

ASSESSING THE ECONOMIC POTENTIAL OF NUTRIENT-DENSE FOODS SUPPLY
CHAIN IN ETHIOPIA

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Abstract

The prevalence of child malnutrition in Africa is alarming. Currently, almost six million children under age five are suffering from this problem in Ethiopia. Reducing child malnutrition requires a multi-pronged approach that includes nutritious foods, improved hygiene, and breastfeeding. Poverty and food insecurity have severely constrained the access to nutritious diets that have high energy, protein, and other micronutrient content. Diets based mainly on plant sources may not meet nutritional requirements and need to be improved, either through adding protein from animal sources such as milk powder or through supplemental nutrition products. One option is the formulation of ready-to-use foods (RUFs), which have been a tool to treat malnutrition and undernutrition. RUF is a nutrient-dense food that contains all the essential nutrients for growth and development that can also serve as a food supplement to pregnant women and the elderly who lack essential food nutrients in their diets. The food is packaged conveniently and does not require cooking or additional preparation.

Increasing access to these foods has become a challenge to producers and buyers. Cost remains one of the main barriers to greater access, further complicated by constrained funding for procuring the products and the variability of prices of some ingredients, such as peanuts. It is, therefore, crucial to have other versions of RUTF/RUSF made from other ingredients (i.e. chickpeas, barley) that can be produced locally and meet the dietary needs of a target population.

Therefore, the focus of the study is to identify the supply chain benefits of alternative nutrient-dense foods in the ready-to-use food supply chain. Data were collected through video interviews with producers and buyers of RUFs in the supply chain. Participants were asked open-ended questions and the responses were transcribed verbatim and analyzed. Patterns and relationships that emerge from the data were coded and analyzed using NVivo 12 plus software.

The analysis of interview data reveals key challenges such as logistics, longer lead times, higher procurement costs, dislike of products by some beneficiaries and shortage of critical ingredients for formulation within the RUTF/RUSF supply chain.

Despite these issues, the interviews with the stakeholders strongly indicated that alternative recipes, if developed properly, could enhance production volumes by augmenting existing products as well as increasing product accessibility by the intended beneficiaries. The insights from the interviews reveal that encouraging the development of alternative products from local ingredients would reduce some problems encountered during production and procurement, such as the shortage of critical ingredients, long lead times, and high prices of the RUTF/RUSF in the market as there are several options available to the buyers.

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List of Abbreviations and Acronyms

CMAM	Community Management of Acute Malnutrition
WHO	World Health Organization
UNICEF	United Nations Children Emergency Fund
MSF	Medicines Sans Frontiers
MAM	Moderate Acute Malnutrition
SAM	Severe Acute Malnutrition
WFP	World Food Programme
RUF	Ready-to-Use Food
RUTF	Ready-to-Use Therapeutic Food
RUSF	Ready-to-Use Supplementary Food
USAID	United States Agency International for Development
DHS	Demographic Health Survey
LNS-SQ	Lipid Nutrient Supplement Paste Small Quantity
EHNRI	Ethiopian Nutrition and Health Research Institute

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Chapter 1 Introduction

1.1 Background

Malnutrition in all forms is a global burden that affects every country, particularly developing countries, leading to public health issues and economic costs (UNICEF et al., 2018). Globally, an estimated 805 million people are chronically malnourished, 159 million children under five are stunted, and 41 million children under five are overweight and obese (UNICEF et al., 2018). In addition, at least 2 billion children and adults do not consume the required amounts of vitamins and minerals (UNICEF et al., 2018). Reports suggest that deficiency in these micronutrients could lead to anemia, blindness, cognitive impairment, and greater susceptibility to many other diseases (United Nations System Standing Committee on Nutrition, 2015). Alongside individual health risks caused by malnutrition, hunger and undernutrition reduce economic activity by \$1.4 – 2.1 trillion (USD) a year (International Food Policy Research Institute, 2015). At the individual level, it has also been suggested that malnourished children are at risk of losing at least 10% of their lifetime earning potential (UNICEF et al., 2018), potentially contributing to a widening gap between rich and poor.

According to several international organizations, nutrition and food insecurity are the predominant health problems in developing countries (FAO, IFAD, UNICEF & WHO, 2017). A study by Pelletier, Frongillo, Schroeder, and Habicht (1995) found that 56 percent of child mortality rates in developing countries result from malnutrition. In Africa, 58.7 million children between 0-59 months of age are stunted, 13.8 million children between 0-59 months of age suffer from wasting, and 9.7 million children between 0-59 months of age are underweight¹ (UNICEF et al., 2018).

¹ Stunting and wasting: The percent/number of children aged 0-59 months who are below -2 standard deviations from median height-for-age of the WHO Child Growth Standards.

Overweight: Number of children aged 0 – 59 months who are above two standard deviations from median height-for-age of the WHO Child Growth Standards.

Underweight shows how the body mass relative to the chronological age, which is influenced by both the child's weight and height. Thus, the proportion of children with weight-for-age below two standard deviation (Bhan et al., 2003).

In Ethiopia, stunting, being underweight, and wasting account for 38%, 24%, and 10% of the underage-five population in the country (Megabiaw & Rahman, 2014; USAID, 2018). About 21.9% and 20.4% of these individuals are moderately and severely stunted. Notably, children in rural areas are more stunted (44.4%) than those in urban centers (26.6%) (Megabiaw & Rahman, 2014). For instance, the rate of stunting in the Amhara, Tigray, and Affar regions is 51.8 %, 51.7%, and 51.3%, respectively, compared to that in Addis Ababa (21.7%), Gambella (27.4%), and Harari (29.0%) (USAID, 2018). Further exacerbating the issue is that as many as 81% of all cases of child malnutrition and its related causes go untreated (African Union Commission & EHNRI, 2013).

The impacts of undernutrition and malnutrition have significant effects on productivity, education, and health. The total annual costs associated with child undernutrition are estimated at 55.5 billion Ethiopian birrs (ETB) or \$ 4.7 billion USD, equivalent to 16.5% of Ethiopia's gross domestic product (GDP) (African Union Commission & EHNRI, 2013). The total costs for families suffering from undernutrition and the health system amount to 1,646 million ETB and 185 million ETB, respectively (African Union Commission & EHNRI, 2013). In education, students who are stunted often have reduced cognitive capacity and are, therefore are more likely to repeat grades in school. Repetitions are costly to the family of the student as well as the government, as both need to invest resources for an additional year of schooling. The total costs associated are estimated at 93 million ETB (African Union Commission & EHNRI, 2013). The loss in productivity due to stunting amounts to 12,857 million ETB (African Union Commission & EHNRI, 2013). Additionally, the child mortality associated with undernutrition has reduced Ethiopia's workforce by 8% (African Union Commission & EHNRI, 2013).

Several factors are thought to contribute to malnutrition and undernutrition in Ethiopia. First, diets are generally lacking in key nutritional elements, such as protein, iodine, vitamins, and minerals (USAID, 2018). Second, natural disasters, such as drought and flooding, have led to higher food insecurity levels. For instance, the lingering effects of the El Nino-induced drought in 2015-2016 affected many people, contributing to nutritional problems (USAID, 2018). These droughts have reduced both livestock and grain productivity. Third, conflicts in neighbouring countries (Somalia, Sudan, Eritrea, and South-Sudan) have resulted in an influx of refugees

entering Ethiopia, putting increased pressure on local food supply systems (USAID, 2018). These factors have forced many poor populations to eat a staple diet that provides relatively low nutritional content.

Further compounding this challenge is the lack of education for rural mothers (caregivers), making it difficult for them to make better decisions for themselves and their children. This often leads to poor feeding recommendations for the child. One way to address these issues would be to place a greater emphasis on the role of innovative food systems and improving nutritional content in food products.

To be clear, agricultural production may provide only a partial solution to the problem of the availability of nutritious foods for vulnerable populations. Recent reviews suggest that agricultural production can help reduce undernutrition by supporting livelihoods, improving household food security, and providing healthy diets. The poor design and implementation of agricultural interventions, droughts, land tenure issues, a lack of infrastructure, distributional problems, and post-harvest issues are partly responsible for inhibiting agricultural production's potential to help address issues relating to food availability. These challenges have led researchers, governments, and relief agencies like UNICEF, WHO, WFP, and many others to promote food-based approaches to increase high access to quality and low-cost foods through the value chain nutrition approach.

The value chain approach involves developing strategies to address nutrition problems. One of the strategies is the development of nutritious diets, such as ready-to-use foods (RUFs). RUFs are nutrient-dense foods that contain nutritious food components such as energy, lipids, protein, and fatty acids micronutrients (Osendarp et al., 2015; WHO, WFP, UNSSCN, UNICEF, 2007). It is an important tool used by relief agencies to manage severe and acute malnutrition (Weber et al., 2017; Briend et al., 2015; Owino et al., 2014; Dibari et al., 2012).

There are two categories of ready-to-use foods (RUFs)- Ready-to-use therapeutic foods (RUTFs) and Ready-to-use supplementary foods (RUSFs). RUTFs are used to treat severe acute malnutrition (SAM), whereas RUSFs is used for treating moderate acute malnutrition (MAM).

RUSFs are meant to improve micronutrient qualities of diets of at-risk communities that may lack access to nutritious foods in order to prevent stunting and wasting and other health conditions. One example of an RUTF for the treatment of undernutrition is Plumpy' Nut[®]. Early evidence of the effectiveness of Plumpy' Nut[®] for the treatment of severe acute malnutrition was significant enough that financial support went towards further development of this product to address chronic malnutrition. Plumpy' Nut[®] product does not require additional resources by the recipient, and its logically attractive in emergencies where large numbers need to be fed, where local food is unavailable, or health system is strained. The first commercially produced RUTF known as Plumpy' Nut[®] was patented by Nutriset, a French company and by 2010, it became the widely used product to treat malnutrition by UNICEF and WFP. Nutriset's patent of process and production of its RUTF initially limited the possibility of the local output in low-income countries where it was needed most. However, in 2005, Nutriset founded PlumpyField, a network of Plumpy' Nut[®] manufacturers' license to produce Plumpy' Nut[®] through franchise or license agreements. This expansion led to a significant increase in production capacity, with Nutriset's network providing most of the RUTF products. In 2017, Plumpy' Nut[®] accounted for 42,656 metric tons out of 52,850 metric tons UNICEF purchased for its program (<http://www.plumpyfield.com/about/key-data>).

Beyond production location, buyers of ready-to-use foods seek to maintain buffer capacity. UNICEF and others require a diversified supply base to ensure sufficient RUTF, RUSF, and other supplementary foods to respond to sudden increases in demand, and to mitigate possible disruptions to supply. However, there are risks associated with this initiative. First, there is a risk of natural disasters such as earthquakes, hurricanes, storms, and flooding destroying production plants or the supply chain. Second, the possibility of terrorism and political instability at different periods has increased globally, and these are increasingly affecting global supply chains because of the delays and complexities in product deliveries. The ramifications could effectively halt the entire RUTF/RUSF supply chain for all their customers.

While there may be significant benefits, single global sourcing may limit the extent to which the supply chain increases production capacity. In the face of a complex emergency, producers who

² Plumpy' Nut [®] is made by mixing peanut, sugar, vitamins and minerals, vegetable oils, and milk powder.

manufacture RUTFs and RUSFs would be forced to prioritize those orders, thereby stressing its production capacity while also reducing the company's ability to meet needs elsewhere. Moreover, in regions where peanuts are not typically part of the diet, consumers of Plumpy' Nut® report that it has an unpleasant taste to some malnourished children, making digestibility difficult (Ali et al., 2013). Further, peanuts, which are a key component in Plumpy' Nut®, have high water content susceptible to bacterial contamination, such as aflatoxin. The consequence of consuming aflatoxins may lead to allergic reactions in malnourished children, which could prolong the recovery times. Additionally, recent data suggest that the volatility of the peanut price could increase the price of the current product.

A quick review of the humanitarian supply chain network shows that risks and disruptions, both predictable and unpredictable, exist in every link of supply chain and that effective risk management should be a priority. Additionally, there has been a big push in humanitarian food supply chains by international food assistance programs to implement so-called 'local-regional procurement (LRP)³ (Coulter et al., 2007). LRP is argued to reduce the risk of single sourcing, which helps reduce lead times in an emergency and fosters economic benefits in the long run (Coulter et al., 2007). These have heightened interest in finding alternative RUF formulations that do not use peanuts as the primary ingredients, particularly in countries where peanuts have been imported. Therefore, looking at the literature and the efforts to encourage the local-regional procurement in the humanitarian supply chains, the study makes these contributions. First, the study uses existing models to examine the forces that shape competition in the industry. Second, interviews with stakeholders enable me to identify the impacts of alternative RUF products on the management of risks and disruptions in the supply chain. Furthermore, this research will help people, including stakeholders, to better understand the issues being confronted in the humanitarian RUF supply chains⁴. Understanding these issues will provide insights to decision-makers when outlining policies to examine similar challenges in the future.

³ Local regional procurement is an innovative international food assistance instruments focused on the procurement of foods within a country where it is to be distributed or in a nearby country using cash and voucher transfers instead of direct distribution of food and commodities.

⁴ The Humanitarian supply chain is driven by non-profit objectives and aims at providing maximum relief to the affected victims in terms of medical aid, food, shelter, and drinking water.

With many instances of supply chain failures and the ongoing global challenges, stakeholders are becoming aware of the impacts of these challenges, the critical question to explore in the humanitarian supply chain is, why is there a dominant product on the market since there could be other alternative products to supplement volumes needed on the market? How have procurement challenges influenced the supply chain of ready-to-use therapeutic foods and ready-to-use supplementary foods? Furthermore, what impact(s) would alternative recipes have on the RUTF/RUSF supply chain? Although there have been several discussions, contributions, and studies over the years that have examined supply chain risks and disruptions in the context of alternative products, financial planning, and quantitative studies and risks associated with suppliers and the supply networks, this study seeks to achieve different objectives.

1.2 Objectives of this study

This study aims to investigate the issues in humanitarian supply chains, particularly as it relates to the number of RUF products. These products, if developed appropriately, could be used for treating undernutrition in Ethiopia and other countries. The specific objectives of the study are as follows:

1. To identify factors that pose threats for stakeholders in reducing malnutrition in the RUTF and RUSF supply chains. In other words, the study intends to recognize the significant constraints in the sourcing and procuring of RUTF/RUSF in the supply chains.
2. To explore the benefits and challenges of alternative RUTFs and RUSFs in mitigating risks in meeting the objectives of reducing child malnutrition.

1.3 Research methodology

According to Yu et al. (2009), scholarly works have confirmed that supply chains can be vulnerable. For instance, Wong et al. (2002) emphasized that today's supply chain is developed to be agile, lean, and effective, but the absence of alternatives makes the supply chain susceptible to system shocks and disruptions. For instance, in the event of an outbreak of global pandemic where production centers need to shut down when employees have contacted a disease that might affect the health of the workers and the finished products produced. Due to the pandemic outbreak do we need to shut down production and leave the severely malnourished children

unattended? Christopher and Towill (2000) and Tang (2006) noted that several firms have implemented various risk management initiatives such as outsourcing, flexible contracts, and global networks to gain cost advantage and market share that are effective in a stable environment. They however, emphasized that, these initiatives could make the supply chain more vulnerable to various disruptions caused by uncertain economic cycles, consumer demands, and man-made and natural disasters. As emphasized by Creswell (2016) that “*the nature of research problem should drive the choice of research strategy*”. Based on this philosophy and the lack of extant knowledge about the phenomenon, I chose an applied research methodology for this study. This method was chosen to examine the risks and disruptions in the RUF industry and adopt a strategy to mitigate these problems. The qualitative research methodology makes use of interviews, documents, and other forms to collect data. The insights from the interviews were recorded, coded and analyzed using computer software.

1.3.1 Research strategy

There are four main social research strategies available in the social and applied sciences; inductive, deductive, abductive, and retroductive strategies (Blaikie & Priest, 2019). In addition to these four, there are other strategies that researchers used in qualitative studies. They are positivist, interpretive, critical, and postmodern (Merriam, 2008). Nevertheless, to answer the "How" and "What" based research questions, this project will adopt the interpretive strategy (basic qualitative research strategy). According to Merriam (2008), the basic qualitative approach is useful in applied fields of practice. Data collection for this strategy is through interviews, observations, and document analysis (Merriam, 2008). In this study, basic qualitative strategy attempts to outline some issues in RUF supply chains and identify the benefits and challenges of RUF formulations in the supply chains.

1.3.2 Research design

To answer the proposed questions and realize the research objectives, this study will investigate the dominance of a one product formulation in RUTF/RUSF sourcing strategies (i.e. its impacts, the risks in humanitarian supply chains, and risk mitigation in the humanitarian supply chains). Even though several risk mitigation strategies are suggested in the literature, the specific focus of

this study will be the proactive risk mitigation strategy of a flexible supply base (i.e. development of alternative products). The following structure will be adopted:

- First, there will be a literature review on ready-to-use foods, single sourcing, the benefits and risks involved in relying on one product in the supply chain. Also, I will look at the supply chain risk management, risk mitigation strategies in humanitarian supply chains, and the humanitarian supply chain model used for this study.
- Second is the theoretical framework for this study, which makes use of Porter's Five Forces framework of industry competition (Porter, 2008). The structure provides an understanding as to why there is sometimes one dominant supplier on the market and the benefits of new entrants to the supply chain.
- Third, I develop interview questionnaires to enquire about producers' and buyers' perceptions of RUTF/RUSF procurement issues and the need to have alternative recipes to reduce these procurement challenges. Their contributions will enable us to understand issues in the RUFs supply chain and allow policymakers to make informed decisions going forward to minimize the risks in these supply chains.
- Finally, a conclusion section will highlight the main findings of the study and what this may mean for stakeholders in the RUF supply chain, as well as caveats and suggestions for further research.

1.4 Organization of the thesis

The thesis is structured as follows: The next section (Chapter Two) contains the literature review, in which much emphasis is placed on RUF products before the chapter goes on to discuss single sourcing and supply chain risk management. Also discussed in this chapter is the supply chain risks with emphasis on single versus multiple sourcing strategies to mitigate disruptions in the chain. Chapter three presents the theoretical framework for this study. The chapter discusses Porter's Five Forces that shape competition on the market. Chapter Four presents the data, methodology and structure of the interview conducted for this study. Chapter Five gives insights into the interviews from the participants. The interviewees' perception of RUTF/RUSF issues in the supply chain and the benefits and challenges of alternative recipes are discussed. Chapter Six concludes the study, addresses the limitations of the research and identifies areas for further research studies.

Chapter 2 Background and Literature Review

2.1 Introduction

In order to more clearly understand the question of why there are limited RUF offerings considering the scale of malnutrition in the world, it is important to understand the background of RUF. In the following section, I will provide this background. Following the background, I examine both the literature on the history of ready-to-use foods (RUFs) and supply chain risk management and sourcing strategies.

The first part of this chapter gives an overview of RUFs, the types of RUFs, alternative RUFs, RUFs product development, and RUFs supply chain of ready-to-use foods and its production specifications. There exists a large body of literature relating to sourcing strategies and supply chain risks. Considering the relevance, I review the literature on supply chain risks and disruptions and the comparison of single sourcing and multiple sourcing strategies. The last section describes how the research in this thesis fits within these different literatures.

2.2 Ready-to-use foods (RUF)

Ready-to-use foods (RUFs) are one of the tools for the treatment of severe acute malnutrition (SAM)⁵ and moderate acute malnutrition (MAM)⁶. The foods are used for uncomplicated cases of SAM and MAM with care provided by mothers and supervised by community health workers, through the community management of acute malnutrition (CMAM) program (World Health Organization, 2013). This program was officially endorsed by the World Health Organization (WHO) and other humanitarian agencies in 2007 (WHO, WFP, UNSSCN, & UNICEF, 2007). The objective of this program was to allow many affected children to receive adequate treatment and recover fully (UNICEF/Coverage Monitoring Network/ACF International, 2012). RUFs comprise different formulations recommended by the WHO to treat all forms of malnutrition

⁵ SAM is defined by a very low weight for height (below -3 z scores of the median WHO growth standards), by the presence of nutrition oedema (WHO, WFP, UNSSCN, & UNICEF, 2007).

⁶ MAM is the weight-for-age between -3 and -2z- scores below the median of the WHO child growth standards, due to low weight-for-height (wasting) or a low height-for-age (stunting) or the combination of both (World Health Organization, 2012).

(Wagh & Deore, 2015; Whiting et al., 2018; WHO et al., 2007; World Health Organization, 2012; Pee & Bloem, 2009; Defourny et al., 2007).

2.2.1 Types of RUFs

RUFs are classified based on the functions they perform. Some are used for the treatment of only malnutrition, and others are for treating malnourished children suffering from diseases such as HIV/AIDS. The five primary classifications for these products are; Ready-to-use therapeutic foods (RUTF), Ready-to-Use Supplementary Foods (RUSF), Ready-to-Use Complementary Foods (RUCF), Fortified Blended Foods (FBF), and Ready-to-Use Foods for HIV (RUF-H) (Wagh and Deore, 2015).

The more widely used ones are RUTFs and RUSFs. RUTFs and RUSFs are formulated as lipid pastes or compressed bars, which provide essential food nutrients like energy, quality protein, fatty acids, and micronutrients (Osendarp et al., 2015; WHO et al., 2007)). These two products have different objectives; they are both designed to address the very complex problems of malnutrition and undernutrition in high-risk populations (Wagh & Deore, 2015; Patel et al., 2015; Grellety et al., 2012; Huybregts et al., 2012).

RUTFs are nutrient-dense foods used for treating severe acute malnutrition (SAM)⁷ in children and adults. The food is used to treat uncomplicated cases of SAM, which has replaced the formula F100 (Wagh and Deore, 2015). F100 is a liquid diet with 100kcal/100ml prepared by mixing dried skimmed milk, oil, sugar, and a vitamin and mineral mix (Briend et al., 1999; Wagh & Deore, 2015; Manary, 2006; Osendarp et al., 2015). Additionally, the food has an advantage of containing less water compared to F100, making it resistant to microbiological contamination, and suitable for storage without refrigeration. A policy brief by IBFAN (2017) suggests that the consumption of two 500 kcal packs of RUTFs gives children 1000 calories, which reduces the nutritional demand on mothers, improves nutritional recovery in young children and infants, and protects their immune system from disease (IBFAN Policy Brief, 2017).

⁷ Severe acute malnutrition (SAM) is a nutritional problem in which there is a low intake of calories, vitamins, minerals, and other nutritional elements required for growth and development in children under five years of age. In other words, SAM occurs when children under age five are deficient in essential food nutrients.

RUSFs, unlike RUTFs, treat children with moderate acute malnutrition (MAM) in the same populations (Wagh & Deore, 2015; Grellety et al., 2012; World Health Organization, 2012). The food is not designed to provide 100% of daily calories relative to RUTFs but is formulated to combine with other complementary home-based foods.

These products are designed to be consumed intensively as part of the short-term measure of emergency treatment and are exclusively distributed by aid institutions such as UNICEF, WFP, and Doctors Without Borders. Many RUTFs and RUSFs being produced contain peanuts, sugar, oil, skimmed milk, and vitamin and mineral mix.

The PlumpyField, a network of independent producers formed by Nutriset, mostly developed and created lipid-based RUTF and RUSF for international food assistance programmes. One such food of RUTF/RUSF is the Plumpy'Nut®, developed in 1996 by Nutriset and commercialized in 2001 as a short-term emergency treatment for malnutrition. Peanut is the primary ingredient for this product. Plumpy'Nut® is one of the most widely used RUTF procured by UNICEF, WFP, and other aid institutions. Manufacturers who produce the food note that it does not require any refrigeration or additional preparation before eating.

Given the success of RUTF, particularly Plumpy'Nut®, new ready-to-use foods have been developed and added to the industry to treat acute malnutrition. For example, Nutriset, through its network, has introduced new products based on the original formula, including *Plumpy'Doz*, *Plumpy'Mum*, *Plumpy'Sup*, and *Enov'Mum*. These new products are already produced in large quantities. For instance, in 2017, the PlumpyField network produced 42,656 metric tonnes of RUSF, with Nutriset producing most of the product (PlumpyField Network, 2020).

2.2.2 Alternative RUTF/RUSF products

The potential for further expansion of RUTFs and RUSFs has led to the production of alternative formulations. Alternative RUTF/RUSF products are nutrient-dense foods produced from raw materials without using all the original ingredients in Plumpy'Nut®. It can be developed from maize, sorghum, chickpeas, sugar, and many other raw materials. They are affordable,

acceptable, and nutritionally appropriate food products for beneficiaries (Hawkes and Ruel, 2011).

There are several examples of alternative RUTFs/RUFs being produced in African countries and other parts of the world. In Nigeria, Dala Foods is one such processing firm manufacturing nutrient-dense food product called “*Action meal*” (Gambo and Safiyanu, 2014). “*Action meal*” is a food supplement developed for malnourished people and is processed from maize, soya-bean, and groundnut (Gambo & Safiyanu, 2014). According to the manufacturers, “*Action meal*” promotes local food patronage and provides opportunities to farmers by using local sourcing of inputs. “*Power Flour*,” also known as “*Kimea*,” another high quality fortified nutritious food produced by Power Foods Industry Limited, located in Tanzania (Kibona et al., 1995). According to Kibona et al.(1995) grains and cereals are the raw materials for *Power Flour*. Additionally, Abbott Nutritionals in Haiti produces infant formulas and breastmilk substitutes called “*Nourimanba*,” RUTF, for the treatment of malnutrition (Bonifaz, 2011).

In addition to the above products, some other private entities have also sprung up to produce RUTF and other supplementary foods. For instance, MANA nutrition based in North Carolina, together with other partners, produces supplementary food to prevent moderate acute malnutrition (Bazzano et al., 2017). Similarly, a non-profit entity, Valid Nutrition, based in Ireland, produces RUTF in Malawi using large quantities of local ingredients. Valid Nutrition, through its expansion, is also producing supplementary food for treating chronically malnourished children. They have partnered with Amul, the largest private food brand and dairy in India, to produce RUTF. In addition, Toddler Food Partners, a U.S. based company, has partnered with private companies in India, including Hexagon Nutrition Private Limited, a pharmaceutical company, the State Nutrition Mission, Tata Chemicals, Nufluor, Compact, and General Mills to produce local RUSFs (Toddler Food Partners, 2020). The development of alternative RUTFs, RUSFs, and other supplementary foods are steered by guidelines to ensure the product meets the international standard, and that the intended population finds it acceptable.

In summary, private and other stakeholders can formulate alternative RUFs from other ingredients (i.e. chickpeas, lentils, and many others) besides the ones originally used to develop

the peanut based RUFs to treat malnutrition depending on its availability and affordability (Schoonees et al., 2013).

2.2.3 The RUTF/RUSF product specification

As more RUTFs and RUSFs are being produced using globalized procurement networks, the policies and guidelines covering product design and development to meet the nutritional needs of malnourished children are being revised to reflect changes in the supply chain and further expansion in the distribution of the RUTFs and RUSFs. The standard settings and guidelines, such as the ISO and Codex, are to harmonize regulations for RUF product quality and safety and streamline product inspections and audits.

The production methods and storage of RUFs products, as well as reduction of nutrient content during storage, are formulated according to the policy documents from UNICEF, WHO, WFP, and WHO technical notes for foods for treating malnutrition (WFP et al., 2016). The technical notes provide the standards or guidelines for which all production process follows.

Peanuts, dried skimmed milk, oil, sugar, and vitamins and minerals premix are the main ingredients for the production of RUTFs, RUSFs and other supplementary foods (WFP et al., 2016). Other raw materials are also being used in place of peanuts such as chickpeas, sesame, almonds and others, provided product standards are maintained (i.e. nutrition and safety) and proven acceptable to the targeted populations (WFP et al., 2016).

Several standard practices guide the production of RUTF/RUSF products. These practices include the general principles of food hygiene (CAC/RCP 1 – 1969, of the Codex Alimentarius⁸), which guides the general principles for the addition of essential nutrients to foods, ISO 22000:2005: food safety management systems, and ISO/TS 22004 which provides guidance on the application of ISO 22000:2005 (WFP et al., 2016).

⁸ The Codex Alimentarius provides a reference for manufacturers on how the products should be formulated for the management of severe and acute malnutrition (UNICEF, 2018)

Additionally, there are standard guides for pesticide control and place of manufacture. This is to ensure the product is safe and free from any bacterial contamination. Examples of these guidelines are the International Code of Hygienic Practice for Foods for Infants and Children, CAC/GL 08- 1991 specified in the Codex Alimentarius and Codex Committee on Pesticides Residues (CCPR) (WFP et al., 2016). Additionally, producers must have a food safety policy in place and complete the quality management practices based on Hazard Analysis and Critical Control Points (HACCP) (UNICEF, 2018). In addition, RUSF products should be free from micro-organisms in any amounts, which may be hazardous to beneficiaries' health.

In addition to the above standards, there are packaging and labelling guidelines that manufacturers follow that are aligned with international standards and best practices (for instance, the Codex Stan 146-1985⁹ and Codex Stan 1 - 1985¹⁰) (World Food Programme, 2016). The labelling contains trade name, product name, target use, net weight, nutrients content, ingredient list, preparation instruction, storage instruction, manufacturer name, manufacture batch number, and production date (WFP et al., 2016). In addition, there is a manufacturer address, donor and relief agencies logo, and beneficiary feedback hotline (WFP et al., 2016; World Food Programme, 2016). Further, the food is put in food-grade sachets and sealed to prevent leakages and protect the product throughout its shelf life. The food must be able to be stored for at least 24 months at 30 degrees Celsius with 65 percent relative humidity. Besides the general requirements, RUTF and RUSF have a smooth, homogeneous, thick paste, and be easy to squeeze out from the sachet (UNICEF, 2018).

2.2.4 The supply chain for RUTF/RUSF products

The supply chain for RUF is not like the supply chain of other food products where users pay for the products. Users of RUFs are mostly malnourished children, pregnant women, and HIV/AIDS patients who get the products for free. In other words, children and lactating women consume these products without having to directly purchase them from retailers or other vendors.

⁹ General standard for the labelling of and claims for pre-packaged foods for special dietary uses.

¹⁰ General standard for the labelling of pre-packaged foods.

The production and distribution of RUFs are funded through humanitarian action and world government support. The donations can be directed to a specific project or just general funding. In 2017, UNICEF required 110.5 USD million for its humanitarian program in Ethiopia, and as of July 2017, it had received 34.5 USD million, with 33.5 USD million carried forward from the previous period (UNICEF, 2017).

The RUF supply chain utilizes a set of fundamental processes to plan, procure, produce, and deliver the products to the users.

2.2.4.1 Plan

UNICEF and other affiliates maintain estimates of RUTF need in their communities based on demographic information conducted by partners' knowledge on the project. The planning process starts when the partners identify the specific needs for RUTF among malnourished children in an area. The partner identifies the volumes required to treat malnourished children and the availability of funds to carry out the project.

2.2.4.2 Procure & Produce

Once funds are secured and proposals are reviewed, donors release funds to the buyers (i.e. UNICEF, and others), and the institutions (buyers) make purchase orders to the producers. This happens when funds for transportation have been released to the processor. The purchase orders are adjusted based on the availability of RUTFs. If no other adjustments are made, the producer produces the product and delivers them as scheduled.

2.2.4.3 Deliver

Once the RUTF product is manufactured, the RUTF producer communicates with a global logistics supplier to arrange a date for product pick-up from the production facility, containerization, and transport to the port of export for sea or air freight. The country and regional offices of UNICEF and other agencies clear the goods at the port, transport them to their warehouses, load them on trucks, and deliver to the communities.

In addition to plan, procure, produce, and deliver processes, there are other activities such as monitoring and evaluation, invoicing and payments, and quality assurances that go on to the supply chain. Quantity assurances mechanism starts with RUTF producers who inspect the ingredients for the contaminants and nutritional value. UNICEF and others also conduct periodic inspections on producers to ensure personal hygiene conditions and consistency of product quality.

Apart from UNICEF, who is the largest humanitarian buyer of RUFs, there are other humanitarian institutions and NGOs that work alongside or in parallel to UNICEF. Some other institutions also have their own supply chain who independently purchase the RUTFs to avoid supply shortages that can occur within the UNICEF channel. This happens when these institutions purchase RUTF directly from producers and work with an import agency for in-country transport and customs clearance.

Figure 2.1 shows the stakeholders and the processes in the RUTF supply chain. The process starts with the planning of volumes of RUTFs required for the treatment of malnutrition by humanitarian institutions. Once those quantities are known, UNICEF and others begin to procure by placing purchase orders to RUTF production by processors. The solid line boxes show the linkages between UNICEF and partners at other institutions in the RUTF supply chain. Other agencies also operate alongside or parallel to UNICEF shown in the long dashed-lines boxes.

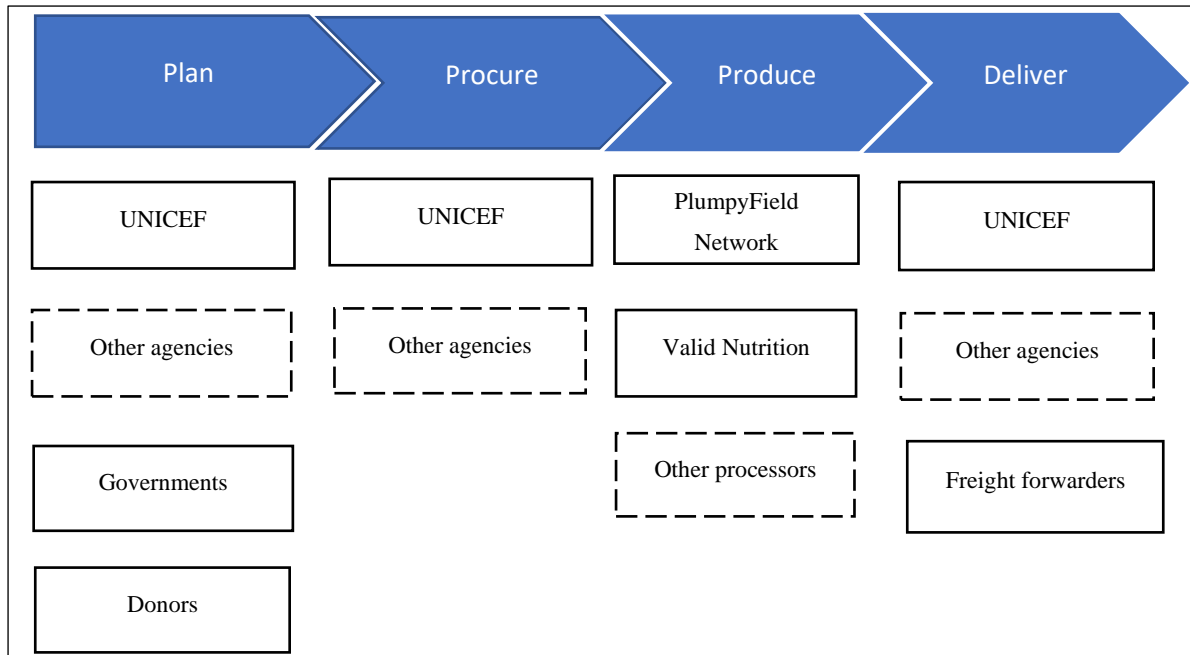


Figure 2.1 The stakeholders in the RUTF supply chain

Source: (UNICEF, 2009)

It is important to note that the fundamental processes to plan, procure, produce, and deliver supply chain decisions are done to streamline the three flows-product flows, information flows, and fund flows.

2.2.4.4 Product flows

The product flows are processes that ensure RUTF and other supplementary foods are produced and deliver to the intended beneficiaries. The processors of RUTFs can be local, global or both. Local processors produced RUTF located in countries or regions where there is greater need for and use of the product. Examples of these processors include, but are not limited to, Hilina Foods in Ethiopia, Valid Nutrition in Malawi, and Insta Food in Kenya. Global manufacturers produce RUFs for export such as Nutriset in France and Edesia in USA. The global manufacturers produce the RUTF to an agreed location, mostly to the nearest port. Most of the RUTF used in developing countries like Ethiopia was sourced from Nutriset in France and delivered to Kenya by air or sea transport. In other circumstances, the products are flown directly to the recipient country's capital, Addis Ababa, and then transported by trucks to the regional warehouse.

Currently, there are 21 RUTF processors in the supply chain that supply RUFs to UNICEF and other agencies. Compact AS (Norway), Compact Pvt. Ltd (India), Diva Nutritional Products Ltd (U.S.A.), Edesia (U.S.A.), Hilina Enriched Foods (Ethiopia), Nutriset S.A.S. (France), Samil Industry (Sudan), Project Peanut Butter (Ghana), Valid Nutrition (Malawi), Insta Products Ltd (Kenya), and others. Among all these manufacturers, Nutriset and its franchises are the dominant manufacturer for these products, with production volumes of 86,854 metric tons in 2017 (i.e. 60% of the total production capacity) comprising 42,570 metric tons of RUTF, 42,656 metric tons of RUSF, and 1,629 metric tons of LNS-SQ (PlumpyField Network, 2020).

Nutriset has a network called PlumpyField, comprised of independent producers licensed for manufacturing RUTF/RUSF products in countries where they are most needed. The network members share the same vision and ethical approach, enabling them to work within a strategic framework to respond to the needs of people (PlumpyField Network, 2020). Besides that, by joining this network, members benefit from Nutriset's technology, experience, and reputation as a leading producer in RUTF/RUSF products to treat and prevent malnutrition. In addition, being a member of the network may allow new firms to leverage the reputation of Nutriset and PlumpyField. Additionally, members enjoy training from Nutriset to help improve production volumes. There is initial and continuous training for the teams about new equipment that enables them to improve on their performance. Through training, members get access to research results to provide different product formulations.

Individual producers set their prices based on the cost incurred in producing the product. The price is subject to negotiation with the institutional buyer(s) based on the costs of sourcing raw materials and other costs experienced before and after production. In the PlumpyField network, the members are like a family sharing the same goals and principles and working together to promote better nutrition to its customers. Given that, the network applies pricing policies that are transparent while ensuring that producers cover all their costs, considering investment and product improvements to respond to demands. In other words, they set prices to enable them to cover all their costs, including fixed and variable costs (labour, utilities, and others). As of December 2018, the PlumpyField network has 11 members based in Central America, Africa, Asia, France, and the United States. Table 2.1 shows members of the PlumpyField network, their

location, and production capacity per year. Figure 2.2 shows the product flow for RUTF in the UNICEF’s supply chain.

Table 2.1 PlumpyField network and their production capacity

PlumpyField network	Location	Capacity/per year (MT)
Nutriset	France	NA
Hilina Enriched Foods	Ethiopia	7,000
Dansa & Nutrik	Nigeria	NA
Edesia	USA	14,000
InnoFaso	Burkina Faso	2,400
Meds & Foods for Kids	Haiti	4,800
Nutriguinèe	Guinea	650
Nutrivita	India	4,800
Samil	Sudan	7,000
STA	Niger	7,000
Tanjaka Food	Madagascar	5,000

Source : (PlumpyField Network, 2020)

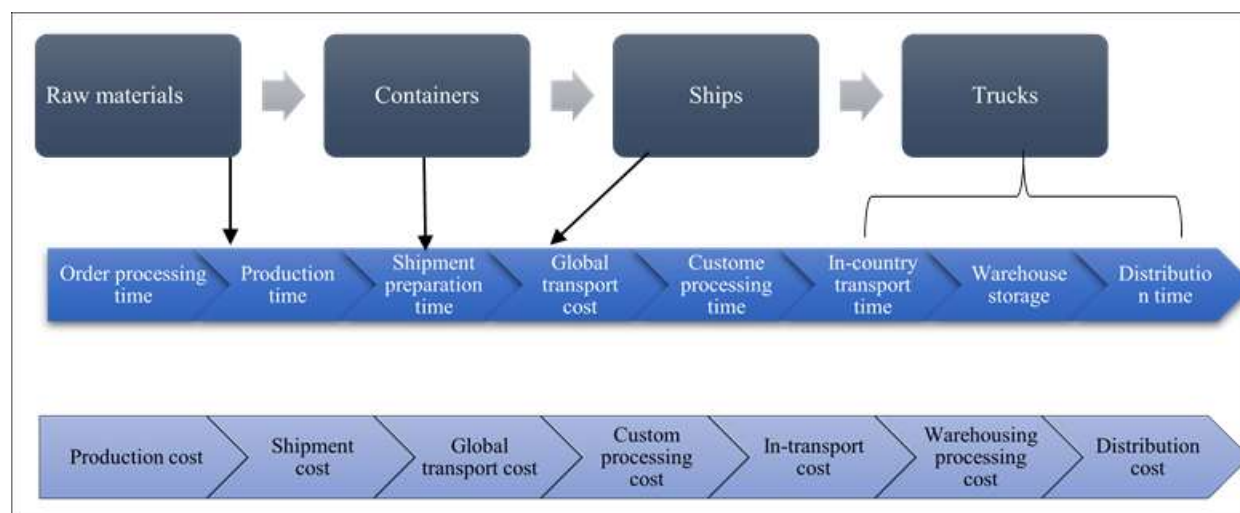


Figure 2.2 The product flow of RUTF in the UNICEF's supply chain

Source: (UNICEF, 2009)

2.2.4.5 Information flows

The amount of RUTF required for the treatment of malnutrition is calculated based on the surveys conducted by the regional and country offices, government, and other partners. Based on the investigations, the country and regional offices write proposals to donors for funding. After the review and feedback for the availability of funds, the office places the order for production. Once producers finish production, they communicate the quantity produced and delivery date to the buyers, while logistics firms communicate shipment information (i.e. desired location) to the agents involved. Figure 2.3 shows the information flow for RUTF in the UNICEF supply chain.

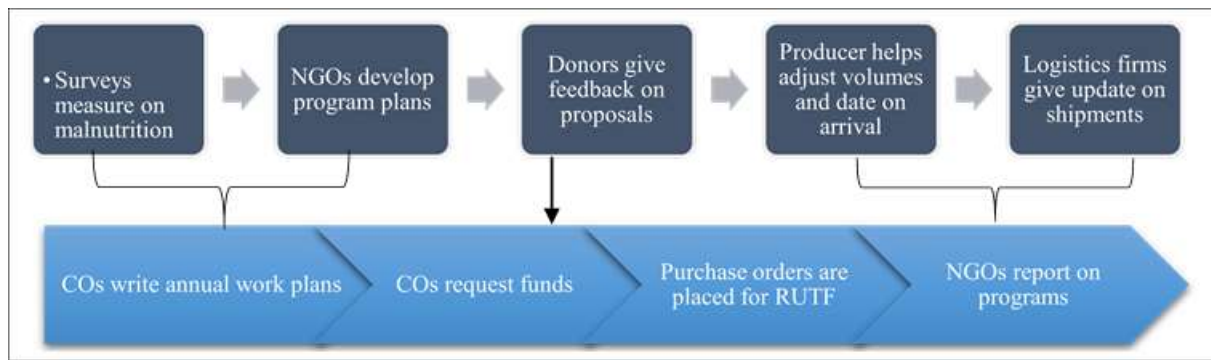


Figure 2.3 Information flow of RUTF in UNICEF's supply chain

Source: (UNICEF, 2009)

2.2.4.6 Funding flows

The funding flow is an essential tool in the RUF supply chain. UNICEF and other agencies write proposals to donors for funding. Once donors show the commitment of releasing funds, the country offices place purchase orders for RUTF. The funds are disbursed in installments on varied schedules. After the products have been produced, processors of RUTF and transporters send the bills to instance UNICEF's Supply Division for payment. Figure 2.4 shows the funding flow for RUTF in the UNICEF supply chain.

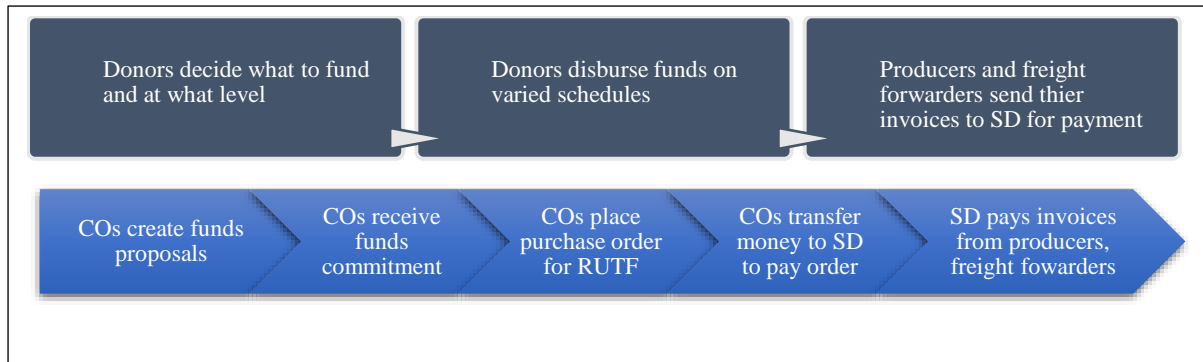


Figure 2.4 The funding flow of RUTF in the UNICEF's supply chain

Source: (UNICEF, 2009)

2.2.5 Challenges in the RUF supply chain

UNICEF is the largest buyer of RUTF compared to other agencies in the supply chain. UNICEF purchases approximately 75% -80% of the total RUTF produced by the manufacturers.

Nevertheless, supply through UNICEF still only covers approximately 23% of the estimated global severe acute malnutrition caseload of 16.4 million children. Other agencies like WFP, MSF and others procure an additional five percent of the global estimated caseload. In other words, most of the children suffering from SAM globally remain untreated. This fact implies that there is a need for increased RUTF production along with other improvements in the supply chain to address the severely malnourished population.

Some issues are highlighted in the supply chain analysis of RUTF. They include variability in lead time, delays in product delivery/ transport delays, uneven ordering, lack of information sharing among supply chain agents, demand uncertainty, and the high cost of logistics. Lead time is the length of time between the start of production and the final delivery. Variability in lead time inhibits proper planning as it is difficult to predict the arrivals of orders leading to inefficiencies and erode trust among supply chain actors. Long delays at the ports and poor road networks are some of the causes of variability in lead time. The sparse road infrastructure restricts the size of load a truck could carry and seasonal road networks that are inaccessible during the rainy season. In an emergency, air transport has been used to reduce the lead time, but international air freight alone is very expensive. In 2011, it cost at least 4.5 USD million to transport 8,335 metric tons of RUTF to Africa by air (UNICEF, 2019b). This cost was reduced

by 21% as UNICEF sourced greater share of its supply nearer the areas of need in 2017. On average UNICEF was able to decrease cost per metric ton by 830.30 USD from 4,003 USD in 2011 to 3,173 USD in 2017, as supplies rely on cheaper overland and sea freight cost (UNICEF, 2019b).

Additionally, the costs of RUTF are covered by different donor partners who make commitments for funding the program before UNICEF, WFP, and others place purchase orders for RUTF.

Variable lead and production times make it difficult to facilitate a quick response to emergencies, both in terms of the availability of funding and product delivery.

Uneven ordering happens when the demand for RUTF increases during emergencies. During that period, the volumes of RUTF that are ordered are higher, which puts increased pressure on producers, consequently affecting production lead time. Further, the limitations in terms of low production capacity from the processing firms put pressure on lead time. This happens when there are external shocks to the supply chain such as the rise in price of some key ingredients making it difficult for processors to purchase on large quantities. Lack of data about forecast and consumption that could inform proper planning on production capacity is among the causes of the uneven ordering of RUTF products.

The lack of information flow between supply chain actors combined with an improper assessment of product needs for RUTF affects the performance of the supply chain. A general lack of data regarding production forecasts and consumption limits the ability to plan for the medium and long-term sustainability of RUTF (i.e. limits proper planning and transportation of RUTF).

Uncertainty about the availability of funds and timeliness of funds disbursement is a major challenge in the supply chain. Delays in the availability of funds are a frequent contributor to the delivery delays and product stock-out (Komrska et al., 2013). Processors required funds to purchase modern equipment to boost production and start-up new product formulations. Buyers need funds to purchase RUTF for users. This might make the case for a more inexpensive RUTF. If funds are not always available or are not quickly sourced and allocated, then the ability procure more product per dollar would not be improved.

Quality control is also a major challenge in local production as there is sometimes a lack of proper grading for raw materials for RUTF production. Further, there is a lack of quality assurance institutions to monitor food production at the processing level (Segrè et al., 2016). RUTF has stringent quality and nutrient content specifications, and to be a manufacturer, processors need to meet all the specifications. The lack of systems to provide certifications to fulfill all these requirements present a challenge at the production level. The absence of market signals about a product's quality and price create information search costs. For instance, to know the price of chickpea, a buyer needs to go to the open market and ask for the price before making a price decision. Spot market transactions increase the time needed to find buyers and sellers and negotiate an agreement on the quality and price of the chickpea, creating negotiation cost.

In addition to the above challenges, there is the possibility of some manufacturing plants not functioning due to employees' strike, fire outbreak, global pandemic, and others that could affect the operational activities in the supply chain (i.e. the shutdown of the main supplier production center). Also, inadequate key ingredients for RUTF production is a challenge in the supply chain. Some of the key ingredients are often not available at the time buyers place orders and must import from somewhere, which is very costive, thereby increasing the cost of production. Thus, at times some of the ingredients are available during the peak period and unavailable at a certain period. For instance, powdered milk and vitamin and mineral mix are sometimes imported, which is more expensive. The timely arrival of these ingredients and the availability of foreign exchange to purchase the orders are also a challenge in the supply chain.

The figures 2.5 and 2.6 show the supply chain process for the RUTF product. Processors purchase raw materials such as peanuts, chickpeas, cereals, and other ingredients from intermediaries and process it to RUTF. This process happens once they receive purchase orders from buyers. The finished product is then released to the buyers based on the scheduled date and delivery mode (air or sea transport) to the various offices. The buyers then transport RUTF by trucks to the communities which are then distributed to the children with the support from the country's representative or the government.

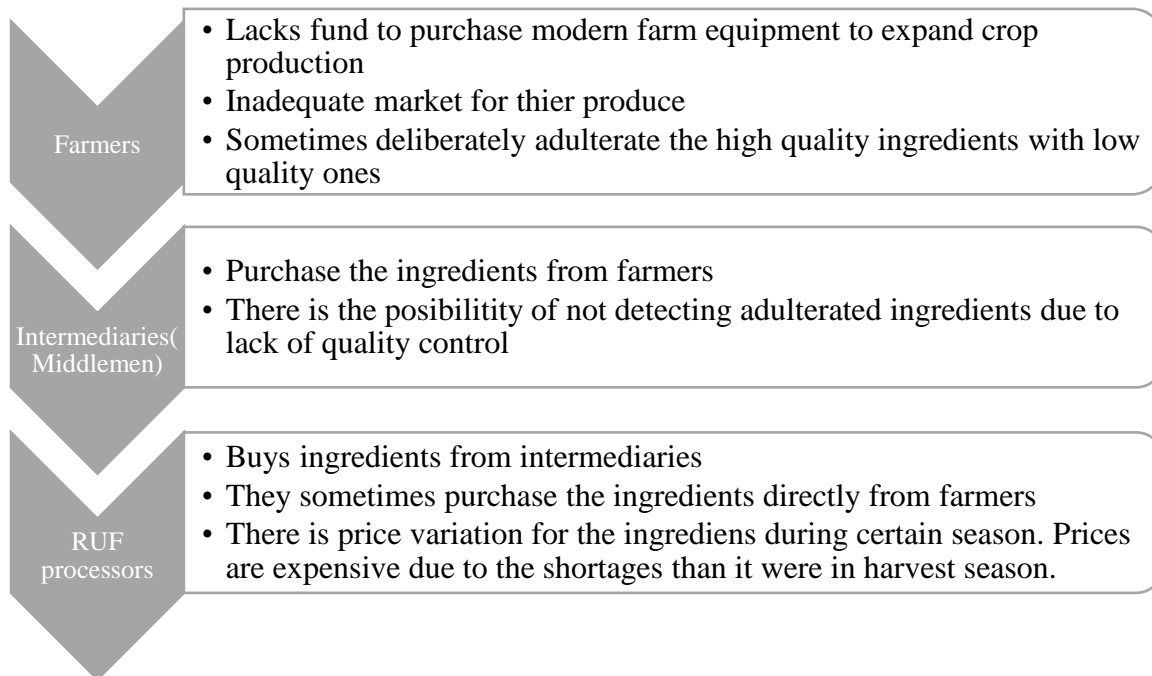


Figure 2.5 The procurement of RUTF ingredients for production

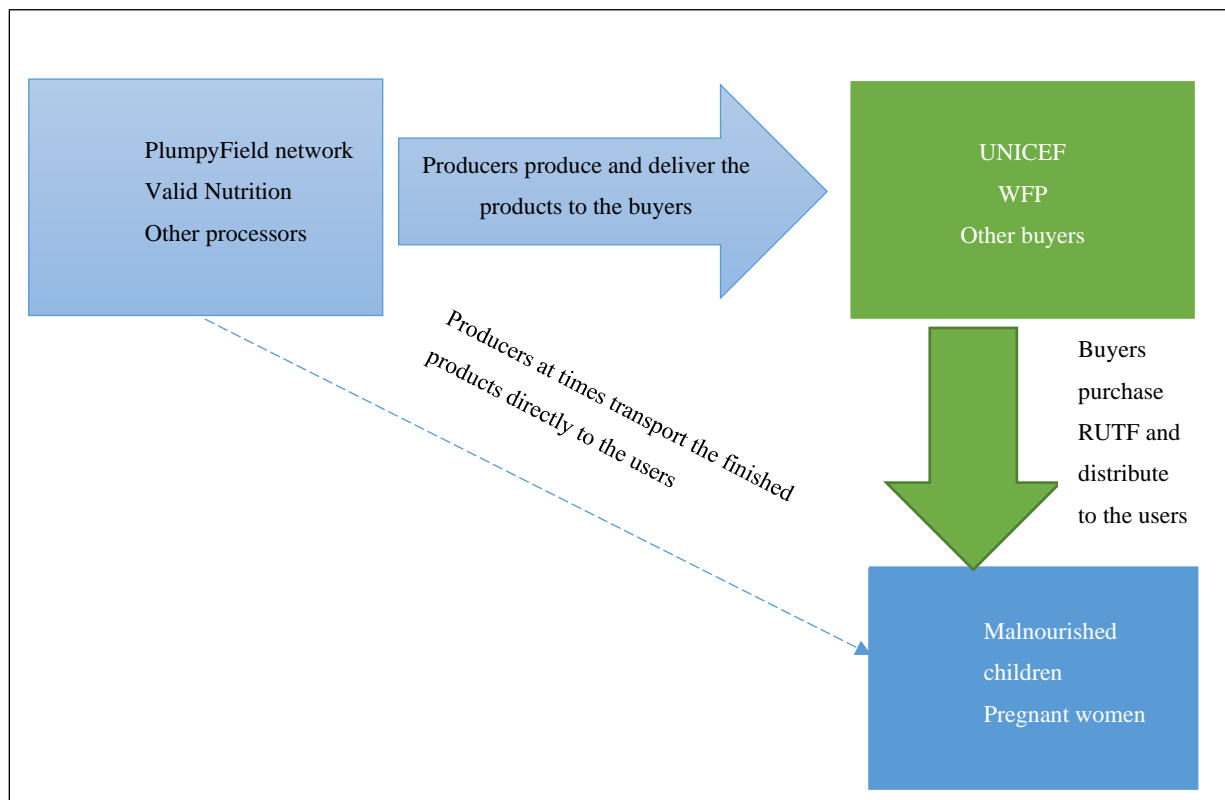


Figure 2.6 The supply chain process of RUTF

The above challenges confirm the ongoing global humanitarian crises be it operational or disruption that needs to be addressed.

2.3 Supply chain risk

With the continuous increase in humanitarian crises globally, there has been an intense research effort to study supply chains and disruptions both qualitatively and quantitatively. With such awareness, scholars have researched supply chain vulnerability. Jüttner et al. (2003) defines supply chain vulnerability as “*the propensity of risk sources and risk drivers to outweigh risk mitigation strategies, thus causing adverse supply chain consequences.*” Tang (2006) defines supply chain risk management as the coordination or collaboration among the supply chain partners to ensure sustainability in supply chain disruptions (see also Jüttner et al., 2003). Some scholarly works have confirmed that natural disasters, terrorist incidents, industrial or direct action, unexpected accidents, and operational difficulties are some of the causes of supply chain risks and disruptions (Rao & Goldsby, 2009).

To support the research on supply chain risks, Kleindorfer and Saad (2005) classify supply chain risks into operational risks and disruption risks. Operational risks are inherent uncertainties that exist in supply chains (Kleindorfer & Saad, 2005). An example is an uncertain demand and supply of certain products. Disruption risks are caused by natural and human-made disasters such as earthquakes, floods, terrorist attacks, currency fluctuations, and employee strikes (Chopra & Sodhi, 2004; Kleindorfer & Saad, 2005; Tang, 2006).

Several papers focus on supply chain disruptions and operational risks and discuss measures supply chains should use to mitigate disruptions. In the context of specific features (i.e. quality, price, and inventory category), a study was conducted in 1988 which uses a risk/benefit approach to carefully examine sourcing strategies from the perspective of the purchaser and supplier (Treleven & Bergman, 1988). The inputs to the model were the degree of risks/benefit in three categories, expressed in terms of probability of each category occurring, and the magnitude of the impact expressed on an interval rating scale. According to Treleven and Bergman (1988), there is the likelihood of using a different sourcing strategy depending on the nature and characteristics of the risks.

With regards to the supply chain disruptions, Kleindorfer and Saad (2005) present a supply chain risk framework called “*SAM*,” where “*S*” represent specifying sources of risks and vulnerabilities (i.e. operational contingencies, natural hazards, terrorism, and political instability), “*A*” refers to risk assessment and “*M*,” risk mitigation. The “*SAM*” framework was built on four premises, (i) specification the nature of the underlying risk (ii) the valuation of the risk (iii) the approach for managing risk must fit the characteristics and needs of the decision environment and (iv) integration of appropriate management policies and actions with ongoing risk assessment and coordination among stakeholders.

Overall, the above literature differs concerning the definitions and viewpoints about supply chain risks and disruptions. Moreover, the literature considers supply chain risks as a crucial question for stakeholders in supply chain management. The task is to find effective strategies to reduce the effects of supply chain risks. Sourcing, in general, is one of the features of supply chain disruptions and can be used to minimize the impact of disruption risks. Analyzing and designing an effective sourcing method in the presence of supply chain disruptions is becoming a topic of focus for research in recent years.

2.3.1 Single versus multiple sourcing

Successful supply chain management necessitates an effective and efficient sourcing strategy to mitigate disruptions, including unreliable supply (Burke et al., 2007). Frequently used sourcing strategies single sourcing and multiple sourcing (Berger & Zeng, 2006; Burke et al., 2007). A single-sourcing strategy is different from sole sourcing (Berger & Zeng, 2006). Sole sourcing is defined as a buyer-supplier relationship where the supplier base contains only one supplier with no other alternatives. In contrast, in a single sourcing, the buyer(s) chooses one supplier even though there are other alternative suppliers (Berger & Zeng, 2006). With a single sourcing strategy, there are shared benefits and close collaboration through a strategic partnership between a buyer and a supplier (Berger & Zeng, 2006). In addition, there is the production of higher quality products or services at a lower cost to the buyer, which leads to higher levels of buyer-supplier cooperation (Berger & Zeng, 2006). However, Berger and Zeng (2006) indicated that the

sole dependence of single sourcing exposes the buyers to a higher risk of supply chain interruptions such as hold-up risk.

In multiple sourcing, buyers procure supplies from several suppliers. The presence of multiple suppliers allows buyers to play one supplier against the other when negotiating supply contracts. Moreover, Burke et al. (2007) noted that in some cases (when supplier capacities are relevant), multiple sourcing is considered the optimal sourcing strategy compared to a single sourcing strategy. Additionally, multiple sourcing hedges the risks of creating a monopolistic supply base and forward supplier integration (Burke et al., 2007). However, the disadvantage of this strategy is that the supplier is responsible for maintaining the necessary technology, expertise, quality, forecasting abilities, and delivery competencies (Berger & Zeng, 2006). Also, dealing with many suppliers is likely to require a longer time in the negotiation and may delay production schedules (Berger & Zeng, 2006).

Another strand of literature examines the determination of the optimal number of suppliers in the supply chain. Berger and Zeng (2006) examined the optimal number of suppliers under the following probabilities: the probability that all suppliers are down due to catastrophic events and unique events that affect individual suppliers. Further, there is an operating cost of working with multiple suppliers, and financial loss caused by all suppliers being unavailable. In the study, Berger and Zeng (2006) considered suppliers' availability to satisfy buyer(s) demand as uncertain, which may be affected by several factors. The result indicates that multiple sourcing is a practical approach in many situations compared to a single sourcing strategy. Building on a decision-tree model, Ruiz-Torres and Mahmoodi (2007) considered unequal failure probabilities for all suppliers. The outcome from their study indicates that when suppliers are highly reliable, single sourcing is the lowest cost approach under all experimental conditions. In addition, sensitivity analyses show that in extreme conditions of unreliable suppliers, high loss to operational cost per supplier, and low ability to mitigate the failure from a partial set of suppliers, a multiple supplier strategy is effective.

Regarding the selection decision between single sourcing and multiple sourcing strategies, Burke et al. (2007) used an integrated selection/allocation model to analyze a single period, single

product sourcing decisions under demand uncertainty, product prices, supplier costs, supplier capacities, and diversification benefits. Their study results indicate that single sourcing is a dominant strategy only when supplier capacities meet product demand. Further, it is mostly preferred by buyers when it does not obtain diversification benefits (Burke et al., 2007).

Using the concept of switching costs in a principal-agent framework, Wagner and Friedl (2006) analyzed whether a firm switches the entire or a partial quantity to an alternative supplier when there is either symmetric or asymmetric information about the alternative supplier's cost structure. Their results indicate that partial switching might be the best decision when competitive effects and economies of scale exist. However, changing the sourcing strategy from single sourcing to multiple sourcing is the buyer's optimal choice when the new supplier has intermediate unit costs (Wagner & Friedl, 2006).

In summary, from both the buyer's and supplier's point of view, both sourcing approaches provide advantages and disadvantages in the supply chain. The choice between a single sourcing strategy and multiple sourcing strategies depends on the trade-offs between sourcing methods and environmental factors. The closest studies of this thesis are Treleven and Bergman (1988), Burke et al. (2007), and Heese (2015). However, these studies differ from this research in framework and methodology. Treleven and Bergman (1988) used a conceptual risk/benefit assessment model, which only considered three features and their impacts without considering the number of buyers. Burke et al. (2007) only concentrated on multiple suppliers with one buyer. Heese (2015) discussed the single versus multiple sourcing and the evolution of bargaining powers.

There is no doubt that humanitarian supply chains are experiencing ongoing challenges such as inadequate product volumes, higher product prices, and others which stakeholders must deal with. In this study, I examine how multiple sourcing strategies might reduce the ongoing humanitarian challenges by utilizing the impacts of alternative RUF products using applied research methodology. The framework to identify strategic responses as well as shape the competition in an industry like the RUF industry is discussed in the next chapter.

Chapter 3 Theoretical framework

3.1 Introduction

In the era of global supply chains, the management of sourcing, production, and distribution of products or services has become a top priority for stakeholders, particularly manufacturers, to gain a competitive advantage in the market. However, recent disruptions in agricultural supply chains have drawn attention to the role of purchasing in buyer-supplier relationships. According to Porter (2008), a buyer-supplier relationship is an essential tool in shaping the competitiveness in the industry. Porter's Five Forces model emphasized that when there are fewer buyers in the industry, they benefit from increased negotiation power. That means suppliers are forced to increase product quality and lower costs. On the other hand, if there are few suppliers in the industry, suppliers' bargaining power increases (Porter, 2008). They may lower product quality and increase prices.

Porter (2001) provided a dynamic framework and structural analysis of an industry called Porter's Five Forces framework in the literature. This analysis uses a simple but powerful model to examine the competition level in an industry. In terms of this framework, the firm's strength is determined by its competitive level and attractiveness of the analyzed industry and construct strategies to gain competitive advantage. For instance, Porter (2001) used the Five Forces Framework to examine how the internet influences industry structure while each industry evolves in unique ways. An examination of the forces influencing industry indicates that the deployment of internet technology will likely continue to put pressure on the profitability of many industries. Martin (2015) analyzed factors that influence the choice of response strategies adopted by Public Universities in Kenya based on Porter's Five Forces framework. Nag et al. (2014) also used Porter's framework to analyze factors driving supply chain strategies within manufacturing industries based on levels of raw materials and finished goods inventories to classify inbound and outbound supply chain strategies. The framework posits that the success of an organization's competitive strategy depends on the positioning of the firm within its environment and the ability to fend off competitors (Nag et al., 2014). Similarly, Rachapila and Jansirisak (2013) utilized the Five Forces Framework to analyze the competitive forces within the sweet corn industry in Thailand.

While both single and multiple sourcing strategies may reduce the impacts of risks and disruptions in the supply chains, efforts are needed to provide a generalizable framework to ensure a competitive level to address these crises. The understanding of the forces that are shaping the competitive landscape is useful to understand how firms operate and how they develop sourcing strategies to manage and reduce risk. The model can help examine why there is a dominant RUTF product in the RUF supply chain as stakeholders define parameters within which new alternative products, participants, and markets continue to emerge (Martin, 2015). As seen in Figure 3.1 on page 30, the forces that shape competition in the industry are the threat of new entrants, the intensity of rivalry, the threats of substitutes, the bargaining power of buyers, and suppliers' bargaining power.

3.2 The threat of entry

The threat of new entrants refers to the ease with which new firms or products can enter the market (Barutçu & Tunca, 2012). The new entrants can threaten existing competitors because they bring additional production capacity to the market. Thus, new entrants to an industry bring new capacity and the desire to gain market share (Porter, 2008), this may result in downward pressure on prices, reducing profits for existing firms.

According to Porter (2008), the key concept in analyzing the threat of entry is the entry barriers. If a company or a processor finds entry into an industry to be difficult or that entry leads to a competitive disadvantage, entry barriers exist. Porter (2008) posits the potential for entry into an existing industry depends on factors including economies of scale (the firm's ability to increase productivity or decrease its average cost of production by efficiently employing more resources over time) and capital requirements (the monetary infrastructure needed to produce or distribute goods or service). The higher the level of investment required for existing companies, the less likely it will be for new entrants to enter the industry (Martin, 2015). Other factors also include competitor reactions to potential entrants and buyer reactions to new products or services (Martin, 2015). According to Martin (2015), new entrants face two responses from buyers: the failure to accept the new products as equal or better than existing products, and the unwillingness to bear the switching cost to the new products. As the number of manufacturers continues to

grow, competition increases and more competition leads to greater efficiency, higher quality, innovation, and several choices for consumers (Martin, 2015).

Regarding the threat of entry concerning RUF production, there are some benefits for UNICEF and others when they purchase the products locally. Increasing the diversification for the production RUFs by sourcing ingredients locally can decrease costs and, therefore, reduce the price offered for the same product. Furthermore, existing manufacturing firms may enjoy some advantages that are not available to new entrants. The established suppliers may enjoy a incumbent advantage as buyers prefer to procure products from trusted companies with their reputation, experience, and expertise. In Nutriset's PlumpyField network, members have guaranteed access to brand names, technology, experience, and reputation as world leaders in ready-to-use nutritional solutions for the treatment and prevention of malnutrition. Nutriset also controls who gets to enter its network to produce the Plumpy' Nut® product, thereby creating limitations to entry.

Additionally, the RUF product specification guidelines allow production from firms who meet these standards to produce RUTF, RUSF, and other supplementary foods. While overcoming this barrier requires significant investment in production facilities and production processes, it is not insurmountable. Due to this, the sector is seeing an increase in the number of firms manufacturing these products, resulting in increased competition among processors in the industry.

3.3 The bargaining power of suppliers/producers

In industry analysis, suppliers are defined as those organizations or companies that provide raw materials, information or knowledge to allow an organization to produce goods and services (Porter, 2008). Supplier power refers to suppliers to negotiate more favourable terms in other areas where buyers have no option than to rely on suppliers' terms and conditions. If suppliers can change the price of products and increase prices quickly, they have power. The bargaining power of a supplier heightens when there are few suppliers, no substitutes for supplier's products, and high switching costs from the supplier (Slater & Olson, 2002). The switching costs include

the costs of obtaining information about the product on the market, negotiating contracts including agents, and costs of enforcing contracts for the project awarded.

In a dominant supplier bargaining relationship, the supplier dominates several other producers in the market. The dominant supplier dictates the terms and conditions of the relationships to many buyers. An example of this PlumpyField network, which produces Plumpy'Nut® food.

PlumpyField network is the largest producer of RUTF in the RUF supply chain. They can control prices by reducing the volumes they produce. However, these powers from a supplier are reduced when the producer gives a supplier a long-term contract.

3.4 The bargaining power of buyers

Buyers play a very significant role in humanitarian supply chains. They ensure that products get to target populations, reduce supply risks, and ensure product quality while working to achieve the highest coverage per dollar invested. Buyer power refers to the ability of a customer to drive down prices (Barutçu & Tunca, 2012). The ease by which a customer can negotiate favourable terms shows the bargaining power of a buyer. According to Barutçu and Tunca (2012) the power of a buyer heightens if there are few buyers of a product and low switching from one supplier to another supplier, and many other factors.

If there are few influential buyers with many RUTF suppliers in the market, these buyers will be able to as a matter of fact with their power in limited negotiate for reasonable price(Dowlatshahi, 1999). For instance, suppose there are many suppliers of RUTF with only few buyers, that means suppliers have limited options available while buyers have multiple options leading to a reduction in price (i.e when supply exceeds demand (buyers with limited budget constraint to increase demand)). According to Dowlatshahi (1999), with few buyers and few suppliers, buyers use dual or multiple sourcing to protect themselves against any possible shortages, strikes, and other emergencies caused by a single supplier. Buyers can maintain competition among their existing suppliers by decreasing the volume for non-performing suppliers who have a lower share of the total product volumes (Dowlatshahi, 1999). They may also choose to have two or more suppliers if a single supplier cannot adequately meet their product design and technical requirements.

With few buyers or few suppliers in the market (i.e. two or more buyers or suppliers with balanced power), a buyer or supplier has a balanced choice in selecting its trading partner and protecting its business (Dowlatshahi, 1999). Buyers use dual suppliers to protect themselves against any disruptions that may originate from a single supplier. When a single supplier cannot meet the product design and technological requirements, buyers can choose two or more suppliers. On the other hand, suppliers can protect themselves against a possible loss of business that arises from a decline in sales volume. They can choose a few buyers if they possess the capabilities to meet the needs (i.e. the demands and technological needs) of many buyers simultaneously.

Regarding multiple buyers and multiple suppliers, buyers can choose any number of suppliers as their trading partners and vice versa. If a new supplier can supply the same product at a lower cost, the buyer will replace the higher-cost supplier with a lower-cost supplier. The reverse is also true for a supplier who wishes to replace a lower offer to a higher offer from a buyer.

In a dominant buyer-power bargaining relationship (i.e. one buyer/few suppliers and one supplier/few buyers), Dowlatshahi (1999) posits that one institution dominates over several other institutions. The buyer allocates its procurements between two or a few suppliers or vice versa. This scenario creates competition and cooperation among suppliers. With the dominant supplier, there is a necessary purchase guarantee to invest due to the mutual and long-term relationship established. The RUF supply chain is a typical example of a dominant buyer-dominant supplier relationship.

In the RUF product industry, relief agencies are the buyers in the sense that they purchase the products from manufacturers and distribute them to the target population. The power of a buyer increases as the goods produced are standardized, allowing buyers to compare alternative products and make more informed decisions (Martin, 2015). The more options a buyer must choose from, the more power the buyer has in terms of price or other components. New substitutes and new alternative products erode the power that suppliers of existing products have on the market. The use of multiple sourcing strategies increases buyer power as more

manufacturers produce a range of alternative RUF products. The critical point is, how are contracts awarded, and how are prices determined?

UNICEF procures most of its products by tender, in exceptional cases, they engage in direct negotiation (Ilie, n.d.). Logistics staff have developed standard product specifications in consultation with UNICEF headquarters in Geneva and with local tenders. UNICEF procurement specifications typically differ from standard trade contracts in many ways. First, UNICEF establishes its procurement price through tender and only rarely reverts to direct negotiation as most trade does typically. Bids are sealed and opened transparently by UNICEF's procurement committee. Second, all procurement must follow UNICEF's guiding principle like (using competitive tendering for all procurement, invites an appropriate geographical range of suppliers to tender, purchases products that comply with recognized technical standards, and many others). After the evaluation from the committee, there is an adjudication and award recommendation. Contract finalization and issuance and contract management are the last steps in the procurement process. The contractual instruments have two faces - agreements (long term agreement) and contract types (purchase order and contract for construction work). In the RUF supply chain, they always use long-term agreement, which is in the form of a memorandum of understanding. The contractual obligations only begin once the purchase order is issued.

One of UNICEF's procurement objectives is to ensure there is the best value for money for all its products. The prices are determined through a tendering committee guided by the principles of fairness, integrity, and transparency through competition (Ilie, n.d.). Thus, transparent and appropriate regulations are applied to all suppliers, fair processes, equal treatments, and a transparent system. Selection of many suppliers maintains the competition in the RUF market, which gives UNICEF the bargaining power to negotiate for a lower price.

3.5 The threat of substitute products

A substitute product performs the same or similar function as the current product, and it is a function of the relative price of competing products and the switching cost (Porter, 2008). The threat of substitutes depends on the buyer's willingness to substitute the product, the price and performance of alternatives, and the costs of switching to substitutes. Moreover, the threat may be lowered if the existing product has a strong brand identity on the market (i.e. building positive

relationships with buyers) or increasing the switching costs from the current product to the new product. In the RUF market, a buyer's ability to find a new alternative to the current Plumpy' Nut® product determines the threat of the substitutes. The threat of substitution is high if alternative RUF products offer an attractive value proposition (cost-efficient) relative to the current product (Olson & Boehlje, 2010). The threat is high if the alternative products are effective in alleviating malnutrition and being acceptable to end-users. UNICEF's tender for RUTF conducted over the end of 2018 and early 2019 included acceptable offers of alternative recipes of RUTF from 15 processors, along with an outline on the variety of ingredients in the new formulations (UNICEF 2019).

3.6 Rivalry among existing competitors

The rivalry existing among competitors comes in different forms; price discounting, new product formulation, advertisements, and service improvements (Porter, 2008). High intensity of competitive rivalry among firms can influence the company's profitability (Porter, 2008). The intensity with which companies compete and the basis on which they compete influences the profit of companies (Porter, 2008). In other words, the number of competing products and the degree to which these products are differentiated determines the rivalry within an industry. The intensity of rivalry is high when there are numerous competitors in the industry, and exit barriers are high (Olson & Boehlje, 2010). The competitive rivalry among firms is the commitment to the market, the number of players, their strategy and disposition, and their similarity to or difference from one another (Porter, 2008). Higher exit barriers could also intensify rivalry and competitive pressures in the market. This happens when firms cannot cover their variable cost but are unable to leave (or exit quickly) due to higher investments in critical areas, high shutdown cost, contractual relationships, and emotional attachment to the market (Porter, 2008).

Technology has also contributed to the intensity of rivalry among firms. Through technology, firms have invented other alternatives that provide similar or better functions compared to the current products. In the RUF industry, the increased production of alternative products as a result of sourcing from diversified manufacturers has reduced capacity constraints that buyers have operated under and provides extensive available options for buyers to choose from, resulting in improved product quality.

Figure 3.1 demonstrates the Five Forces framework that shapes competition in the industry. The other four forces are connected to industry competition. The working together of all the forces shape competition among stakeholders in the industry. There is high competition when more products are offering the same properties and functions with low switching costs for buyers. Low competition in the industry demonstrates that some forces have advantages over the other. For instance, suppliers might have higher bargaining power in negotiations when there are few of them with many buyers. Thus, when buyers choose a single sourcing strategy as a means of procuring its products, the bargaining power of a supplier increases since there are no other alternatives available to the buyer for comparison. Furthermore, the absence of alternative products (substitutes) gives room for dominancy with less competitiveness.

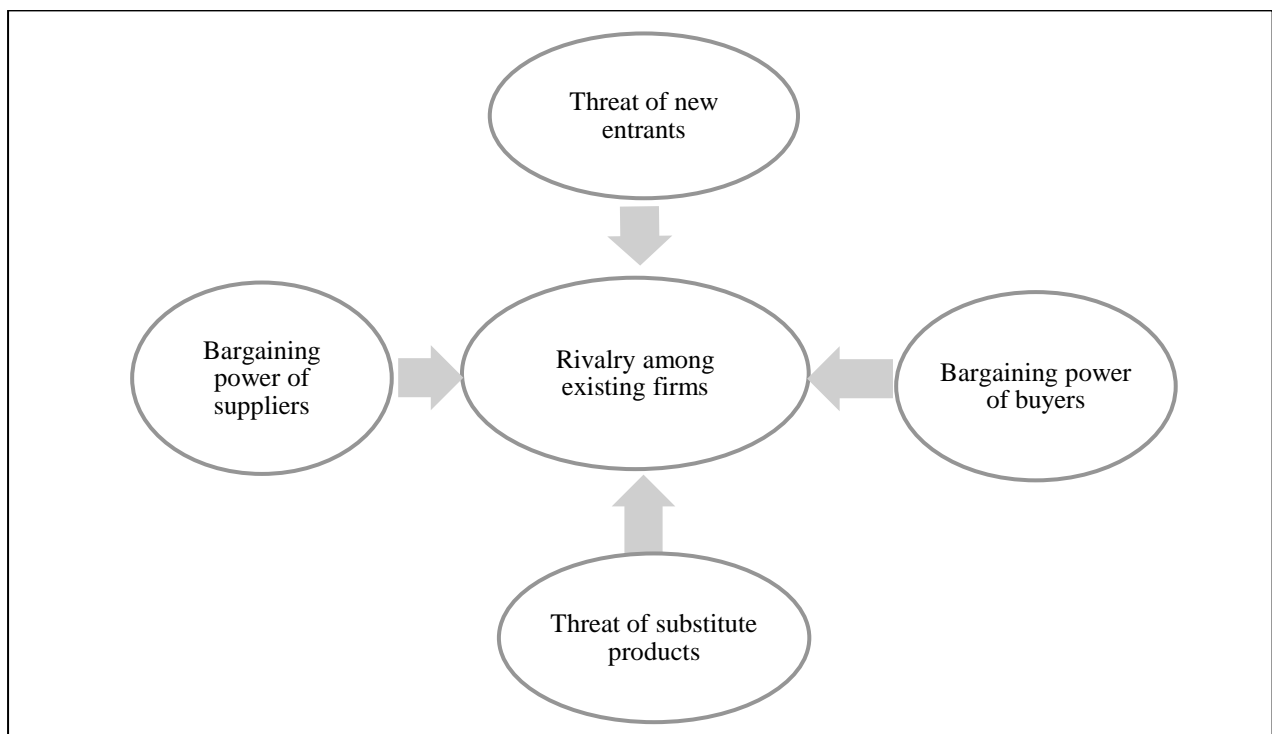


Figure 3.1 Porter's five forces framework that shape competition

Source: Adapted from (Porter, 2008)

3.7 The buyer-supplier bargaining power and the five forces framework

The significance of contract and outsourcing in manufacturing has increased in recent years. While some have used outsourcing to reduce costs and focus on their core competencies, the continuing improvement in the RUF supply base has accelerated this trend. Firms and institutions have been using this strategy for the procurement of their products to meet the specific needs of a buyer but comes with some challenges.

When procuring a product or service, a buyer can use one supplier (single sourcing) or distribute the contracts among or between two or more suppliers. In recent years, many firms have increased their supply base using single sourcing, but some firms also use multiple sourcing to promote competition. The absence of new entrants and substitute products (single sourcing) leads to reductions in production costs due to economies of scale and learning effects, lower inventories and better quality due to just-in-time and continuous product improvements (Berger & Zeng, 2006). Single sourcing in the first period maximizes learning effects but also reduces the relative competitiveness of the unemployed supplier, who might not decide to bid in the future due to high entry barriers. The presence of product substitutes from new entrants (multiple sourcing) might help reduce a firm's exposure to potential risks such as shortages, strikes, natural disasters, and technology malfunctions (Berger & Zeng, 2006).

If the buyer considers only benefits in the short term, the optimal strategy is to source exclusively from the supplier with the lower production cost. Hence, firms that put too much emphasis on short term cost minimization will conclude that single product sourcing is optimal strategy. While this is true in some settings, it is suboptimal as it increasingly shifts power to the dominant supplier (increases the bargaining power of a supplier) and harms the buyer's ability to negotiate for a reasonable price (Heese, 2015). The absence of new entrants or substitute products shifts power to the dominant supplier, consequently reducing competitive rivalry among suppliers. However, as suppliers' bargaining power increases, multiple sourcing strategies become increasingly attractive compared to a single-sourcing strategy, and it is optimal for buyers with lower bargaining power (Heese, 2015). A multiple sourcing strategy increases the numbers of suppliers and encourages competitive rivalry, which erode a supplier's advantage over the buyer

during contract negotiations for reasonable prices, leading to the procurement of RUFs to serve the needs of the children (Heese, 2015).

In summary, this section integrates Porter's Five Forces framework with the single/multiple sourcing decision of buyer-supplier bargaining relationship. Being awarded a contract allows suppliers to progress up their learning curves, leading to reduction in future production costs. While the focus has been on the evolution of power between a buying firm and its suppliers, determined by the sourcing decision of the buying firm, there are some potential benefits of using a single sourcing strategy. For example, a single sourcing strategy can reduce costs by maximizing learning effects. However, relying on a single supplier might also erode a buyer's power in negotiating for reasonable prices. Thus, in the absence of substitute products due to low threats of entry for new entrants, the buyer is potentially unable to negotiate reasonable contract prices which is paramount in the procurement of RUF products. Further, single sourcing increases the supplier's bargaining power, as the buyer's threat to use an outside option comparatively becomes less credible. In addressing the crises and disruptions in the RUF supply chain, stakeholders might reduce the ordering quantity from the primary supplier and increasing the reserve capacity for the development of alternative products.

Overall, Porter's Five Forces indicate that new entrants into the RUF supply chain promote the development of alternative products (substitutes) to enhance competition in the RUF supply chain. However, these efforts are being limited by inadequate funds for investment, competitor and buyer reactions to new entrants. If there are no entry barriers, then the threat of substitution is high. This means other products can replace the existing products in the supply chain. The development of new products (i.e. the entry of new producers) means that the institutional buyers have several product options available to purchase. This heightens the buyers' bargaining power in the supply chain. There is an intense competitive rivalry in the RUF supply chain if there are several rivals (suppliers producing similar products), culturally diverse competitors, low switching costs, diversity of competitors, and high exit barriers. Thus, because of the absence of entry barriers and the presence of many suppliers, there will be high competition levels among suppliers and between each other. The supplier also maintains high bargaining power if there are

few or no alternative products for buyers. Suppliers may dictate the operations and conditions of service if there is one dominant supplier with few buyers.

Understanding the forces that shape the industry competition is the starting point to understand how firms in the RUF industry have chosen to organize themselves for future competition. For instance, understanding the nature and complexities inherent within the RUF industry will enable stakeholders to roll out comprehensive and practical strategies to respond to ongoing humanitarian crises. The forces will also provide a baseline for determining the size and structure of the industry as well as unveiling its strengths and weaknesses. More importantly, a better understanding of the industry's structure guides stakeholders and decision-makers to choose strategic actions that will better shape the balance of buyer-supplier relationships for a better future

Chapter 4 The Data and Interview structure

4.1 Introduction

Although the target population of the study is Ethiopia, the idea of the study is to contact key actors in the humanitarian supply chain about the benefits of alternative RUTF/RUSF products in reducing supply chain risks. The data collected for this study are primary data. The primary data comprises interview data that attempted to discover producer and buyer perceptions about procurement issues and risks within RUTF supply chains, as well as the impact of alternative products in the supply chains. The interviews were conducted via web conferencing software with participants in Africa and other locations. Secondary research examined journal articles, books, reports, and conference papers with an emphasis on ready-to-use foods, supply chain risks, and risk management risk strategies.

4.2 The Data for the study

Qualitative research methods for collecting data were used. The primary data for this study were collected using a semi-structured interview guide conducted over Skype with the participants. Interviews can provide an in-depth and richer understanding of the social phenomenon that may be obtained from quantitative methods (Gill et al., 2008). Semi-structured interviews allow either the interviewer or the interviewee to provide further details on the subject matter or pursue an idea (Gill et al., 2008; Cosgrove et al. 2014). Overall, thirty-two invitations were sent via email to individuals at UNICEF, WFP, and Médecine Sans Frontiers (MSF) (each at the country and regional offices), Valid Food Nutrition, Mana Foods, and Save the Children Foundation.

4.2.1 Participants' Information

Individuals from five out of thirty-two institutions contacted (14.29%) participated in the interview. The five participants comprise three producers - Project Peanut Butter, Inzsta Products, Valid Nutrition, and two buyers - UNICEF and Save the Children International. UNICEF procures at least 70% of the total RUTF/RUSF products (UNICEF, 2019b), and other aid institutions purchase the remaining 30 percent. Six manufacturing companies producing other RUFs were contacted initially, but only three agreed to participate in the interview. An individual

from each of these companies was interviewed. It is important to note that there are other producers who did not participate in the interview. Most of them requested a face-to-face interview, which was impossible for me to do so. Others also refused to honour the invitation due to their busy schedules.

The Project Peanut Butter representative is an influential member when making decisions at their organization. Project Peanut Butter is a company that produces RUTF/RUSF with branches in Ghana, Sierra Leone, Ivory Coast, and Malawi. As of 2018, the combined production capacity of RUTF is 750 metric tons in these regions according to the respondent. The company uses peanuts as a primary ingredient in the manufacturing of RUTF and RUSF products.

The representative from Save the Children Foundation is a key member who takes part in the decision making for the institution. Save the Children Foundation is an international humanitarian agency established in the United Kingdom. It has branches in other countries, including Canada. Save the Children Foundation procures RUTF products to programmed states other interventions to countries in need.

The Valid Food International representative is a staff member and holds a key position in the company in Malawi. Valid Food International collaborates with Valid Nutrition, a sister company which operates as a social business that develops and manufactures ready-to-use foods in developing countries, made from locally grown ingredients. The production capacity of RUTF/RUSF the company produced in Malawi is 860 metric tons in 2017.

UNICEF is a humanitarian institution established to provide emergency relieves and support to vulnerable people in developing countries. It is one of the UN agencies that procures RUFs products to meet the needs of the people. UNICEF is a buying organization that purchases RUTF, RUSF, and other supplementary foods to malnourished children in developing countries. UNICEF is the largest buyer of RUTF and RUSF products in the humanitarian supply chain. As of April 2019, UNICEF procured at least 75-80 percent of the global demand of RUFs a year, averaging 53,000 metric tons of RUF/RUSF products to treat 2 – 2.5 million children (UNICEF,

2019b). The respondent from UNICEF plays a critical role in the procurement activities at the head office, Geneva.

The Insta Products EPZ's representative holds a key position in the company. The representative is involved in making decisions regarding the development of RUTF/RUSF by the company. Insta Products EPZ is a manufacturing company located in Nairobi, Kenya. They produce low-cost flour-based nutritional products for emergency feeding in East Africa, and they work in collaboration with UNICEF, USAID, WFP and other humanitarian agencies. Insta Products sources raw materials from local farmers in Kenya and Uganda. Since its inception, the company has manufactured at least 37,000 tonnes of micro-nutrient meals.

Table 4.1 The summary of institutions who participated in the interviews

Institution	Category	Production/Purchase Capacity (MT)
UNICEF	Buyer	54,260
Save the Children International	Buyer	N/A
Project Peanut Butter	Processor	750
Valid Food International	Processor	860
Insta Products EPZ	Processor	N/A

4.3 Methodology

This study will be utilizing an applied research strategy through interviews (qualitative research) to understand the benefits of alternative RUTF/RUSF, and how these products could reduce the risks in the humanitarian supply chain.

The interviews were conducted using a 21-question interview guide, which was developed based upon the review of literature and discussions with members who have knowledge in the field. This enables flexibility in the questions asked as interviewees were prompted for further information when they raised interesting issues. To gain the in-depth knowledge required for this

research, interviewees had to be knowledgeable with several years of experience. Hence, non-probability, purposeful sampling was employed, and a small number of experts in the RUFs supply chain were targeted for in-depth interviews. The interviews were conducted face-to-face via web conferencing and lasted approximately 60 minutes. The answers of the respondents were recorded and transcribed.

4.3.1 The interview structures

The interviews commenced with a range of questions about the respondents and the institution they work with, and the institutions' production and procurement capacities. These questions were essential to determine if the respondents who participated in this study are an appropriate representation of the population. Follow up were questions about the sourcing and procurement of RUTF/RUSF products, not specifically on alternative recipes (Wagh & Deore, 2015). For example, questions concerning different RUTF/RUSF respondents frequently purchase. "*How many different RUTF/RUSF products do you currently source?*" This interview question was followed by "*How many manufacturers did you purchase products from last year?*" See Appendix A.3 for further details on the interview guide.

The interview questions then focused on the RUTF/RUSF pricing to understand the value of RUTF and RUSF in these supply chains (Kakietek, 2018). The results also aim to show whether the invention of alternative recipes would assist in the mitigation of risk of price escalation as there is only one main product on the market (Wagh & Deore, 2015). The first two groups of the questions give the general idea of RUTF/RUSF and the value of the products in the supply chains. The interview guide questions are, "*How does price affect the purchase/tender decision on RUTF/RUSF products?*" "*How does the place of manufacture affect price? [Based on answer] Could any of these issues be mitigated through alternative ingredients formulation of RUTF/RUSF?*"

Following that, respondents were asked questions about the procurement of ready-to-use foods (RUTFs) and ready-to-use supplementary foods (RUSFs). For example, "*Could you describe the distribution network for delivering RUTF/RUSF products?*" I asked this question to know the type of network the agencies used to distribute the RUF products to the needy. Follow-up

questions were on factors affecting stakeholders when procuring RUF internationally or locally (Puett & Guerrero, 2014; Beesabathuni & Natchu, 2010). For instance, “*What are the most limiting factors when procuring RUTF/RUSF locally? How do these factors affect the procurement of RUTF/RUSF products?*” In addition, I asked the participant questions about logistics. How the products get to the final consumer, and the challenges stakeholders encounter concerning logistics. The questions on procurement ended with the effect(s) of the cost of RUF distribution on the participants’ purchase decisions. Thus, “*How does the cost of delivering RUTF/RUSF affect the purchase decision of your organization?*”

Follow-up questions were also asked about the benefits and challenges of alternative ingredients in new product formulation. The idea was to know if RUTF/RUSF made with local ingredients may be able to reduce or otherwise mitigate procurement and logistical challenges, as well as the risks of longer lead times when there is an urgent need of the product (Dibari et al., 2012; Puett & Guerrero, 2014). For instance, “*Could any of these issues be mitigated through alternative ingredients formulation of RUTF/RUSF, either locally or internationally?*”

The last part of the interview questions talks about the quality, regulation, and challenges in the RUTF/RUSF supply chains. The guide questions are the factors interviewees consider during emergency and non-emergency procurements of RUTF/RUSF and some of the barriers to new formulations. For example, “*What are the barriers to new product innovation for RUTF/RUSF?*” Based on their response, I asked the participants a follow-up question on the benefits and challenges to new RUF formulations (Tesfaye et al., 2017). For instance, “*Some manufacturers (i.e. Mana International) have developed open-sourced recipes. What are the benefits and challenges of this model?*”

Although there are products on the market for treating undernutrition, not all of the problems (as demand for the product continues to increase) in the supply chains could be solved through the use of products currently available. Therefore, these interview questions seek to determine whether if expanding the supplier base to accommodate other alternative RUF formulations could be enough to address ongoing issues within humanitarian supply chains.

Overall, I generated the interview questions based on a review of literature on both the humanitarian supply chain as well as the supply chain risk and risk mitigation strategies.

4.3.2 Sampling method

The first point of contact (email correspondences) was sent to the people or institutions about the study (i.e. the objectives of the study) and whether they will be interested in participating. Other emails were initiated again as a reminder. This was to find out whether they will participate in the study. The first target institutions for the study were the buyers of RUF products (i.e. relief agencies) but realized that they are not ready for any engagement based on the initial contacts. Due to that, I decided to include RUF processors, but some of them were not interested to participate in the interview. Some producers cited busy schedules and other important assignments to pursue as reasons why they could not participate in the study. It is important to note that the supervisor for this project and I sent emails to different institutions/individuals (i.e. at least 32 individuals and institutions). Less than ten people initially agreed to participate, but only five eventually showed up. Thus, not all the institutions contacted agree to take part in the exercise. Due to that, the sampling technique used in the data collection was purposive sampling. With this technique, there is not an equal chance for any individual within the target population to be selected. A typical purposeful sampling reflects people's actions about a situation or phenomenon of interest (Etikan et al., 2016).

The interviews with participants took place online through Skype. The responses from the interviewees were recorded, either videotaped or audiotaped. The Skype interview was used as it allows the participants to respond to the questions at their own convenient time and place. In addition to the Skype interviews, participants who were not available for videotaping or audiotaping were given the questionnaires through electronic mail and returned the responses in the same format. No in-person interviews were conducted due to the cost of travelling to different countries.

4.3.3 Coding the data

The interview data were transcribed to facilitate an analysis of the results. The coding of the data commenced by transcribing the recorded interview verbatim using google voice speaking software. I then used auto-coding to group the data based on the interview questions (arranged using the paragraph styles). Paragraph style groups all the interview questions in the same format and numbers. For instance, the first question and their responses are all showed on the same page without necessarily going through all the text individually. This style makes coding more comfortable and faster. Text search and word frequency are also exploited to identify the most frequently used words by the participants in their response. All these initial processes aimed to make the coding easier and access each of the participant's answers to the questions without necessarily going through each document again. The data was then categorized into themes for which the responses provided insight. In other words, patterns and relationships that emerged from the data were grouped into themes. The following items were used:

- (a) The responsibilities of key decision-makers and their organizations, where it is based, what it does, and the production and procurement capacities of RUFs of these institutions.
- (b) Respondents' perception of RUTF/RUSF. Included in this theme are the sourcing of RUTF/RUSF ingredients, types of RUFs on the supply chain, acceptability of the products, regulations governing the formulation of these products, and the market potential of RUFs on the supply chains.
- (c) The procurement of RUF. The data provides respondents with their perception of the impact of multiple producers and the use of diversified ingredients on the supply chain, factors considered in the procurement of RUTF/RUSF, and issues in the RUTF/RUSF procurement (Puett & Guerrero, 2014). In the procurement process, the data provides respondent perceptions on distribution mechanisms for RUTF/RUSF (i.e. how does the product gets to the final consumer and in what form) and tender bidding for RUTF/RUSF.

(d) Alternative recipes. The data provides respondents with a perception of the benefits and challenges of alternative recipes. Before that, I asked the respondents their perceptions of the impacts of the presence of a dominant RUTF/RUSF on the supply chains.

I used NVivo 12 plus software for the coding of these themes (QSR International, 2019). There are other alternatives, such as manual coding, which works better for a small sample like the sample for this study. However, the software makes qualitative analysis better and easier (Leech & Onwuegbuzie, 2011). That is, data can efficiently be coded, indexed, sorted, recorded, and easily retrieved using NVivo (Leech & Onwuegbuzie, 2011). Furthermore, through its mapping concept, the software enables data visualization of the idea, categories, themes, and codes (Leech & Onwuegbuzie, 2011; Leech & Onwuegbuzie, 2007; Merriam, 2008; Mclafferty & Farley, 2006; Sinkovics & Alfoldi, 2012).

Ethical approval for this study was approved by the University of Saskatchewan Behavioral Research Ethics Board (Beh-REB) per the current version of the Tri-council Policy Statement. A verbal consent statement was obtained from all the participants. Appendix A4 gives details about the consent form for this study.

Chapter 5 Insights from the interviews

5.1 Introduction

In the previous chapter, I talked about the data and methodology that will be utilized in this study. An applied research strategy in the form of key informant interviews was used as the primary tool in this study. This chapter presents the insights from the engagements with the participants about the study.

Before I present and discuss the interviews' insights, it is crucial to understand the basis of measurement for the results. Participant responses based on their perceptions were coded and measured with the coding references. The coding references show the frequency with which participants mentioned a theme to the question asked by the interviewer. In other words, the coding references show the important texts the interviewees emphasized during the conversation. It is also equally significant to know that not all the discussions with the participants were coded and analyzed. Only those texts that contribute to the study were considered. The insights from the participants were grouped into four categories to ensure proper organization of the research questions. The classifications are interviewees and their company's history of RUTF/RUSF production and procurement capacities, the RUTF & RUSF products, the procurement of RUF products, and alternative formulations.

The guide starts with the participant's institution or firm's motivation to engage in the production and purchase of RUTF/RUSF products to mitigate the ongoing humanitarian crises. The interviews' results suggest that participants were not motivated by economic profit, as we usually see in commercial supply chains. Their motivations are to produce quality and affordable products to support malnourished children in need.

Producers' perceived interest in producing an affordable product and high-quality products that are easily accessible to meet the nutritional needs of children in at-risk regions. For instance, the representative from Valid Food International, which is a manufacturing enterprise for RUTFs/RUSFs, indicated that:

We do product development and recipes using local products that are cheaper and culturally more acceptable for the beneficiaries in different regions." Also, "We also ensure that the availability of affordable essential medicines and nutrition supplies for primary health care and emergency relief.

Buyers on the other hand, want to procure quality and affordable product to treat malnourished children in programmed countries. In other words, product quality is the highest reference for buyers when purchasing RUF products. For instance,

My motivation is to ensure the availability of affordable and quality nutritious food for primary health care and emergency relief in distressed communities – The UNICEF representative.

At least to ensure that the product we procure from producers is of higher quality and meets the international standard or international protocol," said Save the Children International's representative.

The coding reference refers to the text taken out from the interviewee's statement that may contribute significantly to the analyses and discussions of the results. All the reference texts generated from the interviews were coded. From Figure 5.1, product quality, support for the children, and delivery of affordable products were mentioned five times across the interviews. In other words, these factors are the primary reason for them to engage in RUF supply chains.

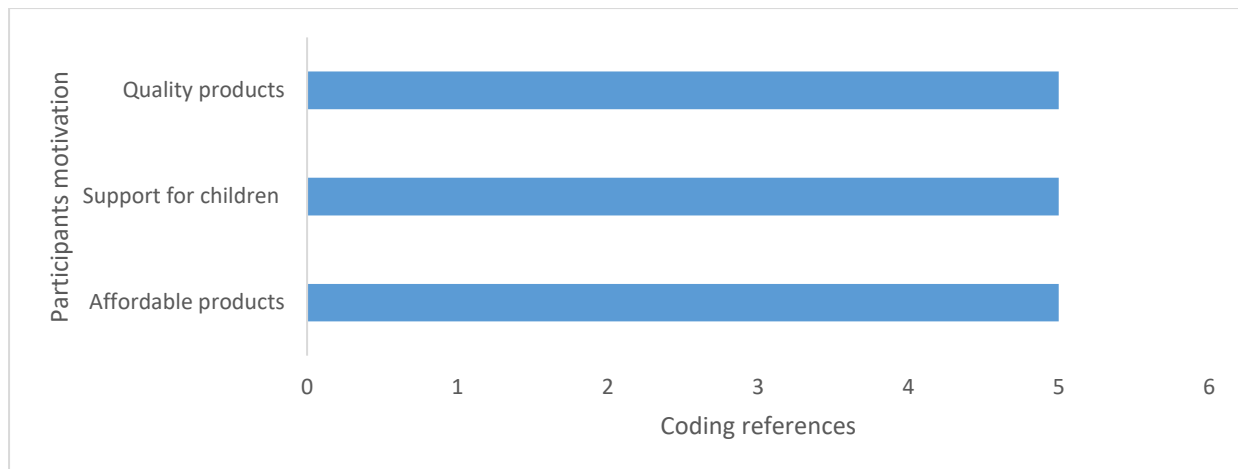


Figure 5.1 Participants motivations in RUTF/RUSF market

Figure 5.1 suggests that the primary objectives or motivations for these stakeholders in the supply are not profit-making institutions or enterprises, but rather to develop or procure affordable foods that are easily accessible by vulnerable people in at-risk communities.

Building on the participants' motivation, the next questions were on the insights about RUTF/RUSF and other supplementary foods being developed in the RUF industry. Based on this premise, I asked them about the RUTF/RUSF products, the products currently procured by humanitarian agencies as a solution to malnutrition globally.

5.2 Insights on RUTF and RUSF

The creation of this theme was to get an insight into the types of RUTF/RUSF produced or procured in the supply chains, and the regulations of RUTF/RUSF, and the market supply of RUTF/RUSF products. The theme in this analysis contains all other elements which aim to provide insight about addressing the research question. The relatively large network comprising many producers can manufacture many products within a short period. Buyers will have options, as many producers produce the same product. In a buyer-supplier relationship, increasing the number of producers with few buyers or a dominant buyer leaves each supplier with the necessary purchase agreements to make needed investments. This creates competition among suppliers to reach their full potential leading to the development of quality products

5.2.1 The sourcing of RUTF/RUSF ingredients

The researcher asked participants (Producers) where they source the ingredients for the manufacture of RUTF. Furthermore, I inquired about what factors they usually looked at when purchasing the ingredients. The data reveals that intermediaries and farmers are the primary sources of ingredients for producers. The farmers transport the raw materials directly from the farm to the production centers. Valid Nutrition International's representative indicated that they source the ingredients from intermediaries and sometimes from farmers. The nearness to the source of raw materials reduces the transportation cost and could directly impact the price of the products they produce.

Regarding the most factors considered when purchasing ingredients for RUTF and RUSF formulations, the data reveals that ingredients' safety (free from bacterial contamination such as aflatoxin), affordability, accessibility, and quality are the most significant factors considered for production. Project Peanut Butter's representative stressed that farmers and intermediaries sometimes mix higher quality ingredients with ingredients of low quality (bad ones), which compromises the quality of the inputs. The participant further emphasized that if the raw materials are low quality, they negotiate the price or reject the shipment. Apart from the harvest season or peak period, there is sometimes a shortage of raw materials for production. The producers indicated that easy access to ingredients reduces lead times for ordering and delivering the product to the buyers, which is a potential risk in the humanitarian supply chain if there is an urgent need for the product.

Overall, intermediaries and farmers remain the primary source from which RUTF/RUSF producers purchase the ingredients. Therefore, stringent measures such as vigorous inspection procedures should be laid out to ensure proper scrutiny of ingredients before purchases are made. In addition, signed contract among the actors in the supply must be enforced and that any party who breach the contents of the agreement be punished to serve as a deterrent to others.

5.2.2 Product varieties

In recent years there have been the developments of RUTFs and RUSFs using peanut as primary ingredients and other alternative ingredients. Additionally, there has been a big push for product formulations using local ingredients without importing the primary ingredients. Based on that, I asked participants which kinds of RUF products the institutions frequently procure in the supply chains.

The data provided in figure 5.2 indicates that manufacturers are producing peanut-based RUTFs and RUSFs as well as alternative recipes using local ingredients as the primary source. The data further reveals that manufacturers developed more of peanut-based RUTFs and RUSFs with peanuts as the primary ingredient than other ingredients. For instance, the representative from UNICEF indicated that:

The most purchased RUF is the peanut-based ready-to-use therapeutic foods (RUTF) with an estimated capacity of 52,850 metric tons (3,829,740 cartons) in 2017, of which 55% was sourced in programmed countries. We procure more of this from Nutriset, who produces Plumpy'Nut® and other peanut-based RUTFs from its franchise.

The producers particularly mentioned that they cannot produce peanut-based RUFs in countries where peanut is not part of their diet (i.e. culturally not the product they like to consume). This implies that there is the need to consider developing alternative RUFs in countries where people do not regularly consume peanuts as part of their daily diets. For instance, the representatives from Valid Food International and Insta Food Products, manufacturing companies that produce RUTFs and RUSFs, indicate that

They think UNICEF and other aid institutions already have this plan, considering that all producers should make room for this alternative formulation going forward. So, we have an alternative formulation that contains different ingredients altogether.

Regarding the procurement of alternative recipes, Save the Children Food International's representative who has work with institution for many years experience indicates "The reliance

on the current peanut-based product is not enough to meet the increasing demand while the humanitarian crises continue to rise."

UNICEF's representative also indicated that

We are looking forward, and a new formulation is developed using alternative ingredients that may better suit local availability for some ingredients and user preferences, as well as reducing production costs further.

This is in line with some studies that use ingredients like chickpeas, lentils, and maize to formulate alternative RUTF/RUSF products (Ryan et al., 2014; Weber et al., 2017; Hassan et al., 2016; Choudhury et al., 2018).

Figure 5.2 shows the response from the participants on the types of RUF products they produce or procure. The graph shows two main products purchased by aid institutions or produced by manufacturers: Peanut-based RUTF/RUSF and other alternative formulations. The figure indicates that peanut-based RUTFs/RUSFs was mentioned seven times across all the interviews, whereas other formulations, including alternative recipes, were mentioned four times. It also implies that peanut based RUTF/RUSF is a common RUF in the supply chain than the other alternatives. It also shows that both products were mentioned more than once by one respondent across the interviews.

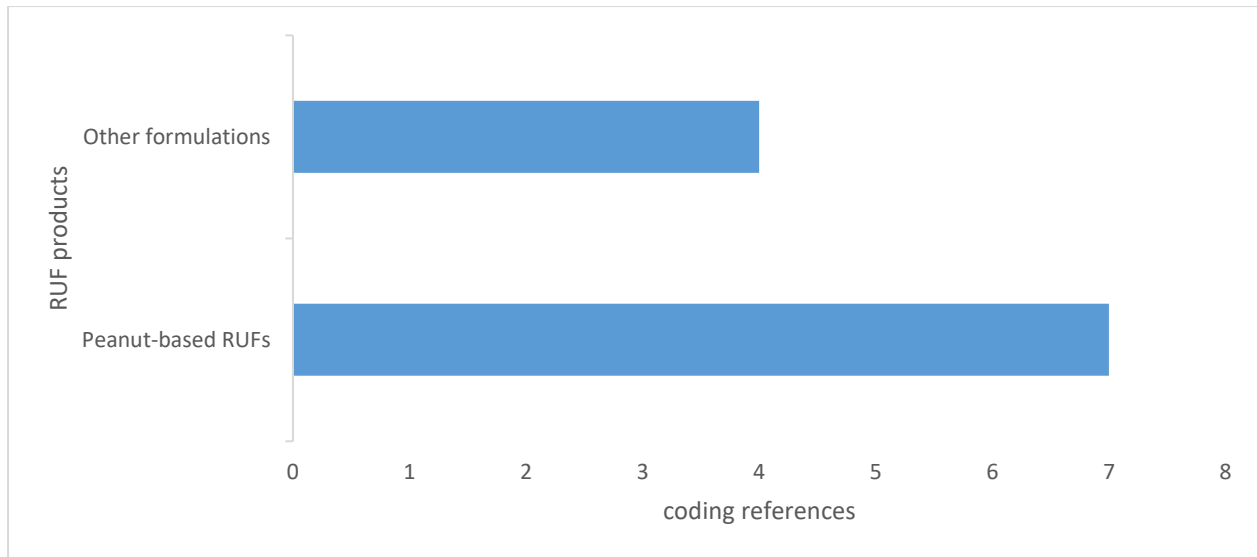


Figure 5.2 The procurement of RUF products by relief agencies

5.2.3 RUF regulations

As more RUFs are being produced by private institutions using globalized procurement network, policies and guidelines about the product development designed to regulate the nutritional needs are revised to reflect the changes in the supply chain and to expand distribution of RUFs. The policy change in this sector is to ensure harmonization of RUF production regarding product quality, safety, and inspection and auditing practices. The harmonization of RUF is to make policy regulations or government policies in different jurisdictions that are similar or identical to the production of the product elsewhere. Policy harmonization helps to reduce the time spent in inspection of ingredients or time spent on exchanging information about the nutritional content of the product produced.

The development of RUFs follows product specifications which are based on policy documents from UN agencies such as: The joint statement on Community-based Management of Severe and Acute Malnutrition (2007); Technical note on Supplementary Foods for the Management of Moderate Acute Malnutrition in Infants and children 6-59 months (World Health Organization, 2012); Technical Specifications for RUSFs, and the Updates on the Management of Severe Acute Malnutrition in Infants and Children (World Food Programme, 2016). These standards and guidelines provide references for manufacturers, purchases, and government regulatory

authorities to follow and provide the needed framework for the supply of consistently safe and nutritionally appropriate emergency food aid products for at-risk communities.

The push for local regional procurement and the development of alternative recipes give access to interested parties who want to produce RUFs. In other words, the open access to policy documents for the formulation encourages the entry of potential processors. The open access allows many firms entry into the industry which might create an intense rivalry competition among manufacturers. The competition among processors increases buyers' bargaining power to negotiate for reasonable price for the products.

However, the effort to promote local regional procurement creates diversity for certain aspects of the process and the existing food safety and quality standards do not appear to an issue for maintaining product quality. Harmonization and policy regulation may be difficult to meet as the effort of using local raw materials might vary from country to country (Osendarp et al., 2015). For instance, certain crop varieties like Desi and Kabuli chickpeas may not have the nutrients when processing such as the protein content after extrusion or milling, which could complicate the global nutritional standard during local production. Additionally, there is also a challenge of navigating state-level food security and nutrition policies. The regulatory standards and guidelines for some national programme can vary depending on the perception of the RUTF. Some countries consider RUTF ingredients like premix as pharmaceutical products, while others recognize the finished product as food products. These variations present a challenge to applying harmonized product guidelines and standards to ingredients crossing international borders.

Based on the RUTFs and RUSFs product development guidelines and specifications, I asked participants about the essential factors considered during the procurement or development of RUF products. The interviewees indicated that the most significant feature of RUF development is making sure the product meets the required standard. In other words, the product's quality is the most critical determining factor considered on the market. They emphasized that there are standards or guidelines outlined to be followed when manufacturing or intending to produce RUTF/RUSF products. Also, through the monitoring and evaluation systems, the aid institutions test the products during production to ensure the products are safe and effective for the intended

purpose. The reason might be that RUF innovation is constrained as it needs to meet the stringent procedures established by the institutional buyers and government agencies. The Valid Nutrition International's respondent stated that:

The main factor that we usually look out for is the quality of the ingredients. We seek to make sure that what we want to use will be able to meet the requirements of the buyer. I mean, what we produce should be able to heal children suffering from SAM and MAM.

The representative from UNICEF indicates that:

The intended product formulation should be able to meet all the requirements such as the intended use of the product, texture, nutritional components, colour, flavour and scent, the shelf life of the product should be considered according to the Codex Alimentarius references.

We also look at the shelf life of the product, quality and safety. That is, the product should be free from any harmful substances and manufactured according to the Codex Alimentarius references. Good manufacturing practice and good hygienic practice.

Following-up was a question about the other vital factors they may consider for accepting RUTF/RUSF products in the supply chain. The buyers emphasized that the producers' failure to meet the standard protocols results in product rejection. In other words, buyers reject the product if it fails to meet the beneficiaries' dietary needs. This implies that the product standards are paramount to the buyers in the food assistance program. Quality requirements for critical ingredients are the level of moisture, bacterial contamination, and pest damage. The failure to meet the conditions result in a renegotiation of the ingredients' price or rejection.

Regarding storage, the buyers emphasized that producers developed RUTF/RUSF that can remain shelf stable for at least 2 – 3 months. This ensures that food remains within the standards required for its effectiveness in treating malnutrition.

On the issue of cost, the data reveals that product price is the main element typically considered in the purchases of RUTFs and RUSFs. This is to give buyers further insights about the volumes of products to be purchased and make estimates of future transactions.

Concerning lead times, participants noted that the ability to reduce the ongoing issues requires a good response for emergencies. They emphasized that the effective and efficient distribution of foods for malnourished people is characterized by sparse road networks, a shortage of key ingredients and complex customs clearance of food products. Inaccessible roads to remote areas and inadequate key elements significantly compromise aid institutions' efforts to provide emergency support. For instance, all the franchisees purchase the vitamins and mineral premix from the Nutriset facility in France, and most of the time, import the milk-powder. The reliance on and importation of key ingredients from different countries imply a delay in the commencement of production, affecting product deliveries to the target communities.

According to the excerpts from the interviews, buyers also indicated the importance of labelling and packaging in RUFs development. The special packaging and labelling will ensure RUFs do not replace the local and unprocessed micronutrient dense foods in local diets. Without labelling and packaging, governments and donor institutions efforts to promote local and unprocessed foods for the treatment of micronutrient deficiencies in at-risk communities.

Figure 5.3 represents the factors discussed above and the coding for this theme is shown in Appendix A1. The figure shows that product quality was mentioned by five different participants across all the interviews. Packaging and labelling and lead times were both mentioned three times across all the interviews. The product price was mentioned by the two buyers (UNICEF's and Save the Children International's representatives).

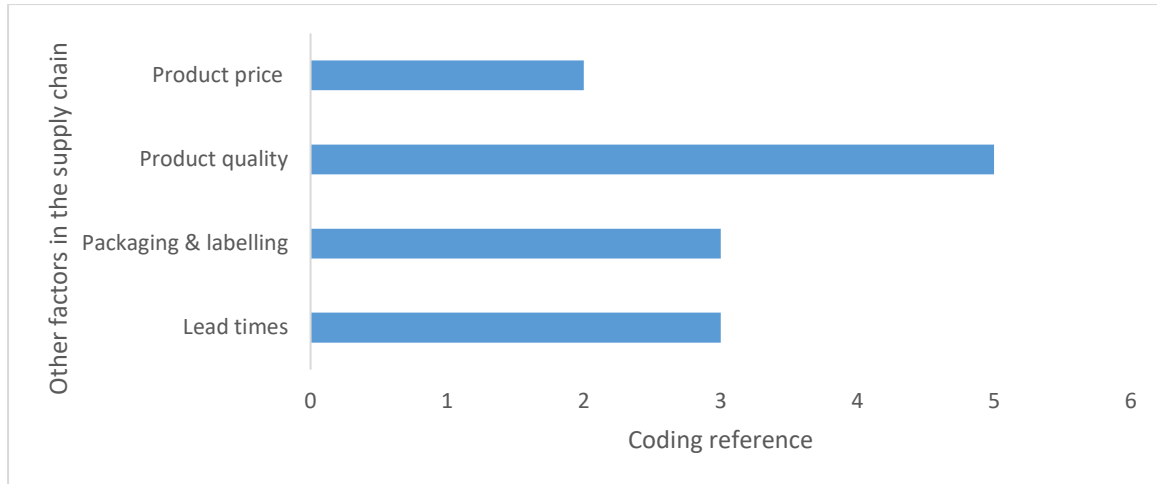


Figure 5.3 Factors considered for the acceptance of RUTF/RUSF products on the market

5.2.4 The market for RUTF/RUSF products

UNICEF is the main purchaser of RUTF, procuring at least 75% - 80% of the global demand (UNICEF, 2019b). World Food Programme procures similar volumes of RUSF as UNICEF (UNICEF, 2019b). USAID also channels between 5% – 10% of the global RUTF/RUSF volumes to support the UNICEF’s project (UNICEF, 2019b). These foods are provided to support therapeutic needs of 25 countries in Africa, Afghanistan, Bangladesh, Haiti, Myanmar, Pakistan, Yemen, and others. For instance, UNICEF increased its demands for RUTFs 34,157 metric tons in 2015 to 52,851 metric tons in 2017 (UNICEF, 2019b). This increase in demand has motivated many opportunities for private businesses to invest more in RUTF and RUSF development. The remaining volumes are purchased by governments, WHO, Médecins Sans Frontières (MSF), Action Against Hunger, the International Committee of the Red Cross (ICRC), and others (UNICEF, 2019b).

Key players are continually investing considerable resources in research and development to enhance their product quality and expand their product portfolio. According to market intelligence by transparency market research, the global ready-to-use therapeutic and supplementary food market is predicted to rise at the compound annual growth rate of 8.6 % during the forecast period 2017-2025 (Transparency Market Research, 2020). According to Transparency Market Research (2020), the market, which was valued at USD 429.9 million by 2017, is estimated to be valued at USD 829.3 million by 2025.

Based on the above numbers, I asked the interviewees the driving forces behind the products' success in the supply chain. This guide was followed up by the potential of new entrants in the supply chain. The entry of new producers will formulate products similar to the current peanut-based RUTFs and RUSFs on the market.

From the respondents' engagements, the rising cases of malnutrition are among the critical points that lead to the market growth of RUTF/RUSF products in the RUF s supply chain. According to them, the increasing rate of malnutrition in developing countries has resulted in a higher demand for them. Further, extreme poverty and intake of the cheap quality of food products are likely to favour the growth of the market. Also, various government initiatives undertaken to deal with constant growing malnutrition cases globally will help the market, particularly in those affected regions. The increasing number of schemes by governments and other stakeholders to feed people below the poverty line is increasing the scale-up of RUTFs and RUSFs, leading to its market growth. For instance, the UNICEF's representative indicated: *"These foods provide essential nutrients for treating malnutrition and supplement the diets of pregnant women."*

However, participants were quick to emphasize that despite the market potential of RUTF/RUSF products in the supply chain, factors such as factory location (considerable distance from the consumer), shortage of critical ingredients, inadequate funds for buyers to procure more of the products, low capacity of some firms to expand production and weak distribution systems as major hindrances to unleash the products market potential. Access to funds has become a burden for buyers to purchase more products to feed the people. For instance, *"We need funds to procure more RUF to save the lives children with malnutrition in Africa and the rest of the world,"* - UNICEF's representative.

The respondent from Insta Food Product also emphasized that:

Now, for the actual demand that can be absorbed on the market, it depends on the availability of funding and the level of aid funds that the institutional buyers use to purchase the product.

The delay of key inputs for production is one of the factors limiting the growth of the market for RUTF/RUSF products. Raw materials are usually imported from different countries, characterized by complicated and lengthy processes that make clearance difficult. Some of the inputs are unavailable for production during certain times of the year, which are generally caused by natural disasters such as flooding and others.

Another factor limiting the market growth for RUTF/RUSF products is the manufacturers' low production capacity. The increasing cases of malnutrition in developing countries have caused relief agencies to increase the demand for the RUTF/RUSF products to mitigate this sudden increase. Nevertheless, these manufacturers' production capacities are inadequate to meet the continually growing demand by the food assistance programs, limiting the growth of the global market. For instance, the total RUF purchased by buyers increased from 115,066 metric tons in 2016 to 144,465 metric tons in 2017 which is still below the estimated production capacity of 207,820 metric tons (Debyser, 2018).

Weak distribution systems also limit the growth of the market for RUTF /RUSF products. UNICEF and others use trucks that take orders from country offices and deliver them to regional offices. However, the sparse road networks in developing countries hamper stakeholders, particularly relief agencies, from distributing the products to those in need. The above points are in line with some studies which mentioned that weak distribution systems, supply chain inefficiencies, lack of market transparency for actors in the supply chains, and marketing costs are the challenges of markets of RUTF/RUSF products (Anim-somuah et al., 2013; Ruel & Alderman, 2013; Humphrey & Robinson, 2015).

Figure 5.4 presents the challenges identified by respondents within the supply chains. The figure shows that five different respondents mentioned inadequate funds for procurement across all the interviews. It means that inadequate funds were considered a big challenge among all the participants. Processors lack funds to purchase modernized machines to scale-up production leading to low production capacity. In addition, buyers are also faced with budget constraints and therefore, unable to procure more RUTF even if demand increases. Weak distribution system and the delay in RUF ingredient supplies were mentioned four times across all the interviews. The

poor road infrastructure in some communities make it difficult for trucks with RUTF and RUSF to be distributed during raining seasons. The location of the factory and low production capacity was mentioned thrice during the interviews. Thus, these two issues were not big problems among all the respondents.

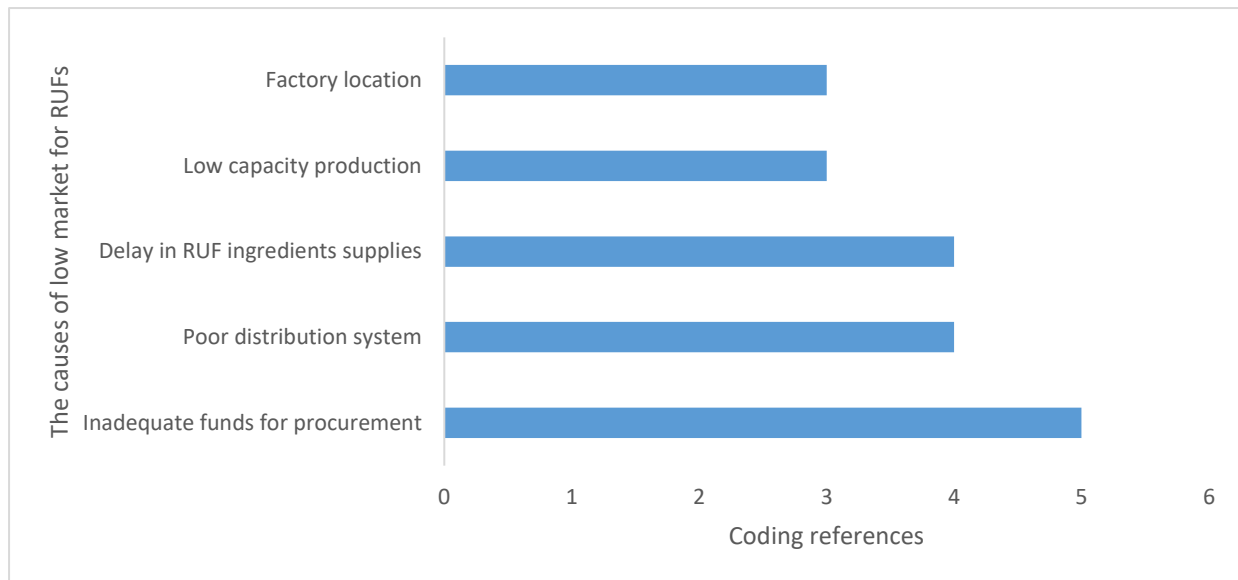


Figure 5.4 factors for low RUF market in the supply chain

In sum, weak distribution systems, lack of funds, low production capacity, product quality and inconvenient factory location are some of the challenges in RUF supply chain. These challenges limit the access to potential manufacturers for RUF products. Producers' bargaining power increases due to the few/limited processors in the supply chain. Competitive rivalry among producers becomes less intense due to the absence of new entrants and substitute products. Buyers' bargaining power decreases in contract negotiations resulting in the purchase of a product at a higher price.

5.3 Insights on RUTF/RUSF product procurement

Despite the success and investment in the development of RUTFs and RUSFs in the RUFs supply chains, the shift and push for more diversified products is not without challenges. As noted by Lentz et al.(2013), in some cases, it is challenging to enforce procurement contracts during an emergency. Additionally, policies for preferential treatment for local sourcing of raw materials

have been criticized for distorting trade behaviour. In line with the research question which seeks to identify some of the issues in the RUF supply chain and how some of these issues would be addressed by alternative recipes, I asked respondents the key issues in the supply chain.

The interviews' data suggest the price of the product as one of the factors posing threats to stakeholders in the RUF supply chain. Higher product price limits the product volumes purchased by the aid institutions. The higher product price is influenced by the value of the ingredients and the cost of transportation and the importation of raw materials due to local production shortage. For instance, Wagh and Deore (2015) stated that 68 percent of RUF's total costs arise from the sourcing the ingredients. While the higher product price affects procurement volumes, it is essential to note that the ingredients' price varies due to the season or time the purchases are made. Thus, it is possible to purchase inexpensive raw materials from the merchants¹¹ when there is an abundant supply of it and delivered within 3 – 4 days.

Besides the product price, participants mentioned other issues such as product quality, higher production cost, and product safety as challenging when procuring RUSF/RUTF products. Food processing companies in Africa usually purchase chickpeas, corn, maize and other key ingredients from the merchants. It is also possible for the processing companies to acquire the products directly from farmers or commercial farms. Sometimes, farmers and merchants mix the quality ingredients with lower quality to obtain a higher quantity for selling. This may compromise the quality of the ingredients used for RUTF/RUSF food production. The processing companies may need to invest extra money to make sure the quality ingredients are sorted, cleaned, and tested by the quality inspection team, which adds to the cost of production. Manufacturers must always comply with the Codex Alimentarius, the international standard guide for food production and safety. Low-quality testing laboratories in some African countries make it difficult to comply with these directives. As mentioned by Adde (2018) samples of special nutritious foods such as corn soya blend were rejected due to the failure to meet the standard specifications. Further, there are difficulties in ensuring that harmonized guidelines for product development are flexible in addressing future innovations at different levels. The

¹¹ The merchants are the middlemen who purchased the chickpeas, and other local ingredients from the farmers and sell to the manufacturers.

representative from Valid Food International, which is one of the private producers, indicated that: *"The proposed guidelines framed are based on the peanut-based formulations which seek to encourage the use of peanuts and discourage the investment in pulses and cereal production."*

Participants also mentioned other factors logistics problems, a lack of government support to invest in new areas, a shortage of critical ingredients, inadequate funding flows, and long lead times as challenging in RUF supply chains. Buyers sometimes find it very challenging to transport the products to rural communities due to sparse road networks. The weak road networks sometimes increase the lead times needed to get the product to the beneficiaries, which adds additional risk in the supply chain.

According to the interviewees, the driving forces for the increased lead times may be the shortage of key raw materials for production and unpredictable demands for the RUTF/RUSF products. The supply of critical ingredients might only be available locally during the harvest season. In other times of the year, essential components are scarce or expensive to procure. Other ingredients like vitamin and mineral premix conforming to product quality specifications must be imported. The imported raw materials are subject to import tariffs and taxes, whereas finished products procured by the relief agencies are not. This makes imported products less cheap than the local ones. The representative from Project Peanut Butter mentioned: *"In Africa, producers sometimes must import these raw materials, which adds extra cost to the production."* Processing companies only produce once the order is made, and therefore, they do not maintain an inventory of raw materials due to their expiry dates and risks of spoilage.

Another critical factor for the shortage of raw materials for local production is the export of commodities to other countries (see also Adde, 2018). The raw materials to produce local ready-to-use foods are sourced locally. Most governments, however, export these ingredients for foreign exchange at the expense of the local producers. This can lead to production halts, which discourage people from investing in such businesses. In addition, the lack of government support coupled with stringent policies, including higher lending rates and import levies, deter companies, particularly smaller ones, from setting up and investing in new areas. Higher import

duties charged at the port and complex documentation processes make the cost of doing business expensive and unattractive to investors.

Additionally, low production capacity is also a challenge in the supply chain. Most of the manufacturing firms lack funds to purchase modern equipment to expand production. For instance, the respondent from Valid Food International stated; “*most companies produce at a low capacity, which is a challenge in the supply chain (i.e. not meet the target demanded by the buyers)*”. This problem is further compounded by access to credit facilities especially, the small-scale firms. A study by Adde (2018) reveals that some producers find it challenging to obtain foreign currency to import raw materials.

Furthermore, the data reveals that the inadequate funds to procure more volumes is very challenging. Since the relief agencies are non-profit organizations, it is not very easy for them to generate funds for their operations. The source of funds comes from governments, agencies, and private individuals. The heavy reliance of funds from these institutions for procuring RUTF/RUSF products makes the supply chain weak in terms of sustainability as the shortage of funds may compromise the distribution of these products.

Setting up a food processing company nearest to the source of raw materials reduces the lead time for production and reduces the merchants' transport costs. In other words, a factory located far from raw materials is unfavourable as intermediaries (input suppliers) transport the raw materials over long distances to reach producers, which adds extra cost to the price they charge. In an emergency, a manufacturer situated nearer to the target population may distribute the products in a timelier manner compared to a distant producer. Transporting from offshore takes a much longer time and is very expensive, which adds additional costs to the product's price.

Respondents also emphasized the limited number of RUTF manufacturers as a risk in the humanitarian supply chain. Supplier power is high when there are a limited number of suppliers for relief agencies to purchase RUF products. Inadequate RUTF/RUSF producers limit the options available to buyers since there are limited products produced. There is the risk of not meeting the required volumes needed in urgent situations as the low number of suppliers may

reduce the quantities demanded by the relief agencies and government due to the low production capacities of some food processing companies.

Besides the inadequate volumes of RUFs to cater for the needs of the children, the buyer(s) are handicapped in negotiations as there are no other product options available to make comparisons in terms of price resulting to a producer charging a higher price for its product. Within single sourcing frameworks, the low number of suppliers weakens the negotiation powers of buyers due to the absence of substitute products.

In addition to the above factors, participants did indicate that as the cases of malnutrition increase, manufacturers are forced to produce more to scale-up existing products. The growing demand for the products by the buyers, the procurement from a few suppliers, limits the extent to which the supply chain includes an increased capacity. Therefore, in the face of a complex emergency, the producer would be forced to prioritize those orders, thereby stressing their production capacity while also reducing the company's ability to meet needs elsewhere.

Figure 5.5 presents the challenges participants highlighted in the RUTF/RUSF supply chains. The coding references are the frequencies with which each interviewee stressed a challenge in response to the question the researcher asked. The bars in Figure 5.5 indicate that the shortage of raw materials was mentioned six times across all the interviews. Thus, the shortage of raw materials was mentioned twice by one respondent during the engagements. Also, higher product prices, long lead times, and inadequate funds were mentioned by five different participants during the interviews.

Furthermore, logistics issues were mentioned four times across all the interviews (i.e. it may have been that one respondent did not say anything when the interviewer asked the question, or the answer given was not relevant to the question the researcher asked). Quality ingredients, low production capacity, and inadequate planning were mentioned three times across all the interviews. In other words, three out of five respondents spoke about these problems during the interviews. Appendix A1 shows the entire coding results for this theme.

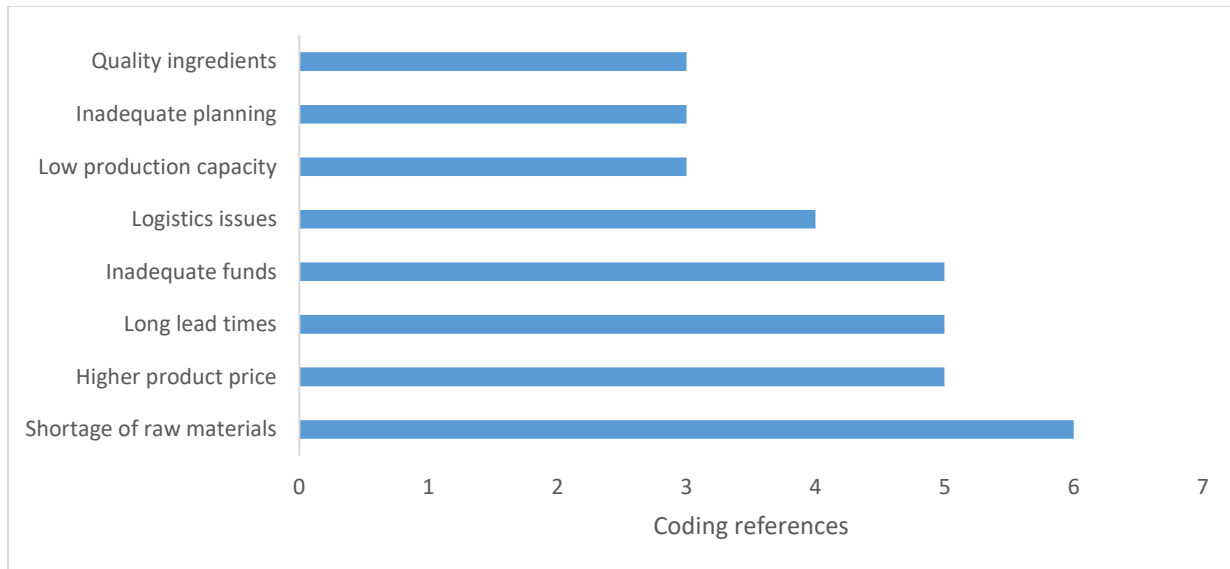


Figure 5.5 The issues in the RUTF/RUSF humanitarian supply chain

To summarize, participants raised issues such as higher product prices, product quality, higher production costs, product safety, logistical issues, stringent government policies, and low production capacity as some of the main challenges in the RUTF/RUSF supply chains. In addition, the shortage of critical ingredients, long lead times, higher products price are also very challenging issues in the RUF supply chains that need to be addressed.

Given the stakeholders' concerns, it is imperative to consider ways of reducing or mitigating these challenges in the supply chain. In other words, the issues raised by the stakeholders, if not addressed, will continue to hinder the operations and the activities in the supply chains. One of the strategies is to allow multiple sourcing of ready-to-use food products. Multiple sourcing strategies will provide opportunities to producers for the manufacturing of alternative foods made with some traditional ingredients or without the usual ingredients, while still meeting international standards. In other words, alternative formulations that meet the dietary requirements and needs of the target population may alleviate some of these problems by providing buyers and producers with new options if product shortages in key ingredients limit firms' ability to fulfil orders. Additionally, an alternative RUTF/RUSF that satisfy the dietary needs of target populations and are produced at facilities located closer to the people will ensure the fastest delivery and respond to emergencies, as producers may supply the required volumes when there are disruptions to the supply of the current product.

Given the challenges expressed by the participants in the push for alternative formulations, the threats of substitutes are low because there are no other alternatives. The absence of substitutes products reduces buyers' tendency to switch between suppliers which creates intense competitive rivalry among and between each other. It also decreases the bargaining powers of the buyers to negotiate for reasonable prices because there are no other alternative products. The absence of competitive rivalry among processors may reduce the development of quality products to the market.

5.3.1 Distribution types

The emphasis of this theme is to examine how the products get to the children. Because of that, I asked the interviewees about the mode of distribution of RUTF/RUSF products. The data given by the respondents shows that buyer-to-beneficiaries, government delivery, and producer-to-buyer types are the primary means of distributing RUTF/RUSF products through humanitarian supply chains. There may be other forms that can be explored but these are the ones they usually use for procurement process. Further, respondents suggested producer-to-buyer-to-consumer is the most preferred form of distribution for RUTF/RUSF products in the supply chain. The reason may be to ensure that country representatives for UNICEF and other aid institutions get access to the product on time and are thus able to respond to emergencies. The products are distributed to various centers using trucks. The relief agencies pay for the fueling of these trucks. According to the buyers, this route increases the lead times of getting the product to the children during an emergency. Most of these products are procured from international suppliers and on average, international procurements take three months from order to delivery. The supplies mostly arrive via sea shipments, which take at least two months. Air freight, which is the fastest form of transportation, is costly.

Regarding the buyer-to-consumer distribution, buyers purchase the products from manufacturers and distribute them to the target populations. The institutional buyers who purchase the products from the manufacturers normally use this form of distribution. With government delivery, governments procure the products from manufacturers as well as the aid institutions and distribute them to their people. The distribution is normally facilitated and administered by health

workers working in various community health clinics in remote areas. With all the distribution types, the children do not pay for the product they consume. Surprisingly, it was revealed during the engagement with the interviewees that some portion of the products is also marketed commercially to end-users. Some people take advantage of the weak monitoring system and divert the products intended to be used by affected children and instead sell them for personal gain. When the products become scarce, parents or caregivers have no option than to purchase the products from retail shops. It was revealed during the engagement with producers that, the prices of products sold in the shops are much higher than those purchased by the humanitarian agencies or the governments. Overall, the producer-to-consumer, producer-to-buyer-consumer, government distribution, and third-party distribution are the main forms of delivering ready-to-use products to the target populations.

Figure 5.6 shows the various forms of distributing RUTF/RUSF products in the supply chain. These forms were coded based on the frequency with which each participant emphasized a statement which is represented by the coding reference. In other words, the codes were drawn from the relevance of the respondents' answers to the interview question asked by the interviewer. From Figure 5.6, producer-to-buyer-to-consumer was mentioned by five different participants. It means that each of the respondents' emphasized this distribution as a common form in the RUFs supply chain. Producer-to-buyer-consumer was mentioned three times across all the interviews. Government and third-party deliveries were mentioned twice and once across all the interviews. It implies that the latter two distribution forms are not the common forms of distributing RUFs in the supply chain.

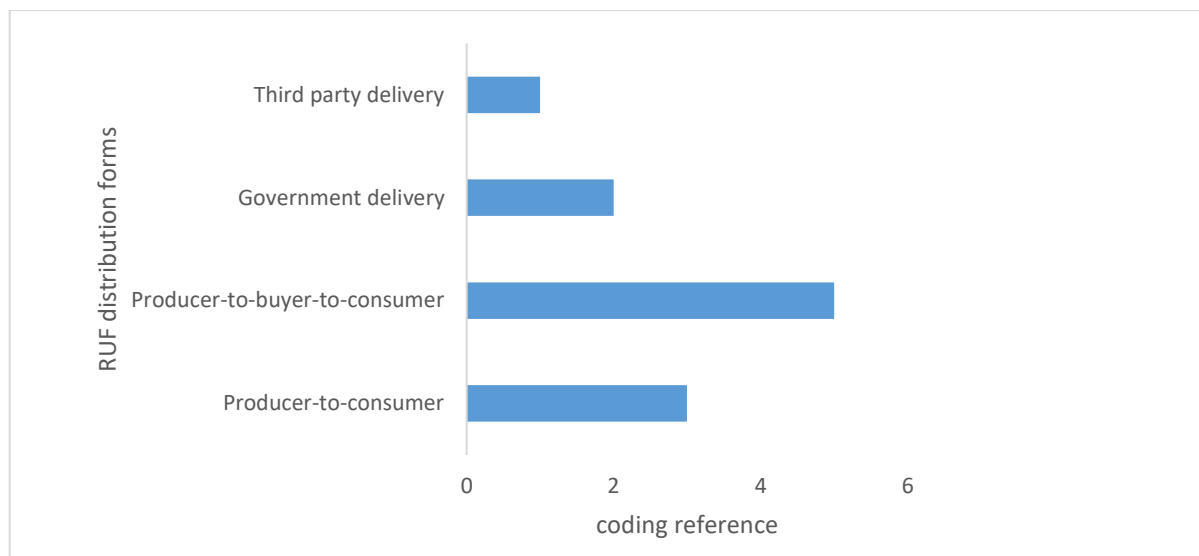


Figure 5.6 Forms of distributing RUTF/RUSF in humanitarian supply chain

5.3.2 Bid tendering

The development of RUFs follows a bid tendering process where a buyer opens tender for all potential manufacturing enterprises for scrutiny before the buyer's institution awards the contract to the selected winner. This theme (i.e. bid tendering) was to get an insight into the tendering process before a producer is selected to produce the RUF products. The insights as part of the interviews were to get the most important factors a buyer considers during the bidding process to inform new entrants in the RUF supply chain.

The data reviews indicate that buyers open the bidding process once they decide to procure RUTF/RUSF products or when there are urgent needs for the products in target populations. They then allow producers to submit their bid for competitive tendering. The proposals comprise the cost of the product, quantity to be produced, and the standard required. Thus a potential producer has to submit as part of the process, the price of the product they intend selling to the buyer, the volumes the entity can produce, and the guidelines to ensure that the proposed product meets the international standard protocols including the standard on nutrition requirements, product safety, and many others. The proposals are framed in consultations with the product development officer in that manufacturing entity. Once the buyer settles on the producer, they sign a long-term agreement that becomes binding for the two parties. Other agencies also rely on

tender bidding, which generally aims to select the best offers from among potential competitive suppliers. There are clauses and penalties in the agreement that is applied to any party who breaches the contract agreement.

The buyers also indicated the importance of data on previous products or new product formulation from each bidder in the bid tendering process. The data provide buyers with details (ingredients selection and nutritional components) of the product formulated and ensure that the nutritional elements and product preferences for the beneficiaries are met. It also gives organizations the volumes of the product procured during the previous contracts awarded.

UNICEF's representative indicated:

At the headquarters, we specify the kind of product we want to procure, the quality of the product, nutritional components, cost, the impacts on the beneficiaries, transportation, and the times of delivery.

Besides the processes and factors mentioned above, buyers also mentioned discount offers from the manufacturers who have submitted their proposals for consideration. The discount is subject to the volumes of quantity to be developed, the product's value, and product specification. All these may give buyers better insight into the product produced by the manufacturers, including the volumes they can provide, the lead times to release orders, and the ingredients used for the formulation.

For instance, UNICEF's respondent emphasized that: "*We review this to ensure that the products meet consumers' interest, ensure quantity and quality (best value for money), timeliness at the right place*".

To sum up, producers are required to provide details about product quantity (i.e. capacity it can produce), price of the product (i.e. the bid amount which includes price to be charge per product), and product specifications when tendering a bid for consideration. Other factors, such as data on previous products manufactured or the company's product history and discount offer, are also considered when submitting a bid in the RUF supply chain.

Figure 5.7 shows some of the factors that stakeholders, particularly buyers, usually consider during the tender bidding process before a contract is awarded to a manufacturer for RUF products. From Figure 5.7, Data on products (i.e. ingredients formulations) and the product price were mentioned both mentioned by five different respondents. Product volumes were mentioned four times, each across all the interviews. It may have been that one respondent did not agree to this perception by the other participants. Product specification was mentioned three times across the interviews. Discount offers to be given to the proposed product was mentioned twice across all the interviews. The low reference coding may have been that some respondents did not mention it all during the engagement (i.e. may not be ideally relevant in the bidding process).

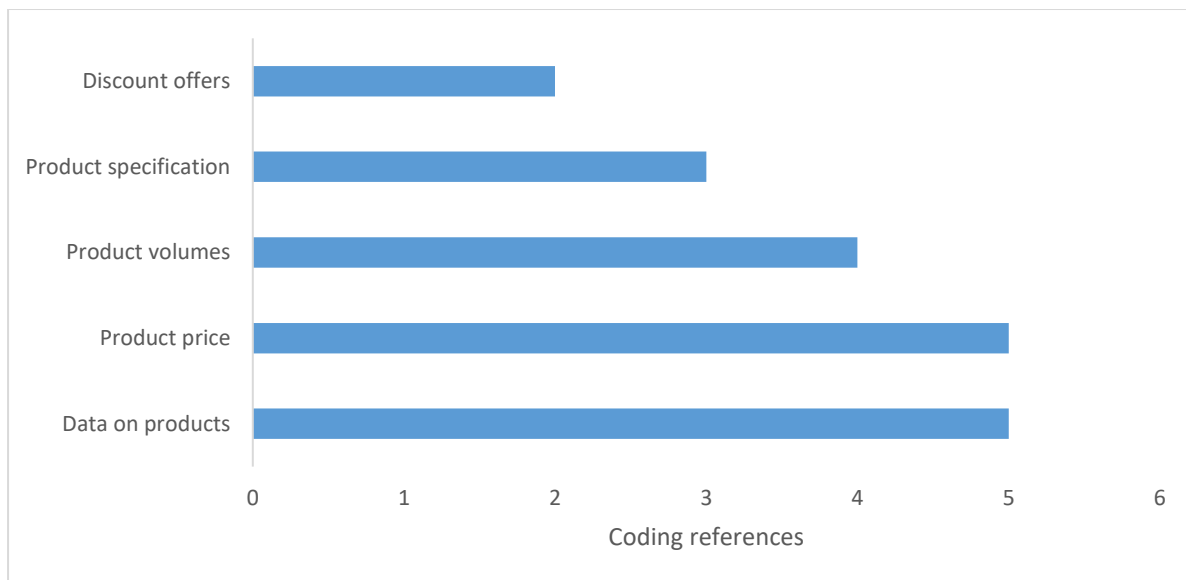


Figure 5.7 Factors considered when tendering a bid for RUF procurement

5.4 Insights on Alternative formulation

The second objective of the study is to determine the benefits of alternative products in mitigating risks in the humanitarian supply chain. Lipid-based nutrient (LNS) supplement and many others, which are sub-types of ready-to-use supplementary foods, have gained significant attention in recent years from the international food assistance programme. One contribution is the improvement in the effectiveness of treating micronutrient deficiencies over earlier formulations such as the corn-soy blend. Some of these LNS formulations use pulses, cereals,

and other ingredients instead of peanuts are shown to be effective at treating moderate acute malnutrition in children.

The ensuing themes discuss the benefits of alternative formulations and the challenges these new products have in the supply chain. To get detailed insights into the impacts of alternative products, I asked participants the benefits and adverse effects of having one dominant product in the supply chain. As a follow-up to that, participants were asked about the benefits of diversified products in the supply chain.

The data reveals that one product makes product selection easier during the tender bidding process. The product does not need to go through a rigorous selection process before receiving contracts from buyers. In addition to easy product selection, focusing on only one product creates some efficiencies in the supply chain. The cost of searching for information about a product price is more accessible and less costly relative to multiple products. Information about nutritional elements such as protein and energy content are easily retrievable and validated relative to multiple products in the supply chain. Further, the cost of negotiation and enforcing contracts is cost-efficient as no complex documentation is required than several products offered for sale on the market.

Although the respondents highlighted the benefits of single product on the market, they however, stressed that focusing on only one product also creates some inefficiencies in the supply chain. In other words, in the event of major disruptions to the current product, the absence of alternative products may create some challenges in the supply chain. First, some malnourished children in countries where peanuts are not part of their diet may reject the currently available products due to the taste or scent. Second, a single product may increase production costs due to the shortage of raw materials or the season in which the purchase is made. The lack of raw materials means producers are forced to either import the ingredients, which increases the transportation costs or purchase the ingredients at a higher price. In the event of inefficiencies in the system, and manufacturers using cost -pricing model will lead to charging higher prices.

Buyers particularly mentioned that the unavailability of other substitute products makes price comparisons difficult. Although the price may be negotiated before the buyer awards the contract, the buyer may not have the opportunity to evaluate and compare the price offered to the product by the producer to other several products available. The consequence is that offering a higher price may limit the volumes of buyers, governments, and other players can purchase with current funding levels.

Figure 5.8 shows the coded text generated from the interviewees on the issues of having a single dominant product in the supply chain. The left axis shows challenges, whereas the horizontal axis represents the coding references for the themes. The coding references indicate that the higher production cost was mentioned six times across all the interviews. With five participants for the interview, it may have been that one respondent mentioned it twice during the engagement. Product rejection by some consumers and the riskier nature of relying on one dominant product were all by four different participants. In other words, one respondent has other opinions relative to what was said by the four respondents.

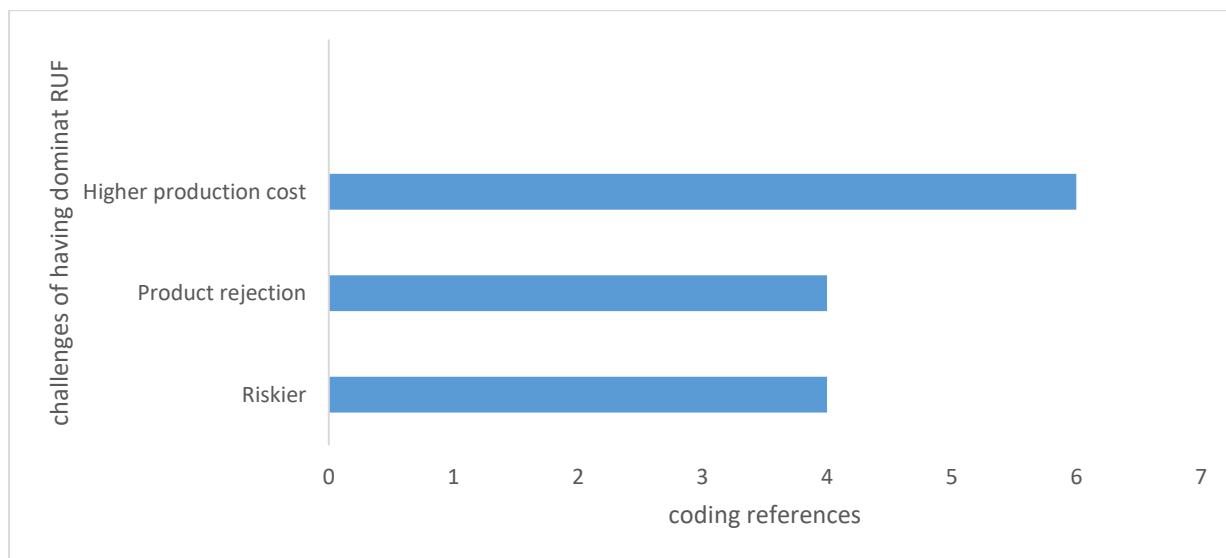


Figure 5.8 The negative impact of single RUTF/RUSF in the supply chain

Even though communication is effective during procurements, sourcing one product (single sourcing) gives much power to supplier(s) due to the limited numbers of suppliers in the industry.

Institutional buyers are handicapped to negotiate for reasonable prices. The intense competitive rivalry among producers is lost due to the absence of RUF substitutes.

Regarding the impacts of having different products on the RUFs market, the interview data indicate an increase in production volumes, cost-efficiency, product quality improvement, and an increase in product acceptability. Participants indicated that alternative products might contribute significantly to reducing some risks, such as product rejection by some people within the target population. Culturally, some children do not like peanut-food products and therefore, developing alternative products could help meet that challenge. Also, alternative products will augment the existing products to meet the increasing demand of the RUFs as humanitarian crises continue to increase. Having several options available to buyers ensures that buyers purchase the product that meets the target population's dietary needs. Buyers and other stakeholders can compare prices on the available products on the market and make price decisions.

Figure 5.9 shows participants' responses to the impacts of the diversified products on the market. The coding references indicate that five different participants mentioned an increase in product volumes across all the interviews. Thus, each participant emphasized the rise in product volumes during the interview. Cost-efficiency and product quality improvement was mentioned four times (i.e. two buyers and two producers) across all the interviews (i.e. it may have been that one respondent did not mention these points or has contrary views about these points). The increase in product acceptability culturally was mentioned twice across all the interviews. From the data, this was mentioned by both the buyer and the producer.

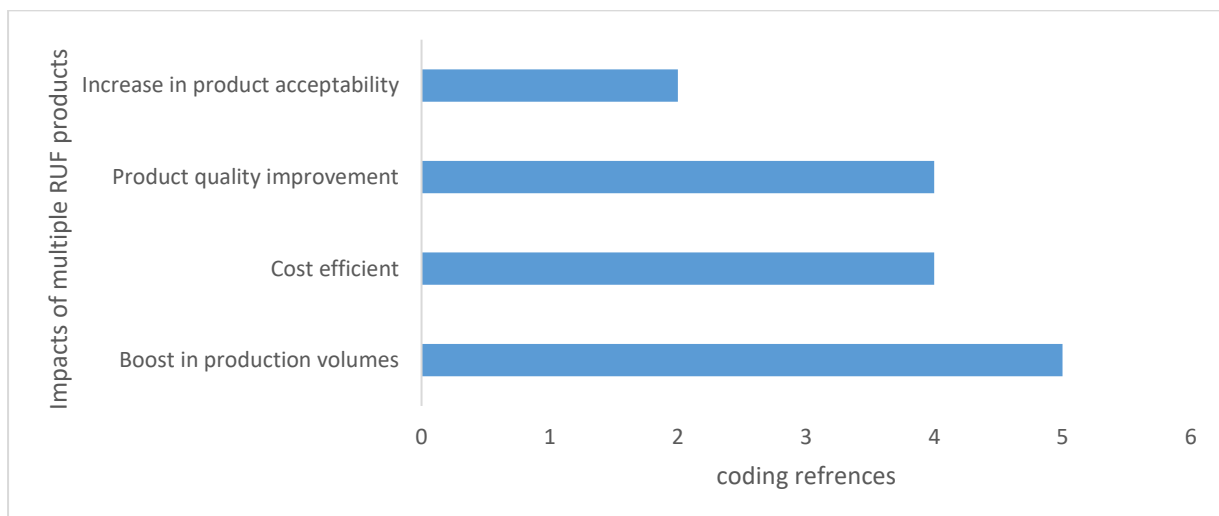


Figure 5.9 The impacts of having different products on the supply chain

Building on the above insights, I then asked participants about the benefits of developing alternative recipes in the supply chain. Participants highlighted that alternative recipes might ensure healthy competition among the products in the supply chain. The development of alternative formulations brings several products to augment the existing RUTF/RUSF in the RUF supply chain. Bids are usually selected based on price, and a supplier can be substituted if it fails to meet the product requirements. The consequence of this competition might reduce the prices of the product as the buyer has many product options in negotiations. This is in line with some studies on alternative products to reduce the market price (Wagh & Deore, 2015; Dibari et al., 2012; Wakhu-Wamunga & Brian-Wamunga, 2017). The representative from Insta Food Products, a manufacturing enterprise, mentioned: *"Having a different product on the market brings keen competition, and of course, competition reduces price, which benefits the institutional buyers."* The reduction in prices may lead to an increase in procurement volumes as buyers may purchase more without increasing their funds. The intensity of competitive rivalry is one of the major determinants of the competitiveness of the RUF supply chain. With the absence of any barrier to market entry and the presence of many producers, there will be higher competition levels among themselves, making the RUF industry efficient.

The interviewees also stressed that alternative RUTF/RUSF might help address the risk of product rejection by some malnourished children in some communities. In some situations where children dislike the peanut-based RUTF, alternative recipes formulated from pulses, cereals, and many other ingredients may help alleviate this challenge.

Alternative recipes might also solve the demand problem from a growing number of countries by providing diversified locally made foods to beneficiaries. For instance, in Pakistan, a ready-to-use supplemental food called Wawa Mum was made from locally grown chickpeas. 'Wawa Mum' is produced entirely in Pakistan and is readily accepted by the children. The respondent from one of the buyers, Save the Children International indicated:

Generally, there is this perception from the community about peanuts; sometimes, some children may or may not like it. So, shortly the institution may look for production that suits the children.

The development of alternative formulations means there are many manufacturers in the supply chain to produce RUTF/RUSF varieties, which may scale-up production volumes. This can be seen by the comment by the UNICEF's representative:

The increasing number of producers and contributions by alternative products have increased the volumes of RUF procured by UNICEF, and other relief agencies increased from 115,066 metric tons in 2016 to 144,465 metric tons in 2017.

Besides the stiff competition among products in the RUF supply chain as well as the rise in product volumes in terms of production, developing alternative recipes from locally grown ingredients is also cost-efficient. Manufacturers usually assemble low-cost ingredients to formulate alternative recipes without necessarily importing the raw materials that are subject to import tariffs. Diversified RUF producers will encourage more alternative formulations to reach a broader market and achieve higher economies of scale (Segrè et al., 2016).

Additionally, the interviews' data shows alternative formulations might generate income to smallholder farmers. Depending on the degree of competition and the number of merchants in the supply of raw materials, or the country where the ingredients are sourced, both small and commercial farmers might receive some income through the selling of raw materials such as chickpeas, barley, and other commodities. This is in line with studies by (Owino et al., 2014; Wakhu-Wamunga & Brian-Wamunga, 2017) that farmers receive their share of income via the selling of their outputs to the merchants (middlemen) or producers.

There are other benefits that stakeholders also enjoy in the development of alternative RUTF/RUSF products. Researchers and businesspeople may have the opportunity to explore or discover new ideas through investment in the use of different ingredients. Thus, the formulation of alternative RUTF/RUSF products motivates firms to invest in new areas.

The development of alternative recipes improves product quality. Through multiple sourcing strategies, many producing enterprises and other private entities may come on board to formulate RUTFs and RUSFs. The involvement of many producers in RUTF/RUSF production creates competition among producers in the supply chain, which encourages them to improve their product quality. Manufacturers will not compromise the quality buyers' demand from the product. Any attempt to compromise the quality will lead to rejection of the product and total loss of investment. As mentioned by the UNICEF's representative, "*Having multiple RUFs in the market to choose from with different formulations will enhance product quality.*"

Figure 5.10 shows the benefits alternative RUTF/RUSF products may bring in the supply chain. The bars represent references I generated during the coding process from the interviews. The coding references show that five different participants mentioned price reduction, improvement in product quality, and an increase in product quality. Thus, all five respondents highlighted these points as essential contributions made by the development of alternative formulations. Income to input suppliers and the economy and ease of acceptability were mentioned four times (three producers and one buyer) across all the interviews.

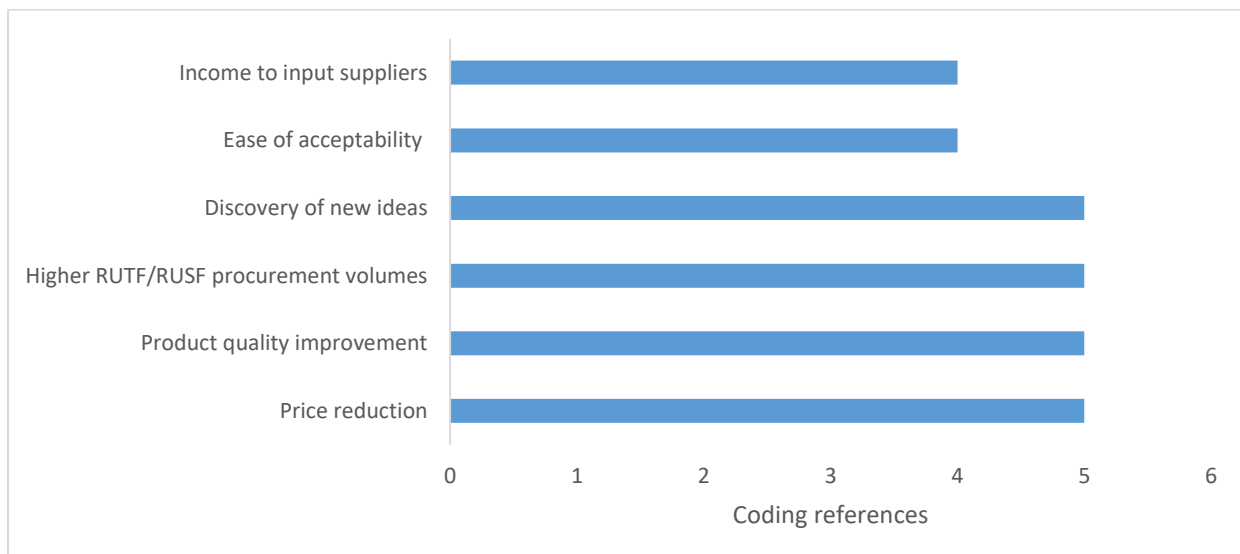


Figure 5.10 The benefits of alternative recipes in the humanitarian supply chain

To get more insight into the participants' claims, I further asked interviewees about the impacts of procuring RUTF/RUSF locally. In other words, there has been a big push for local regional procurement (LRP) of RUFs products by various stakeholders in the RUF supply chain. The participants' insights reveal that the local production of alternative products might bring some benefits to the supply chain.

First, the costs of purchasing the product might be reduced due to the use of local ingredients. Some studies conclude that LRP based RUTFs and RUSFs are more cost-effective and cost-efficient than relying on transoceanic transportation networks (Lentz, Passarelli, et al., 2013b; Haggblade & Tschirley, 2007). Manufacturers need not import the raw materials as the ingredients are available in domestic supply. This will eliminate the levies charged on the imported ingredients, often passed along to buyers of these commodities.

Second, local procurement reduces lead times associated with an international purchase during emergencies. This is in line with a study that argues that LRP is inherent in reducing single sourcing, which helps to decrease the time required to transport supplies during emergencies. Thus, local supply helps in responding to emergency cases and further eliminates the cost of transporting the products by air, which may be required in an emergency.

Third, there is easy and fast communication as there is no time zone challenge when reaching other people. Transportation becomes more straightforward and quicker as suppliers are located nearest to the people and the warehouses.

Fourth, the local regional procurement of RUTFs and RUSFs can bolster local market channels, support for farmers, and improve food quality and safety. Gambo and Safiyanu (2014) noted that contracts with global relief agencies had increased sales and revenue for Dala foods in this niche market, giving the company access to international markets through donor organizations. Participants indicate that local manufacturers generate local employment and purchase local input. While the number of jobs may not be enough to have a substantial impact on the economy, producers mentioned that local procurements had created jobs offering good wages that could

have a ripple effect on the economy especially as manufacturers bring new skills to a region and employees carry these skills into future employment.

Finally, the production of alternative products will promote local tastes and reduce dependency on expensive imported inputs in favour of lower cost and locally available inputs such as chickpeas, cereals, and many others.

However, they emphasized that international suppliers comply with the food safety management practices, have modern technology for traceability, and large production capacities. Thus, internationally sourced products enjoy economies of scale compared to the locally sourced ones. Producers indicated that while there is a reduction in lead times of getting the product to the people, timeliness varies among ingredients. They emphasized that procuring unprocessed grains from and some pulses results in a high cost, while processed commodities like vegetable oils are very high-priced compare to internationally procured ones. For instance, the Project Peanut Butter representative emphasized: "*The disadvantage of global purchase is the higher cost of transporting the product to programmed countries.*" Based on these issues, I asked participants about the challenges that alternative product formulations may encounter in the market or the supply chain.

Overall, it is very clear from the above points that multiple sourcing of RUF products will encourage the development of alternative products. The development of alternative formulations sourced from local or international ingredients may contribute significantly to the reduction of food insecurity in at-risk communities. Culturally, the use of pulses and other ingredients may benefit the local economy as well as increase the consumption of RUTFs and RUSFs to manage the rising cases of malnutrition in developing countries. In addition to that, the development of alternatives might lead to intense competitive rivalry among producers through multiple sourcing in the absence of entry barriers. Buyers bargaining power increases due to the threats of substitutes resulting to negotiations for reasonable prices.

5.5 Insights on the challenges with alternative RUF formulation

Despite the successes around the production of alternative products, efforts to provide alternative products face several challenges. Therefore, I asked interviewees about the obstacles that limit the success of alternative recipes in the supply chain even though there are substantial positive impacts of alternative products. The data reveals the absence of a mechanism to signal nutritional quality and product use, low nutrition awareness, poor quality of supplies, and the difficulty in distributing the products to the intended beneficiaries.

Administering the product requires caregivers to read the labelling of the product. Nevertheless, most caregivers have little formal education and may find it difficult to read the instructions on the products. The problem is being exacerbated by caregivers mixing the RUFs food with other food products to be consumed by the malnourished child. Some also forget even after health professionals give them instructions about the product. Thus, caregivers' lack of access to or understanding of information about quality, nutritional content, and the long-run impact of consumption behaviours on health outcomes result in making decisions under uncertainty and incomplete information. Caregivers may not know how specialized the product is and may give the product to another family (or household). Further, they sell the products to other people for income leaving the beneficiary unattended (See also Karakochuk et al., 2012; Tadesse et al., 2015; Tadesse et al., 2016).

Another informational problem that participants emphasized concerning the development of alternative ready-to-use products is the caregivers' uncertainty over the long-run health benefits of this intervention. Unlike the adaptations of other innovations such as water purification, which has visible benefits to health, nutritional product benefits such as those derived from alternative products are uncertain and invisible in the short-term, with benefits only apparent in the long-run. Not only is there a temporal gap between nutrition intervention and health outcomes later in life for the beneficiaries, but the link between the improved health and the action taken may be less obvious given the many circumstances at play. In some instances, it is difficult for caregivers to justify the cost of the products that have uncertain impacts on the children's health benefits.

Besides the informational problem, producers emphasized that establishing a business is very costly, institutionally complicated and time-consuming. The import duties charged at the ports for clearing goods are high, which discourage manufacturers from engaging in non-profit business such as the RUTF/RUSF supply chains. Some people disguised themselves as intermediaries and demanded certain monies from clearing agents before the products were released. This makes the cost of clearing goods at the port prohibitive. Furthermore, the interest rates at which banks and other financial institutions lend money to businesses and private companies are high in developing countries. Some banks charged as high as 20 – 25 % lending rates at which businesses and other private entities cannot borrow funds to invest in new areas or purchase technology to expand production. In other words, higher interest rates deter businesses and private entities to secure funds for further investment. The higher lending rate means that processors and other institutions lack funds to conduct a test.

According to the participants, reliable sourcing is a big challenge for manufacturers when developing ready-to-use foods. Though UNICEF and others encourage the local development of ready-to-use foods, including alternative products as well as local procurement, sourcing raw materials locally for RUF production remains a constant challenge in developing countries. Raw materials such as peanuts are not consistently available in countries where peanuts are not part of their diets, and those that are available are adulterated. In addition, chickpea, corn, and other ingredients are typically sourced through mediators in Africa. The sourcing of these raw materials poses a problem due to the deliberate mixture of high-quality grain with low-quality grains, which compromise the quality of the ingredients. The quality ingredient check is inspected by a specialist who performs a physical examination and laboratory testing. In addition to the ingredient's adulteration, there is bacterial infestation like aflatoxins for ingredients such as peanuts, which, if not treated, could compromise the quality of the product manufactured. Aflatoxin is a bacterial disease produced by a fungus manifesting as mould found on peanuts and maize and the consumption of foods produced using infected ingredients. These bacteria pose health problems to consumers, especially malnourished children and those with weak immune systems. The major cause of this is that food control systems in developing countries are less developed to support local production and efficient distribution systems to supply safe food to

most communities. Further, effective and efficient monitoring and inspections are lacking, which makes people more vulnerable to diseases.

The lack of research into new areas and under-equipped laboratories is also challenging when developing new formulation from the insights. The interviewees indicated that a lack of funds to invest in research limits their opportunities to develop new ideas. They emphasized that research into new areas may enable them to explore other formulations that may work similarly or surpass current products concerning the effectiveness, cost, and readiness. All products developed need laboratory testing to assess its efficacy through control trials. However, the inadequate laboratory capacity in developing countries to test new formulas and evaluate the trials discourages researchers from inventing new ideas that may be useful to the community. The inadequate testing laboratories, especially in developing countries, make it difficult for people to believe which product meets the required standard. This makes consumers unwilling or unlikely to accept the claims of nutritious food in processed foods that are fortified with added nutrients because nutrients are invisible (credence attributes) in the short-term.

Another challenge in the development of alternative products is the market size. Because of the target market (products are designed to treat malnourished children), volumes remain low, and costs of production high limiting affordability. UNICEF and others procure ready-to-use foods to be consumed by the children. PlumpyField, a network that produces Plumpy'Nut®, has a large share of the market and, therefore, the relief agencies mostly purchase this product which limits the demand for alternative products. PlumpyField has established reputations for safety, consistent quality, and timely delivery.

One of the biggest challenges to the development of ready-to-use foods is establishing consumer trust of local or alternative products introduced to the market. Ready-to-use foods carry credence attribute-the long-term health outcome from consuming the food is not directly visible in the short-time and also having limited information about the products. Beneficiaries do not know of the existence of the RUFs and that the consumption of these foods is driven by generous incentives, which is unlike other products like organic foods with credence characteristics known to many people in the developed world. Households living in poverty conditions with no

knowledge about the nutritional benefits decide to sell the product or give it to family members for the fears that these products may pose health issues or escalate existing health problems if the child consumes it. Because in an open market, there is the incentive to pass off a non-nutritious product as a nutritious one.

Figure 5.11 shows the coded themes generated from the interviews with the participants. Each bar represents the points mentioned during the interview by the interviewees, represented by the coding reference. The figure shows that five different participants mentioned stringent government policies. Poor communication on product uses was also mentioned four times across all the interviews. Quality standards and inadequate research in new areas and laboratories were mentioned three times and twice, respectively.

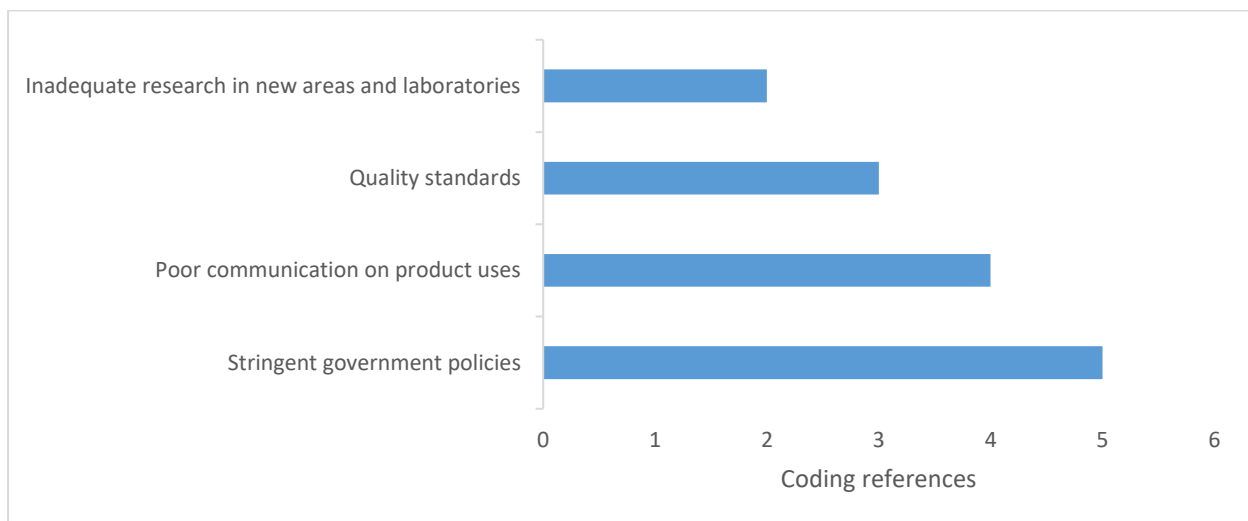


Figure 5.11 The challenges to alternative RUF formulations

To conclude, the data collected from the interviews provided insights into the supply chain of the current and new products and the challenges that actors in the supply chain encounter. The challenges facing both manufacturers and buyers are higher import duties where higher taxes are charged on imported raw materials, unavailability of critical ingredients, which results in higher prices except for during the harvest season, inadequate testing laboratories due to inadequate funds for investment. Also, input quality is a challenge as intermediaries or merchants mix high-quality ingredients with lower quality to increase the quantity for sale, and weak transportation systems due to inadequate road networks. The higher price of the current product is a hindrance

to the buyers due to the costly nature of primary ingredients. Additionally, communication about product use is also an issue in the RUF supply chain. Some caregivers trade the product for the money and or give to family members at the expense of the users. Production capacity is a critical problem for smaller producers due to the unavailability of funds to purchase modern technology and storage materials.

Despite these challenges, the interviewees articulated some benefits of alternative RUTF/RUSF products in the RUF supply chains. Alternative recipes provide stiff competition among the products, which may reduce the risk of price escalation in the absence of multiple products. Also, developing alternative recipes using local ingredients may reduce the costs (i.e. transportation cost and import levies) of importing raw materials. Furthermore, the lead times for ordering and distributing RUTF/RUSF products may reduce due to the availability of ingredients for formulation. The rejection of peanut-based recipes by some malnourished children may reduce as alternative products provide many options for buyers to select products to meet the dietary needs of the target population. Production volumes may also increase as different producers manufacture many diversified products. Less-costly ingredients for alternative RUTF/RUSF products reduce the product price, particularly for relief agencies and governments who procure them for treating malnutrition.

In summary, single sourcing limits the entry of the new entrants resulting in higher bargaining power of a supplier in negotiations. The absence of substitutes makes buyer(s) handicapped during negotiations. Thus, the absence of new entrants or alternative RUFs shift power to the dominant supplier, consequently reducing the intense competitive rivalry among RUF processors. Single sourcing increases supplier's bargaining power, as the buyer's outside option comparatively becomes less competitive. In other words, buyer (s) cannot negotiate for reasonable price due to the absence of substitute products in the RUF supply chains. In addressing the crises and disruptions in the RUF supply chain, stakeholders might reduce the ordering quantity from the primary supplier and increasing the reserve capacity for the development of alternative products. This might promote the development of RUF substitutes which may increase the competition among processors to enhance product quality. Buyer(s), through the availability of substitutes, might increase their bargaining power to negotiate for

reasonable prices, resulting in the purchases of more products to ameliorate the lives of the malnourished children.

Chapter 6 Summary and Conclusions

This objective of this thesis was to explore the reasons and implications of single sourcing of RUTF/RUSF products within humanitarian supply chains and examine how multiple sourcing could reduce supply chain risks when there is an urgent need for the product in target populations. The literature and the insights from the interviews suggest that humanitarian supply chains are subject to risks such as demand risks, supply chain disruptions (the breakdown of production plants), and other risks that need immediate attention. During emergencies, there is an urgent need for these products to respond to people's needs, and therefore, relying on a single product may exacerbate the problem and put the target population at risk.

The sourcing of a single dominant product limits the extent to which the supply chain includes an increased capacity. In the face of a complex emergency, the producer would be forced to prioritize those orders, thereby stressing their production capacity while also reducing the company's ability to meet needs elsewhere. Besides, using low-quality grain by deliberate mixture due to a shortage of ingredients may reduce the nutritional contents needed by the people making treatment difficult and the risk of loss of lives. Furthermore, there is a possibility of equipment malfunctions and system failure not in one production center but the overall manufacturing units as they are under pressure to meet the increasing demands by the relief agencies and other stakeholders when there is an urgent need for the product. The ramifications could effectively halt the entire RUTF/RUSF supply chain for all their customers. Additionally, there is evidence that suggests some children dislike the Plumpy' Nut® product due to some of the ingredients (i.e. peanut) used. There is also a big push for the development of RUTFs and RUSFs through local regional procurement of raw materials to increase the accessibility of these products by various stakeholders in the RUF supply chain.

Therefore, the study investigated if alternative products might reduce risks within the supply chain in developing countries, mainly where malnutrition is severe. This research explored the challenges in the RUF supply chain as a result of the ongoing crises and identified strategies to mitigate these problems through interviews with the stakeholders. The study also examined rivalry among competitors, the threats of new entrants, threats of substitutes, bargaining power of buyers, and suppliers' bargaining power to shape the competition as more stakeholders are

involved in the supply chain. The benefits and challenges of alternative products were also examined through insights gained from the interviews.

A structured and open-ended questionnaire with key stakeholders was carried out to meet the objective and address the research questions. Five key players in the RUTF/RUSF humanitarian supply chain were interviewed, including two buyers and three processors. UNICEF, a buying institution, procures about 70% of the total RUTF/RUSF products for distribution, and the remaining 30% are procured by SAVE the Children International and other agencies. The three manufacturers who participated in the interview were Valid Food International, Malawi, Inzta Food Nutrition, Kenya, and Project Peanut Butter. The latter has franchises in Ghana, Ivory Coast, Malawi, and Sierra Leone. All the interviews were conducted through Skype.

I utilized the applied research strategy to gain insights about the RUTF/RUSF supply chains through interviews with the participants. Patterns and relationships that emerged from the interviews were coded using NVivo 12 plus software (QSR International Party Ltd.). In Section 6.1, I review the main findings, and in Section 6.2, I present the policy implications, caveats, and the areas for further study going forward.

6.1 Summary of significant findings

The study explored the reasons behind one dominant product in the RUTF/RUSF market, and the potential for alternative products in the treatment of malnutrition in the humanitarian supply chain. This was done by examining some of the issues in the RUTF/RUSF supply chain. The study identifies logistics issues (higher import duties, flight and transportation costs), shortage of key ingredients, poor education on product use, and the higher product price due to the costly nature of some components as some problems in the supply chains.

Also, the analysis found quality, inadequate funds for the relief agencies to procure more volumes of RUFs for distribution, and low production capacity by smaller suppliers resulting from lack of funds to purchase equipment are some bottlenecks in the RUF supply chain. This results from inadequate testing laboratories and inspection teams to monitor the operations of

input suppliers. Due to these problems, intermediaries end up deliberately mixing quality ingredients with bad ones to increase input quantity to generate more sales.

The insights from the interviews show that alternative recipes may provide competition in the supply chain to reduce product prices. Competition may encourage manufacturers and intermediaries to enhance the supplies of ingredients to improve product quality. It also suggests that alternative recipes may give many options that could allow humanitarian organizations to distribute products to areas where children dislike the current product. In this way, RUTF/RUSF product acceptability may increase and lead to a reduction of malnutrition cases. The use of alternative RUTF/RUSF will encourage higher product availability and acceptability (consumption) by the beneficiaries that do not consume peanuts as part of their daily diets (Choudhury et al., 2018). Local production of alternative recipes provides increased familiarity of local community and government with the product. The development of alternative recipes based on the insights from the interviews may improve the production volumes, particularly for the humanitarian institutions that rely on RUTF/RUSF for treating malnutrition. Also, prices of RUFs may decline due to the use of accessible, affordable, and diversified ingredients for developing the product.

The insights suggest that as humanitarian crises increase and seeing the need to provide emergency response to the at-risk people, diversifying the supply base through the development of local alternative recipes may reduce the risk of long lead-times from order to delivery when there is an urgent need for the product. Local RUTF processors will use local ingredients without necessarily importing from other countries. This will reduce to the complexities and days agents spent in clearing the raw materials at the port. It also indicated that the availability of raw materials in the local setting decreases the transportation cost and mitigates the levies on imported products. Responding to emergency cases is fast and more comfortable due to the closeness of suppliers and warehouses. Depending on the degree of competition and suppliers involved, local farmers may receive income from the sale of ingredients, which results in economic growth. The availability of these alternative ingredients at local and international settings reduces the risk in lead times in case of emergencies. Furthermore, the sole dependence

on a single dominant firm for the supply of RUFs products is risky should any disruptions occur that affect the network of Plumpy'Nut® producers.

6.2 Policy implications, caveats and the areas for further research

Today, almost six million children in Ethiopia are suffering from malnutrition, and ready-to-use foods (RUF) endorsed by governments, UNICEF, and other relief agencies have become an important tool in meeting this challenge. Consumer awareness of health, good quality food, and healthy nutrition, and ready-to-use foods (RUF) are growing (Scheule & Sneed, 2001). Access to affordable and quality protein foods distributed in a very convenient form in sub-Saharan regions is a significant boost to fight against malnutrition.

The above drivers of consumer demands encompass malnutrition treatment, wellness, health delivery, and food supplements that could be addressed by making alternative RUTF/RUSF. The development of alternative products will expand production volumes, which could lead to the exploitation of market opportunities in other communities. An increase in product volumes means that buyers can purchase more to meet the needs of many children. It will also encourage private enterprises that produce these food products to invest in technology and other areas, which may lead to improved product quality. The development of alternative recipes in the supply will reduce the heavy reliance on peanut-based products and allow food processors to explore different areas. Additionally, local regional procurement of RUTFs and RUSFs may reduce the lead times expected to transport the products during an emergency.

The interviews were carried out among producers and buyers in the RUF supply chain. These players have a significant role to play for the innovation and procurements of these foods. However, it is equally important to assess and include governments' contributions to this sector since they also play a significant role in this sector. Therefore, a study that extends this work by including input from local governments will give additional insights into exploiting the potential of alternative formulations within humanitarian supply chains. I contacted some government representatives, but these contact attempts proved futile due to their busy schedules and unavailability. See Appendix A2 for details about the email correspondences.

The sample size also is a limitation in the study. This is challenging because a small sample size limits the reliability and validity of the results. As numbers form an integral part of qualitative research, meaning in part depends on numbers and patterns. Thus, in qualitative research, numbers are used to extract meaning (to verify and validate the interpretation and conclusion) and to identify the significance of a project. Therefore, further studies with a larger sample size could confirm or refute this outcome and provide better insights for this study from divergent views. Second, due to the topic's sensitive nature, I had limited data as most persons and institutions contacted did not show up for the scheduled telephone interviews, restricting the nature of the data. The reasons might be their busy schedules and the timeline of this research. All these issues make it challenging to conduct detailed research on this topic. Therefore, it may be necessary to do further research to improve the understanding of the problem for this study.

At the end of the study, I found some procurement challenges such as logistics issues, longer lead times, higher procurement costs, dislike of products by some beneficiaries, and shortage of crucial ingredients for formulation. Further research investigating the causes and solutions to these problems will inform stakeholders and policymakers' decisions on alternative RUFs in the supply chain. Issues like logistics, distribution, local business challenges, and product quality are areas of interest that might require further research in the future.

To conclude, the thesis investigated the problems in the RUF industry as well as the contribution(s) of alternative RUFs in addressing those issues. The study found a considerable gap in the production volumes of RUF procured for the treatment of child malnutrition as well as food to supplement the aged who lack essential food nutrients in their diets. This has led to a higher demand for RUF products. Therefore, any product that possesses similar qualities to peanut-based RUF, such as a chickpea-based RUF, may help nullify this gap if adequately formulated. The insights from the interviews suggest that alternative recipes, if appropriately developed will provide healthy competition among products in the supply chains. This competition will encourage manufacturers to improve the quality of the products they produce. More importantly, alternative recipes with low-cost ingredients may reduce costs, which consequently affects product prices. Procurement volumes may be increased due to a reduction in the prices due to competition. Thus, intense competitive rivalry may widen the scope to other

firms to scale-up production to other geographical areas. The existence of logistics problems, poor communication, weak distribution systems, longer lead times, and lack of government support are some of the bottlenecks that impede the success of these products in the supply chain.

Going forward, more time should be devoted to obtaining extensive data from other processors, buyers, and governments. This could provide further divergent views on the questionnaires, resulting in a more representative of the sample population and improve the results from the study. Additionally, in order to understand the impact(s) of alternative formulations and the Plumpy'Nut®, a cost-effectiveness analysis could also be conducted to determine the health and economic impacts of these foods in the supply chain. Moreover, I recommend that caregivers be educated on RUTF/RUSF products' use to reduce the sharing of RUTF with family members and friends or selling the product to earn income at the expense of the intended users. There should be the encouragement of public health education on the appropriate use of the products. We must also note that RUTF/RUSF, including chickpea-based RUTF/RUSF and other alternatives, are not a panacea for malnutrition problems. Therefore, vigilance should be taken when administering this product to the children.

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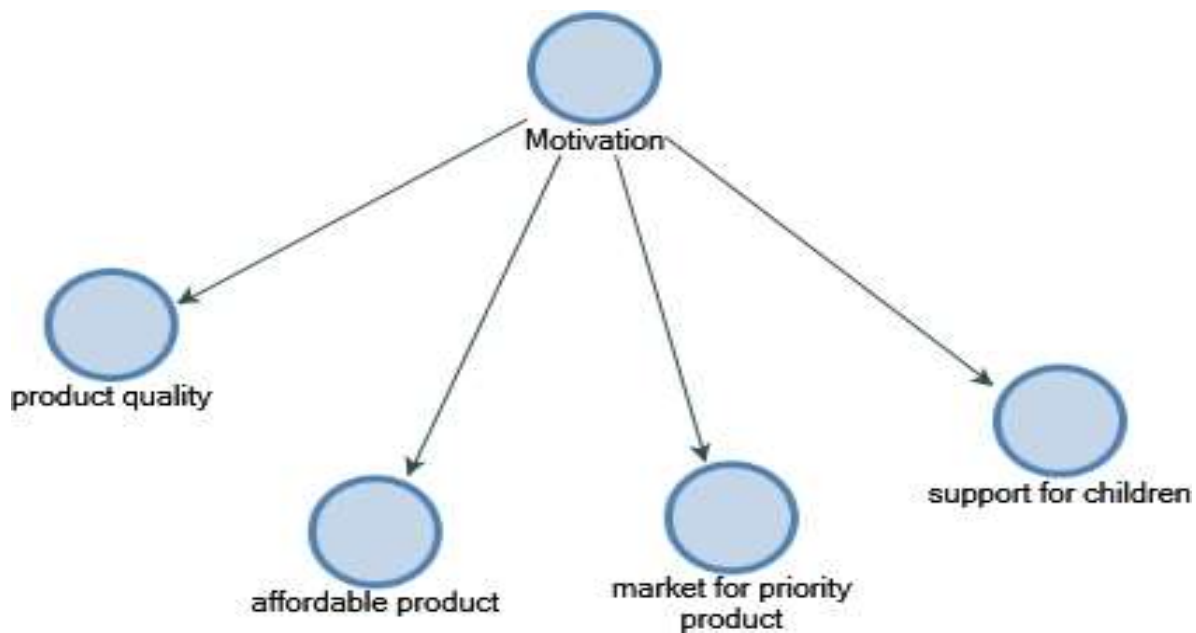
Appendices

Appendix A1

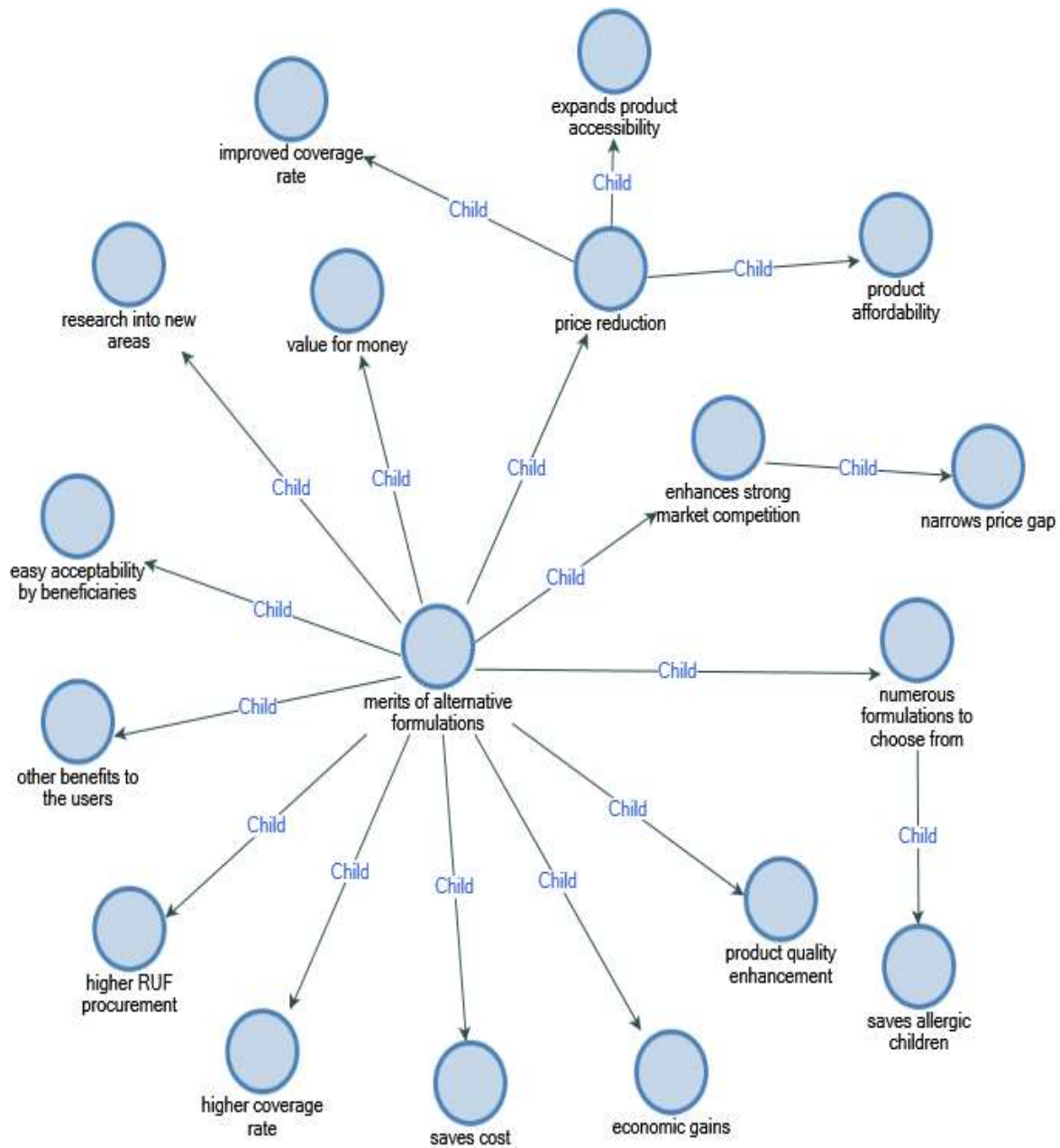
Appendix A1 shows the coding results for the themes created and some other sub-themes that were not discussed but gives further insight about the study.

The project maps comprise the themes created and its sub-codes (child codes). Under each of the themes the most emphasized texts during the interviews were coded as child nodes (codes). Each of the theme has different codes (child nodes) that provides information to the research question(s). The themes (parent nodes) are created based on the research question(s) and the objective(s) of the study.

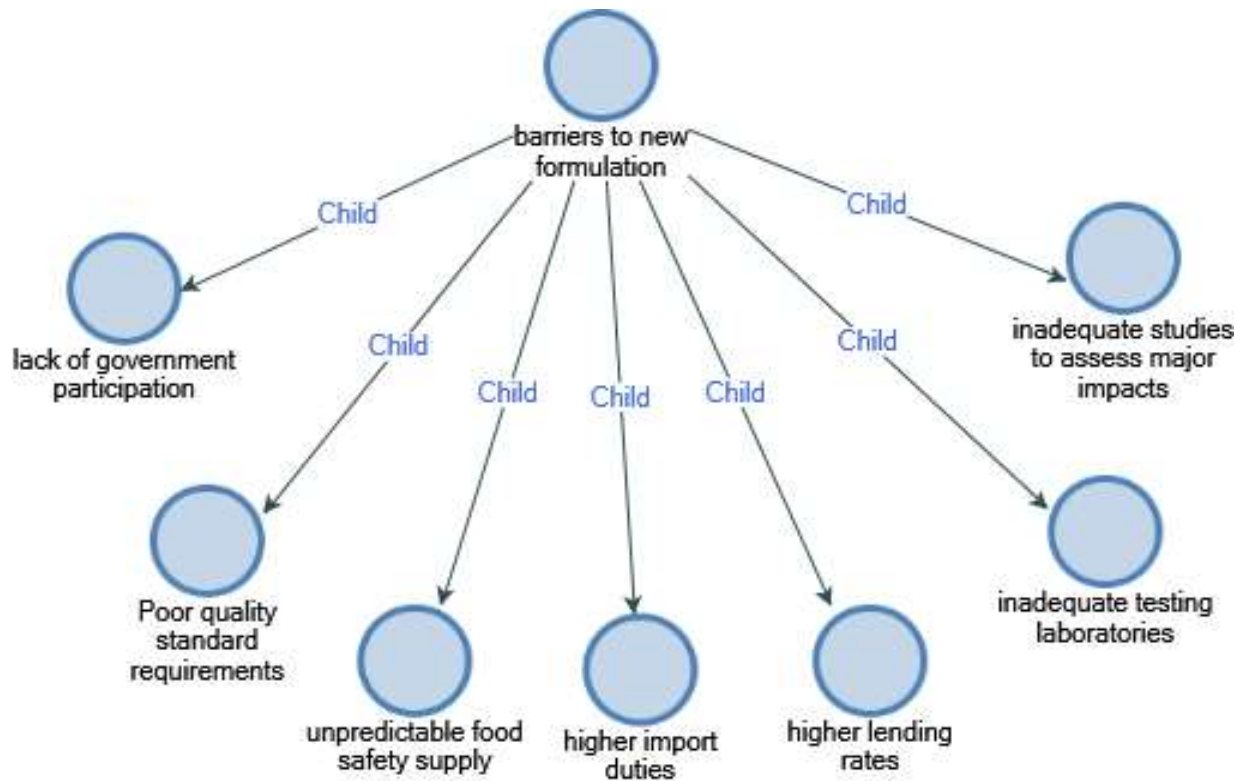
The motivation for the procurement of RUF products



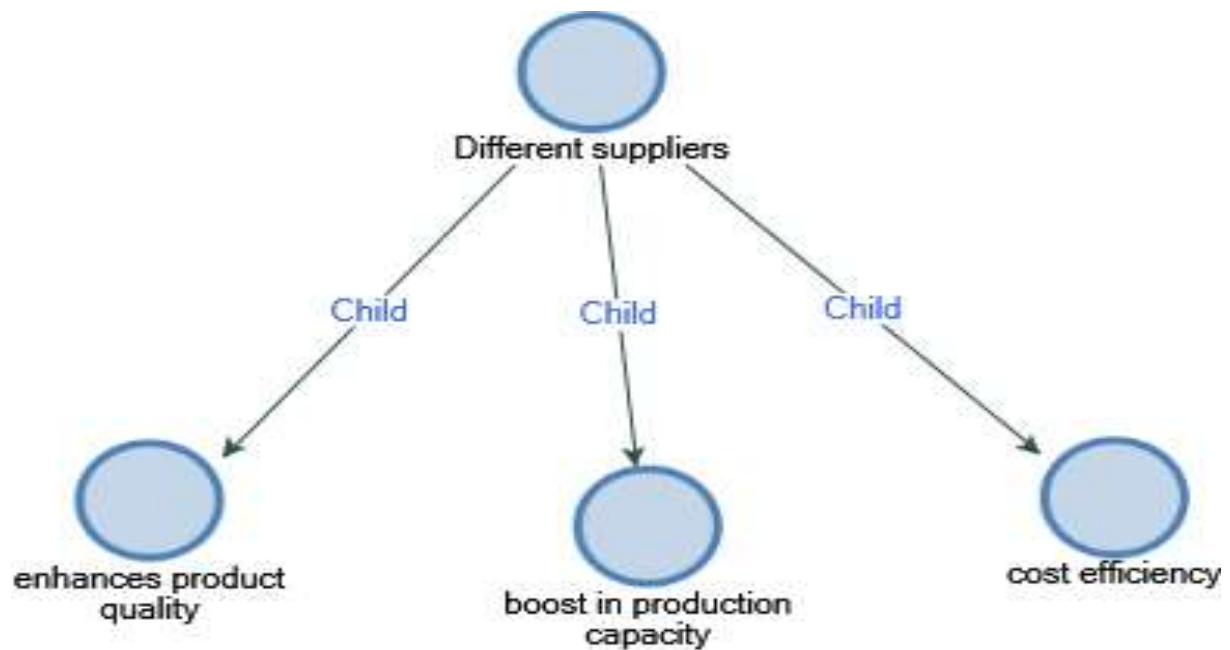
Advantages of developing alternative RUFs



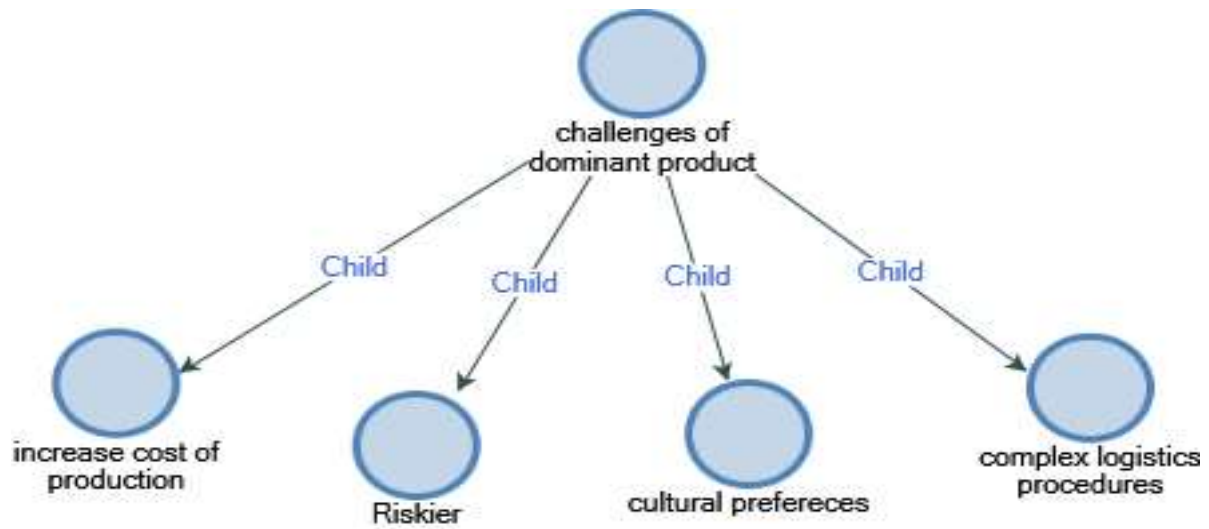
Challenges encounter for developing alternative RUFs



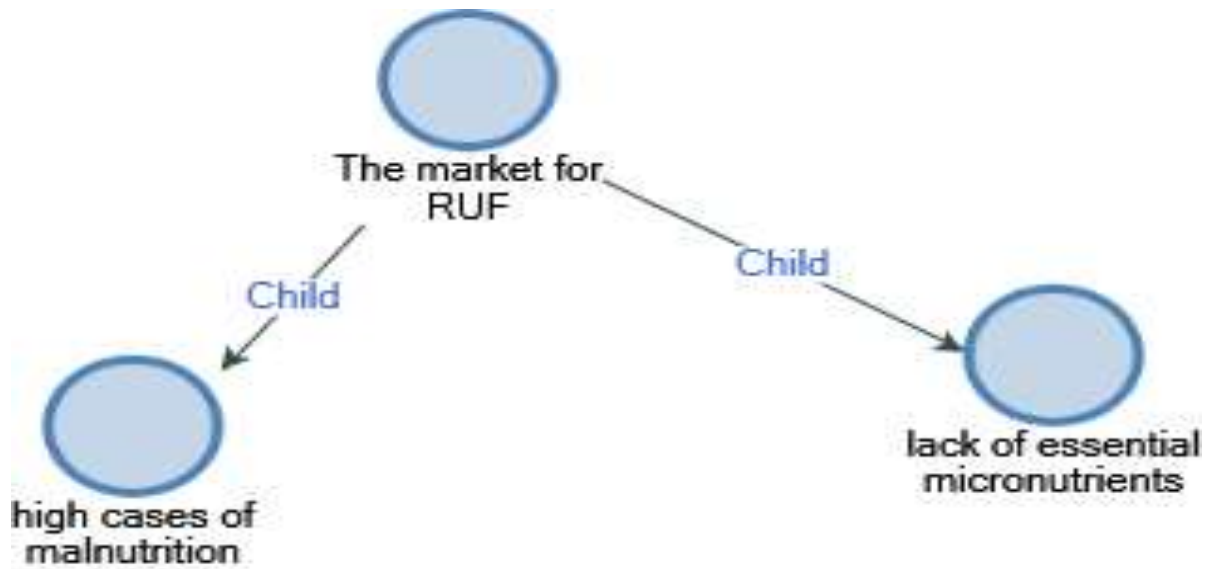
The merits of procuring RUFs from many suppliers



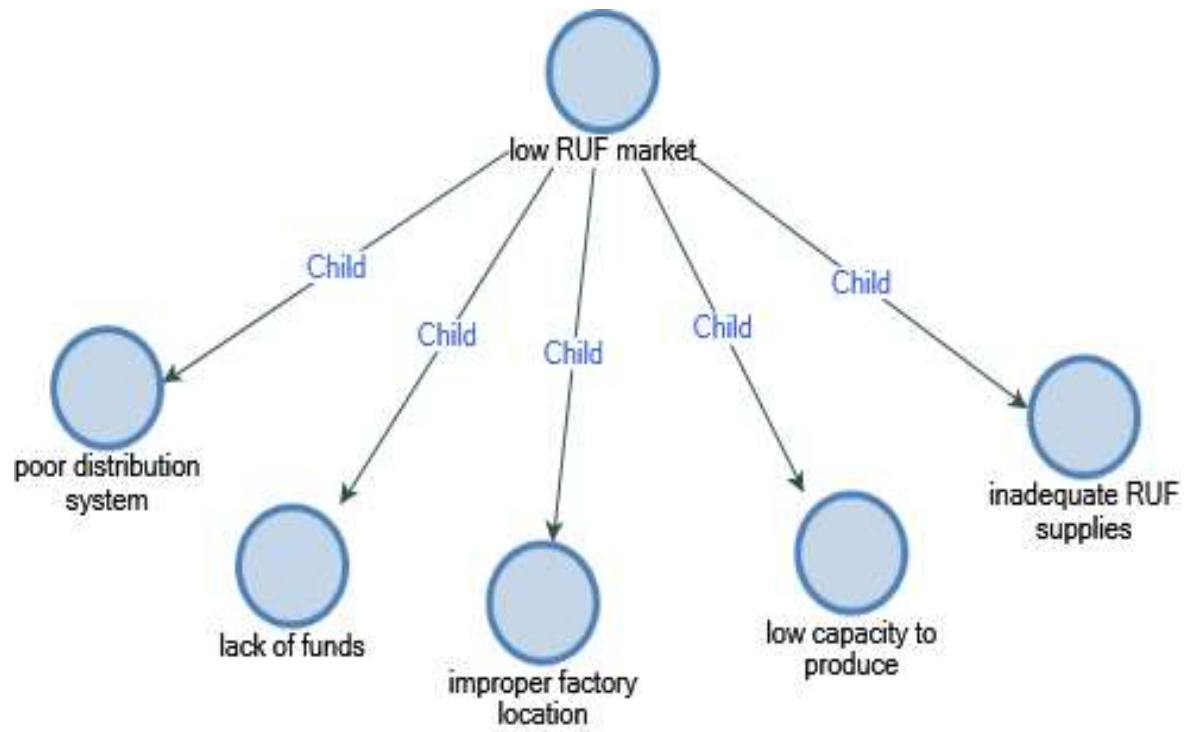
Challenges of having one product in the RUF supply chain



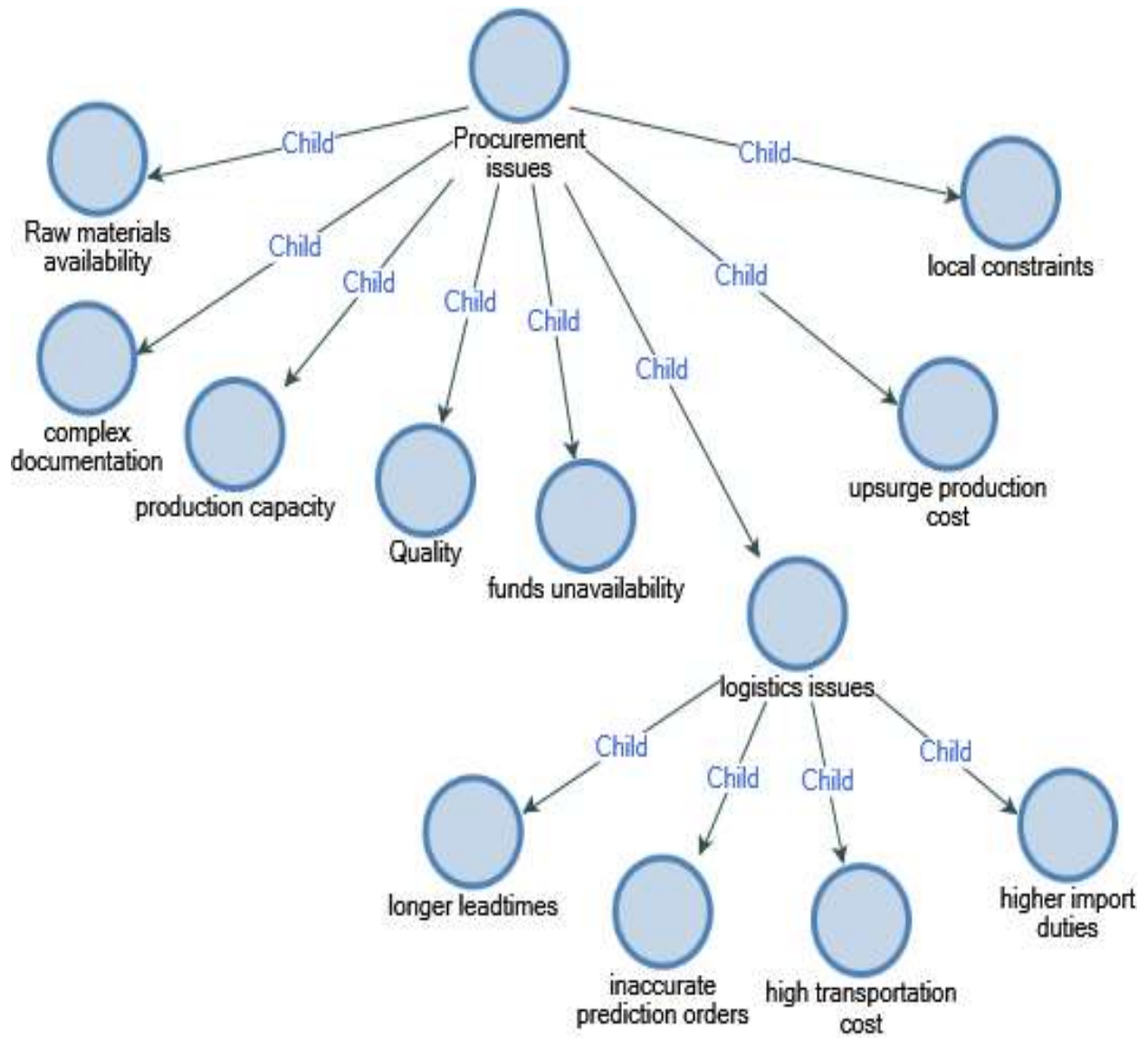
The causes for market demand for RUFs



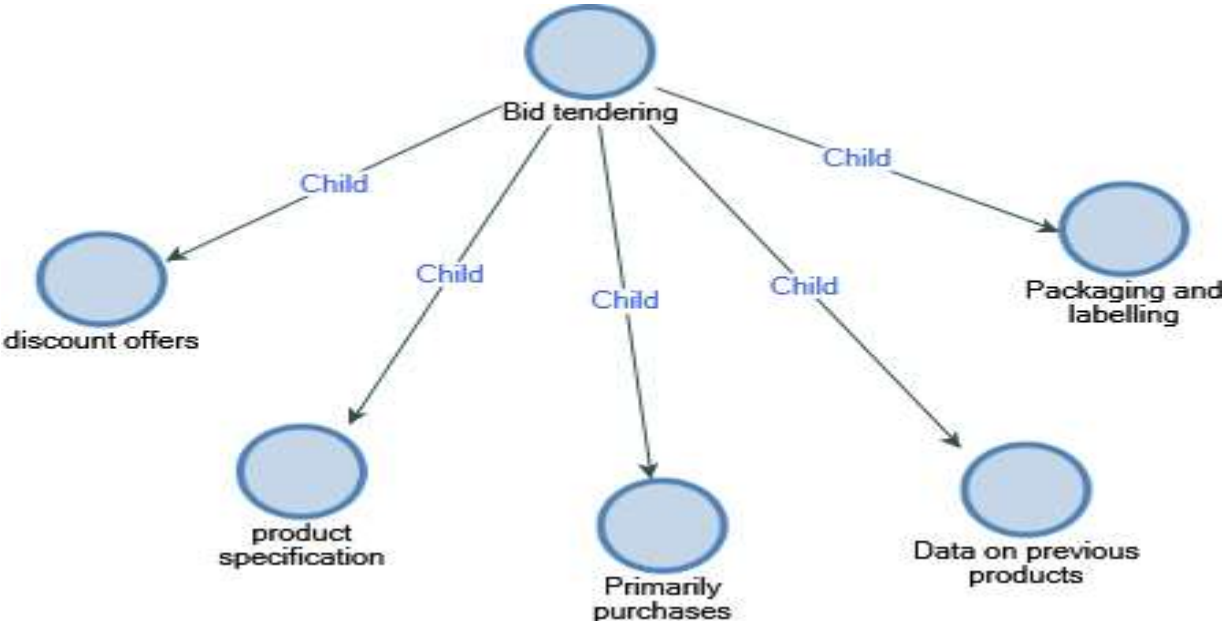
Factors that lead to low market for RUF products



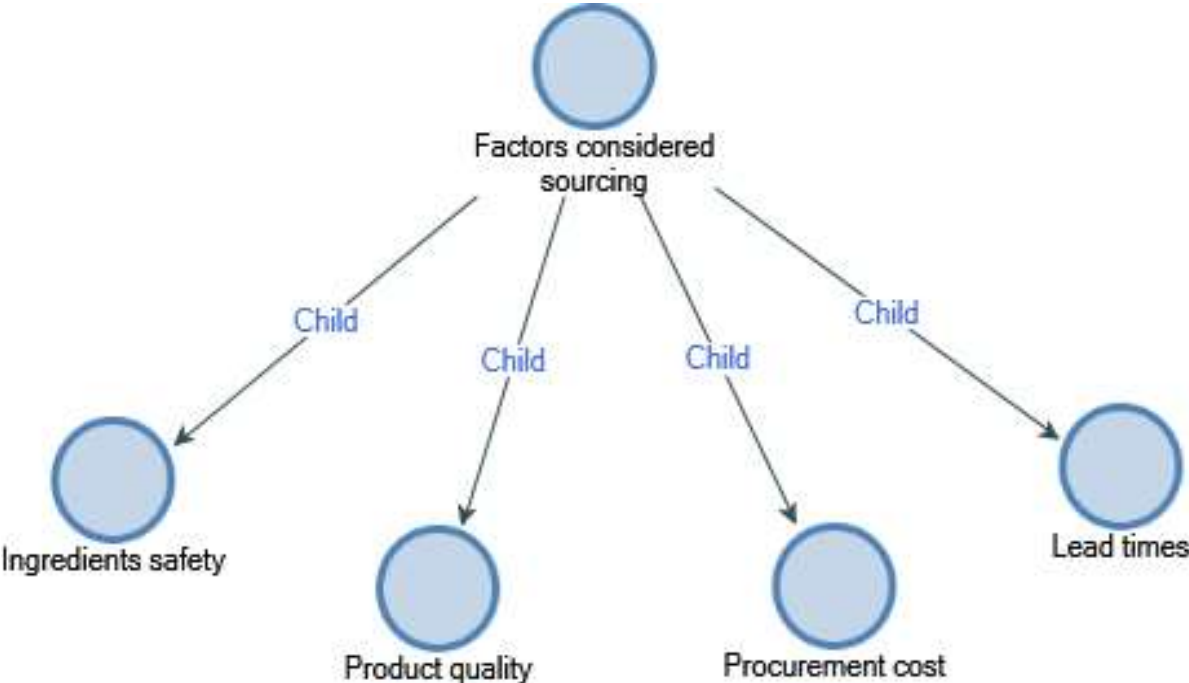
Challenges in RUF procurement



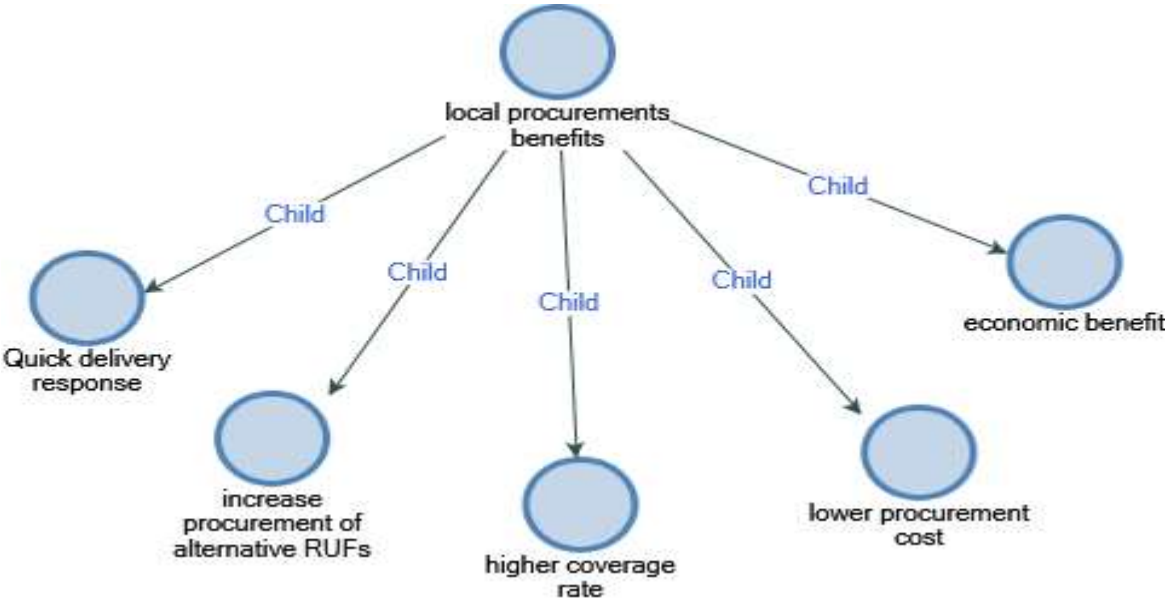
Factors considered in bid tendering



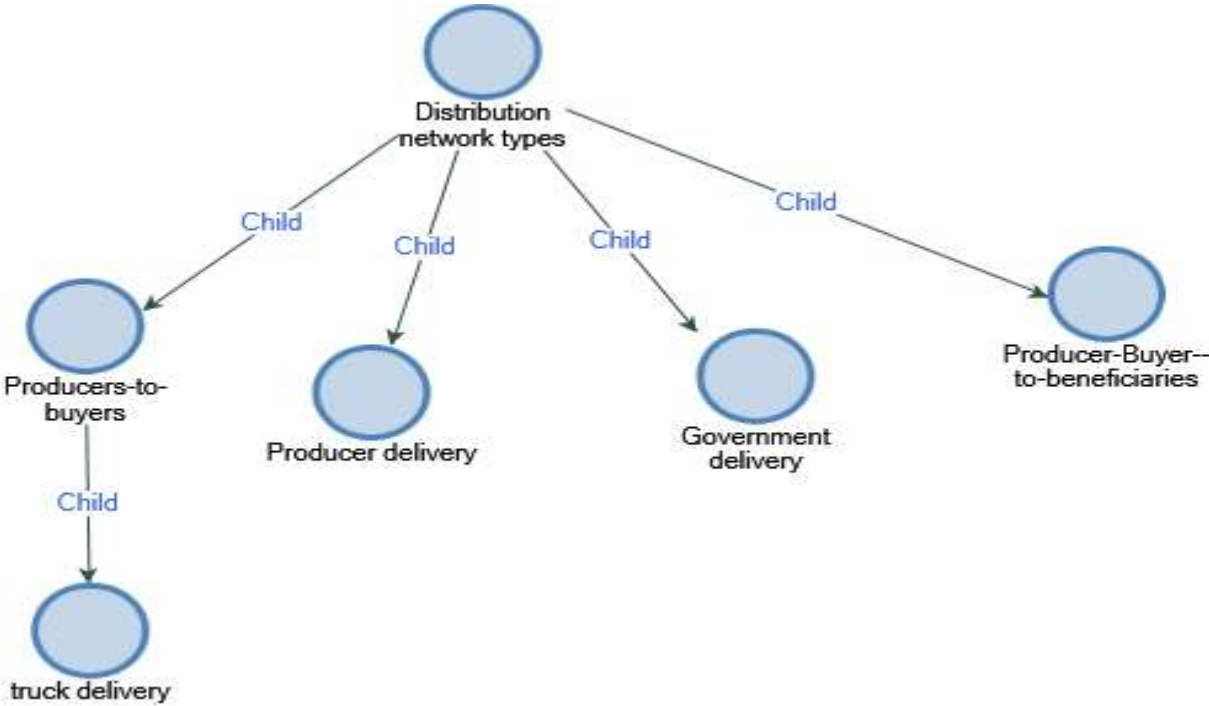
Factors considered when sourcing RUF ingredients



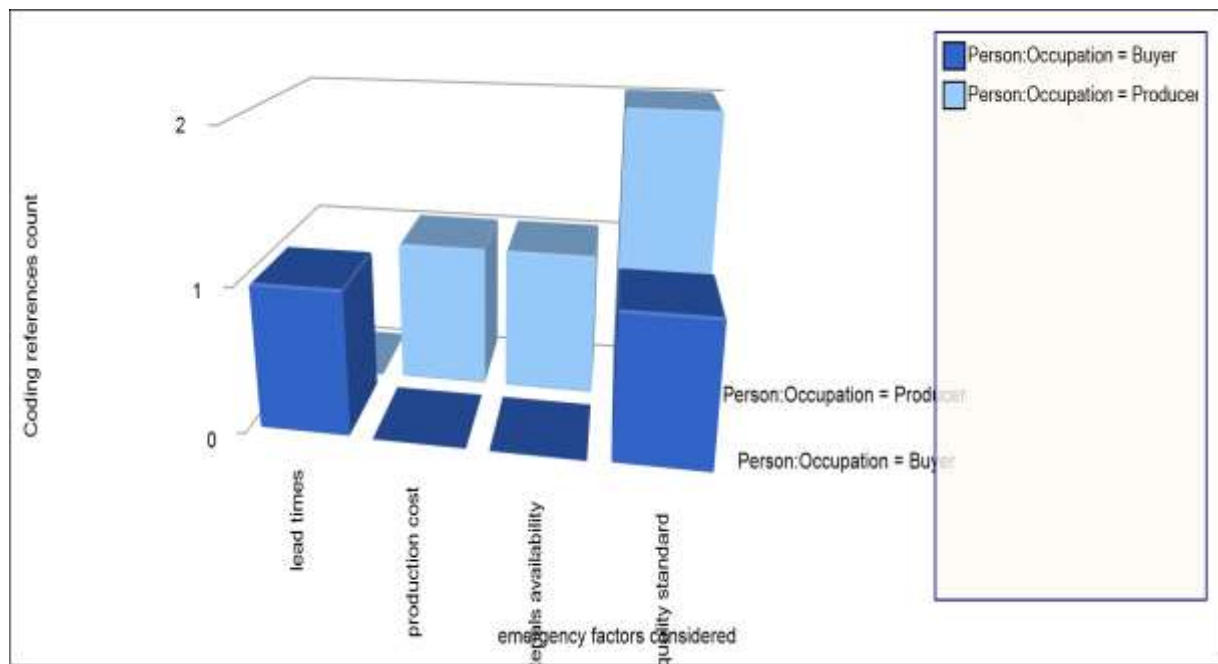
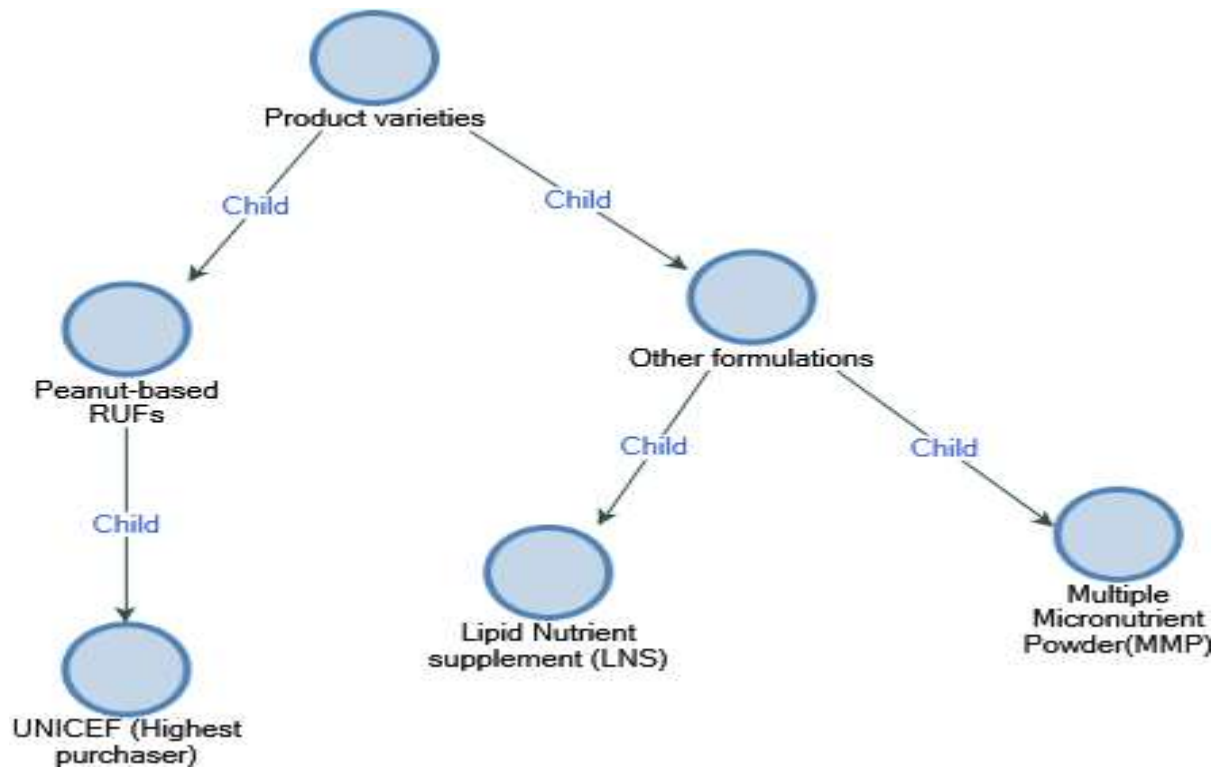
Advantages of procuring RUFs locally



The distribution of RUFs to beneficiaries



Types of RUFs procured in the supply chain



Factors buyer(s) consider during an emergency procurement for RUF products.

Appendix A2

Appendix A2 lists the institutions I contacted for the interviews. A first message was sent to all these institutions through email. Included in the mail was the objective of the research I intend to carry out. Second email was sent following the response from the first engagement (i.e. whether to participate or not). In the second message, the interview questionnaires given to each participant to get a fair idea about what expect from them. Prior to the commencement of the interview with the interviewees, the consent form was given to them for seven days. Before the start of the interview, I read the consent form again to each participant and it is recorded.

Table A2 lists the institutions contacted to participate in the interview.

Buyers	Producers	Other Experts
UNICEF Headquarters	Valid Food International, Malawi	Kansas State University
UNICEF Ghana	Insta Food EPZ, Kenya	
UNICEF Senegal UNICEF Eritrea	Project Peanut Butter Hilina Foods, Ethiopia	
UNICEF Rwanda UNICEF Nepal UNICEF Eastern & Southern Africa UNICEF Canada MSF UK MSF Canada MSF Denmark MSF USA MSF Australia MSF (Headquarters) MSF Kenya MSF New Zealand	Mana Nutrition	

Appendix A3

Semi-structured Interview Questions on Chickpea-based RUTF Product

1. What is your current position at the institution?
2. What are your major responsibilities with respect to RUTF procurement?

Ready-to-use therapeutic foods (RUTFs) & Ready-to-use supplementary foods (RUSFs)

- 2 How many different RUTF/RUSF products do you currently source?
 - a. How many manufacturers did you purchase products from last year?
- 3 What factors do you consider when choosing between manufacturers of RUTF/RUSF products?
 - a. Which of these is most important?
- 4 Is your organization open to competitive bidding?
 - a. Could you describe the tendering process for RUTF/RUSF products?
- 5 What product(s) do your organization buys most often?
 - a. What are the benefits and challenges of having a dominant RUTF/RUSF product?
- 6 How would your organization respond to a new product with different recipe from new manufacturers for RUTF/RUSF?
 - a. What benefit might alternative recipes provide to manufacturers/government
- 7 As a producer, what do you think of the demand for RUTF/RUSF?
 - a. We still have unmet 70% coverage according to UNICEF, as a producer, how do we achieve this as a way of meeting the increasing demand of RUTF/RUSF?
 - b. How does product packaging influence the acceptance of RUTF/RUSF by the buyers and consumers?

RUTF/RUSF pricing

- 8 How does price affect the purchase/tender decision on RUTF/RUSF products?
- 9 How does the place of manufacture affect price?
 - a. [Based on answer] Could any of these issues be mitigated through alternative ingredients formulation of RUTF/RUSF?

RUTF/RUSF product procurement

- 10 Could you describe the distribution network for delivering RUTF/RUSF products?
- 11 How is the distribution network organized?

- a. Whose responsibility is it to deliver product from the manufacturer to the consumer? How are these responsibilities shared?
- 12 What are the benefits and challenges of local procurement when purchasing RUTF/RUSF?
- 13 What are the most limiting factors when procuring RUTF/RUSF locally? How do these factors affect the procurement of RUTF/RUSF products?
- 14 How or the logistics of getting RUTF/RUSF from the place of manufacture to the place of consumption organized?
- b. What are the biggest challenges that your organization faces with respect to RUTF/RUSF logistics?
- 15 How does the cost of delivering RUTF/RUSF affect the purchase decision of your organization?

Quality standards

- 16 What factors do you consider in RUTF/RUSF procurement during emergency situations?
- a. Based on your answer, how does this change for non-emergency situations?
- 17 What are the barriers to new product innovation for RUTF/RUSF?
- 18 What do you think of the estimated cost of alternative recipes compare to peanut-based RUTF/RUSF?

Regulation and challenges

- 19 How do patent rights influence the procurement of RUTF/RUSF products?
- 20 Some manufacturers (i.e. Mana International) have developed open-sourced recipes.
- a. What are the benefits of this model?
 - b. What are the challenges?
- 21 What other challenges does your organization face that we have not yet covered?
- 22 Do you have any suggestions for other people at your institution or other institutions that we should talk to?

Appendix A4

Consent form



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51 Campus Drive
Saskatoon SK S7N 5A8 Canada
Telephone: 306-966-6512
Facsimile: 306-966-8413

Participant Consent Form

You are invited to participate in a research study entitled: Assessing the Economic Potential of Nutrient-Dense Food Supply Chains in Ethiopia

Researcher(s): Appiah, Seth (Graduate Student), Department of Agricultural and Resource Economics, University of Saskatchewan, +1 306 966 8721, sea132@usask.ca.

Supervisor: Professor Eric Micheels, Department of Agricultural and Resource Economics, University of Saskatchewan +1 306 966 8411, eric.micheels@usask.ca

Purpose(s) and Objective(s) of the Research:

- Over the years, there has been a resurgence of malnutrition in developing countries. The current statistics show that globally between the range of 20-60 million children died every due to malnutrition. Out of these numbers, almost 3% of these children's death occurred in sub-Saharan African regions. The causes of these deaths are attributed to insufficient food and lack of nourishing food. Also, malnutrition can result from rapid population growth and poverty. All these challenges have severe consequences on children and adults on their survival and healthy development. Due to this challenge, researchers and other humanitarian institutions decided to embark on measures to curb this problem. One of the measures is to develop a food product that is highly enriched with all the food nutrients. The formulation of this product consists of mainly peanut and other ingredients. This product is called ready to use food (RUTF). Because of the evolving nature of food ingredients, many researchers, humanitarian institutions, and other stakeholders are of the view that there could be other ingredients which could be used to treating people with malnutrition. Therefore, this present study tries to investigate market potential of chickpea-based product in the RUTF supply chains. Specifically, we want to assess the benefits of alternative recipes to various stakeholders in the RUTF supply chain. And also investigate the market potential of chickpeas in the development of RUTF to overcome some challenges in RUTF's supply chain issues.

Procedures:

- Semi-structured interview with top officials working at the humanitarian institutions such as the World Health Organization, UNICEF, Medecine Sans Frontieres (MSF), and the World Food Programme (WFP). In addition, producing companies like Hilina Foods, Project Peanut Butter, Valid Nutrition, and others will be contacted as well. Initial contact will be made through email and confirmed by phone. The interview will be done either by oral (videotaped/audiotaped) or by written responses to interview questions, with interviews preferred. Interview by videotaped/audiotaped (oral) occur using a videoconference of the respondent's choice (Skype, WebEx, Zoom). The survey will be conducted at the participant's own convenient place and it will last for approximately 45 minutes. Also, during the interview, you may have the recording device turned off at any time, without providing a reason. After interview, the content will be transcribed into a format that can be exported to NVivo software for analysis. Transcription will be done either by SSRL staff or by the student.

Funded by: *Internally funded*

Potential Risks:

- There are no known or anticipated risks to you by participating in this research
- **Risk(s) will be addressed by:** None anticipated

Potential Benefits:

- Once the study is completed, we would be able to confirm if there is potential of chickpea ingredient in the formulation of various RUTFs. Such product will help mitigate the challenges of malnutrition that has engulf most children under age five and adults in sub-Saharan African regions. It will also create an opportunity for people who engage in chickpea trading to expand their market base as well as employment to people to improve their standard of living

Compensation:

- In order to thank you for your time you will receive a small gift from the University of Saskatchewan (Approximate value \$20 CAD).

Confidentiality:

- There would be no link to be established between the collected information and the participant's identity. The data from this research will be published and presented at conferences; however, your identity will be kept confidential. Also, the consent forms will be stored separately from the materials used, so that it will not be possible to associate a name with any given set of responses. All identifying information such as the name of the institution, the participant's position will be removed from our report. However, because the participants for this research project have been selected from a small group of people, all of whom are known to each other, it is possible that you may be identifiable to other people based on what you have said.

- After the interview, and prior to the data being included in the final report, you will be given the opportunity to review the transcript of your interview, and to add, alter, or delete information from the transcripts as you see fit within two weeks.

- **Storage of Data:**
 - Eric Micheels and Seth Appiah will be the only people to have access to the data. The data will be stored on a password-protected computer in a locked office belonging to the principal investigator and on a password-protected online storage service as well. Also, as back-up to prevent data loss, the data will be stored on the University of Saskatchewan's secure cabinet (DATASTORE). And it will be retained for 5 years minimum as per the University of Saskatchewan Guidelines.
 - The data is intended for Master's Thesis. A journal article or conference presentation might also be a possibility, but that is not the main purpose of this research.
 - When the data is no longer needed, it will be destroyed using electronic file deletion or a program that will not permit its recovery.

Right to Withdraw:

- Your participation is voluntary, and you can answer only those questions that you are comfortable with. You may also withdraw from the research project for any reason, at any time without explanation or penalty of any sort. If you withdraw from the research project at any time, any data that you have contributed will be destroyed, if desired.
- Whether you choose to participate or not will have no effect on your position or how you will be treated.
- Your right to withdraw data from the study will apply until June 30, 2019. After this date, it is possible that some form of research dissemination will have already occurred, and it may not be possible to withdraw your data.

Follow up:

- The summary of the research results would be available upon request |

Questions or Concerns:

- Contact the researcher(s) using the information at the top of page one
- This project has been approved on ethical grounds by the U of S Research Ethics Board on (insert date). Any questions regarding your rights as a participant may be addressed to the committee at (585-4775 or research.ethics@uregina.ca).
- This research project has been approved on ethical grounds by the University of Saskatchewan Research Ethics Board. Any questions regarding your rights as a participant may be addressed to that committee through the Research Ethics Office ethics.office@usask.ca (306) 966-2975. Out of town participants may call toll free (888) 966-2975.



UNIVERSITY OF SASKATCHEWAN

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Telephone: 306-966-6512
Facsimile: 306-966-8413

Consent

- Your responsibility is to provide accurate response to the researcher's questions asked.
- This form will be available at least 24 hours before we start the interview.
- You also had the opportunity to ask questions and the questions have been answered.
- You are also informed that completion and return of the survey will constitute consent to participate and permission for the researcher to use the data gathered in the manner described
- A copy of this Consent Form will be given to you for your records.
- For participants who agree to a videoconference interview, the interview will start with the interviewer reading the consent form and asking for consent. It will be communicated to the participant, that this consent will be recorded in a separate audio file and stored separately from the transcript of the interview.
- If you choose to respond to the questions by completing and submitting the questionnaire to the researchers, **YOUR FREE AND INFORMED CONSENT IS IMPLIED** and indicates that you understand the above conditions of participation in this study.



Procedures:

- Semi-structured interview with top officials working at the humanitarian institutions such as the World Health Organization, UNICEF, Medecine Sans Frontieres (MSF), and the World Food Programme (WFP). In addition, producing companies like Hilina Foods, Project Peanut Butter, Valid Nutrition, and others will be contacted as well. Initial contact will be made through email and confirmed by phone. The interview will be done either by oral (videotaped/audiotaped) or by written responses to interview questions, with interviews preferred. Interview by videotaped/audiotaped (oral) occur using a videoconference of the respondent's choice (Skype, WebEx, Zoom). The survey will be conducted at the participant's own convenient place and it will last for approximately 45 minutes. Also, during the interview, you may have the recording device turned off at any time, without providing a reason. After interview, the content will be transcribed into a format that can be exported to NVivo software for analysis. Transcription will be done either by SSRL staff or by the student.

Funded by: *Internally funded*

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Compensation:

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