29]. This therefore calls for diversification in freight movements.

*h) Unsustainable Transportation*

Some of the disadvantages related to road freight transportation are social costs which include noise pollution, congestion, and air pollution. Air pollution is the biggest environmental risk to health. In 2012, air pollution and related conditions were the cause of death one in every nine persons [30]. Automobiles have contributed to air as well as noise pollution as a result of congestion and reliance on fossil fuels [8], [31]. Air pollution had also been associated with climate change which led to the birth of sustainable development. The SDGs called upon countries to collaborate in the fight against climate change. Goal Number 13 in particular, was aimed at limiting the increase in global mean temperature to 2 degrees Celsius above the pre-industrial levels in order to limit the effects of climate change [32]. This was followed by the Paris Agreement which was adopted on 12th December 2015, which created a global mechanism to tackle climate change [33].

*i) Poor or lack of physical infrastructure*

In some parts of Kenya, access to markets was hampered by poor road infrastructure which had made transportation to become unreliable in rainy seasons which resulted in high costs of transportation in rural areas [34]. As such, farmers were unable to boost their income making them stuck on subsistence farming [30]. Some farmers became isolated as a result of poor road quality or lack of vehicles and inefficient trucking logistics which result in farmers being isolated [16] For example, the poor state of feeder roads and high transportation costs affected the production of

cocoyam in Southern Nigeria for a very long time [35], [36]. And unfortunately, this remains a wish, as the rural transport systems in many developing countries, particularly in Africa, remain far from optimal [14].

*j) High transportation/ distribution costs.*

Farm input costs in Sub Saharan Africa (which includes Malawi), had risen three times higher than in developed countries, mainly due to high road freight costs [20]. This is as a result of inadequate ports, rail and road networks [37]. The high transportation costs put fertilizer beyond the reach of most farmers [2], [25], [34], [36], [37] & [38].

It is therefore very important to look at factors that would assist in the reduction of transportation costs as this could increase the farmers' income as well as provide reduced prices of food in urban areas. Some of the factors include prioritizing investment in building and maintaining good roads in rural areas, maintenance of main road systems and removal of official and unofficial restrictive practices. For example, in Nigeria, truck transport at night is not advised [19]. Another important factor is promotion of competition among transporters that provide trucking services. This dramatically reduces transport cost, increases service quality and mitigates the inefficient factor on road transport [39]. Lack of competition among transporters might be the main reason for Malawi's high transportation costs. The reason might be the existence of interrelationships between large freight transporters and fertilizer importers. Such interrelationships, destroy the competitive rivalry of freight transporters at various levels of the value chain, which adversely affect the transport cost in the trucking sector [19]. And this being the case, the World Bank suggested that fighting high transport costs could be achieved by among other strategies, allowing foreign trucks to transport third-country cargo in order to improve trade and transportation which exposes domestic truck operators to a wider regional competition [39], [40]. This concurs with Lao PDR where, after eliminating domestic trucking cartels and abolishing restrictions on backhauling by foreign truck companies led to a 20% reduction in road transport prices [41]. This, therefore, affirms that by increasing the foreign participation in trucking and logistics services results in reduced transport cost, improved the quality of services and increased competition in the agriculture sector [20].

However, this is not the case in Malawi, where cabotage restrictions are still enforceable [42].

### 3 Research methodology

This research adopted a pragmatic philosophy which states that there many ways of undertaking the research as there could be many points of view to bring a brighter picture of a research and that there could be multiple realities [43]. And therefore, through this philosophy, the research questions determined the direction of the research. The research was problem centred, pluralistic and assumed a real world practice, with emphasis on the research problem and every approach was used to understand the problem instead of entirely focusing on the methods [44]. The interview questions and the questionnaire formed the data collection tools. The interview questions covered the whole supply chain while the questionnaire was used to come up with transportation challenges in the supply chain in Malawi. Respondents from interviews were requested to outline the fertilizer supply chain while transporters were asked transport related issues. This philosophy integrated both the qualitative and quantitative research methods in data collection to answer the research questions [44], [45].

This was an exploratory research which followed an inductive approach. It started with research objectives and questions that needed to be achieved and answered at the end of the research process [44], [45]. The data collected was based on predetermined instruments and that the research objectives and research questions that were developed, guided the research to a scientific research design. The design was flexible to adapt to any change. No variable was controlled nor manipulated such that the study was carried out in a natural setting. The results from the research laid the groundwork for future studies. Exploratory research saved time and resources as only six months were allocated to carry out the research and come up with the results.

#### 3.1 Research Interviews

A survey was conducted through a one on one interview with managers of government parastatal organizations on one side and the private fertilizer companies, on the other. Traditional leaders in East Bank, in Southern Malawi were also interviewed representing farmers as the consumer (user) of

fertilizer. This involved semi-structured interviews followed by telephone interviews to the earlier interview where clarification was required. The interviewees were top managers in fertilizer companies with integrity such that the researcher did not doubt the reliability and validity of the information provided. Besides this, the study considered the secondary information from established articles, journals and official websites where reliable information was displayed. The authenticity and trustworthiness of the information was confirmed based on the dates of the publications [44].

In this research, where only four respondents were interviewed, a content analysis was used to analyse the interview data. The verbal or behavioural data was categorized by classifying, summarizing and tabulating it and then making sense out of the collected textual data [45]. This was a thematic method of data analysis where common patterns were identified within the response, and by digging deeper and deeper into the analysis, it was easier to understand and interpret the meaning of the data [44]. The analysis of this research did not require software such as MAXqda, Atlas.ti and QSR Nvivo, which require large data sets or electronic recoded data [44], [46].

### 3.2 *Research Questionnaires*

Section A of the questionnaire covered selection criteria for the award of a FISP contract in Malawi. This involved both quantitative and qualitative analysis. Section B was designed to rank transportation challenges affecting the distribution of fertilizer. In order to do this, a list of transportation challenges from literature search had been compiled and presented to transporters with a Likert scale for the respondents to rate the challenges based on the impact on the distribution of farm inputs. The range was from 1 to 5 with one (1) as the transportation challenges with very high impact and five (5) with no impact on fertilizer distribution.

### 3.3 *Sampling Method*

The sampling method used in this research was the Snowball also known as chain referral sampling. This is a nonprobability (non-random) sampling method that was used because the characteristics possessed by samples were rare and difficult to find. The exponential non discriminative snowball sampling method was

used. This meant that the first subject to be contacted to the sample group was requested to provide multiple referrals and each new referral was explored until primary data of sufficient amount was collected. The reason for using descriptive statistics and adopting snowball sampling method was because the researcher's intrinsic interest was examining as well as exploring transportation challenges affecting transporters in Malawi in fertilizer supply chain [47]. The starting point was an audience with the board chairman of Road Transporters Operators Association in Malawi (RTOA), a mother body for freight transporters where the subject was discussed and a request made to provide a referral list of transporters who had previously won contracts to distribute farm inputs. And through the referral method, the questionnaires were administered to a total of thirty-eight transportation companies.

The collected data was inputted in the Statistical Package for Social Science (SPSS) version 25. The software provided an easy way of managing and analysing the data gathered. The descriptive statistics using percentages and frequencies for analysis.

## 4 **Discussion**

The first objective was to investigate the fertilizer supply chain challenges in Malawi. The results from the investigation had been presented through the Roadmap to Fertilizer supply chain (Appendix1) attached which shows the processes involved and from the source to the farmer as the ultimate user.

The second objective was to identify the main transportation challenges in the distribution of FISP fertilizer while the third objective involved proposing interventions for an efficient distribution process. But before this was answered, respondents were asked if the selection process of transporters for distribution of farm inputs was effective. In response, 57.9% of the transporters described the selection process as not effective due to political interference, bias and corruption among other reasons raised. The transporters also described the distribution process as not effective as winners of contracts subcontract to third parties to fulfil the contracts at lower charges which sometimes compromises efficiency.

On transportation challenges that impact on fertilizer transportation, by ranking them on Likert

scale, poor logistics scored highly at 74.4% followed by poor or not utilizing ICT and ITS at 61.5% and high transportation costs (61.5). Other transportation challenges affecting fertilizer transportation included the impact of disregarding transport as the most important problem (53.8%); lack of adequate Research and Development (56.4%); Underutilization of Rail Transportation (43.6%); Reluctance to abide by Transport policies (35.9%); Overreliance on road freight transportation (33.3%); unsustainable transportation (35.9%) and poor or lack of physical infrastructure (35.9%).

In order to improve the efficiency of farm input distribution, the transporters suggest that efficient distribution of fertilizer in FISP could only be achieved through improved logistics, stamping out politics, bias, and corruption in FISP; embracing ICT and ITS as tools for improved freight transportation; provision of adequate physical infrastructure by government; stabilized and lower fuel prices and adequate investment in Research and Development in Transportation. Moreover, information sharing, joint decision making, and risk sharing between farmers and transporter are the relevant factors and suggest that supply chain performance is the most important one [49].

## 5 Contribution and Conclusion

This research had set the foundation for future studies in fertilizer supply chain in Malawi. Malawi, with the economy dependent on agriculture, has to focus more on the supply chain in order to unlock the potential benefits of efficient logistics and transportation. Future studies can refer to the “The roadmap of the fertilizer supply chain in Malawi” to identify a particular link in the chain that requires improvements. The roadmap provided would act as a reference material for researchers and academics. The research had highlighted several challenges in the fertilizer supply chain which included poor logistics, political interference, bias in contracts award and fertilizer distribution and poor road infrastructure. The challenges indicate that the potential benefits of FISP have not fully been exploited. This therefore calls for further research to improve the performance of Farm Input Subsidy Programs for improved fertilizer accessibility and usage.

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Appendix 1

Roadmap of Fertilizer Supply Chain in Malawi.

